PROCEEDINGS ACRS 2018

THE 39TH ASIAN CONFERENCE ON REMOTE SENSING

KUALA LUMPUR

"REMOTE SENSING ENABLING PROSPERITY"

15 - 19 Oktober 2018

Renaissance Kuala Lumpur Hotel

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ACRS 2018 Conference Programme

	0830 - 1015 hrs	1015 - 1030 hrs	1030 - 1230 hrs	1230 - 1400 hrs	1400 - 1530 hrs	1530-1545	1545 - 1715 hrs	1715 - 1745	1800 - 1900 hrs	1945 - 2230 hrs
Day 1 - Monday (15th Oct 2018)	**Opening Ceremony**	Tea Break	**PLS01: (Plenary Session-1)** Remote Sensing and Good Governance	Lunch	TS01: PARTGIS - 1 TS02: MARCOS - 1 TS03: URBAN - 1 TS04: HIRPRO - 1 TS05: AGPLAN - 1 TS06: FOREST - 1 TS07: APSEN - 1 SS01: MDA Special Session 6th ASEAN Workshop (Invited Members)	Tea Break	TS08: PARTGIS - 2 TS09: MARCOS - 2 TS10: URBAN - 2 TS11: HIRPRO - 2 TS12: AGPLAN - 2 TS13: HYDRO - 1 TS14: GEOSCI - 1 **CS01: Commercial Session** 6th ASEAN Workshop (Invited Members)	**CS01: Commer-cial Session**		**GALA Dinner (WOW KL)**
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Day 5 - Friday (19th Oct 2018)	0830 - 1000 hrs **PLS04: (Plenary Session-4)** Challenges in Wealth Creation and Prosperity	1000 - 1130 hrs **Closing Ceremony**		1130 - 1230 hrs Lunch	1300 - 1800 hrs **City Tour**					

Ballroom A	Room 1	Room 2	Room 9	Room 10	Room 3	Room 4	Room 5	Room 6	Room 7	Room 8	WOW KL GALA Dinner	R-Studio	Concourse	Ballroom B	
Opening /PLS/SS/ ST/CS/ Closing	ALAMANDA		JASMINE		SAKU-RA	TULIP	ROSE	ORCHID	LILY	LOTUS		AARS GC/ Dinner	Student Night	Exhibition / Poster Area	City Tour
Parallel Session															

SS-Special Session, **ST**-Special Topic, **TS**-Technical Session, **PLS**-Plenary Session, **PS**-Poster Session, **CS**-Commercial Session, **GC**-General Conference (of AARS), WEBCON-Web Contest, White Elephant, Student Session, **GMS**-Glocal Monitoring Session, **ASPS**-Asian Satellite Programme Session, 6th ASEAN Workshop - The 6th ASEAN Workshop on Ground Station Experts Exchange

List of Session

1 **Plenary Session (PLS)**

PLS01 : **Remote Sensing and Good Governance**

PLS01A	**Prof. Ir. Dr. Md Azlin Md Said** Universiti Sains Malaysia	A
PLS01B	**PPj Mohd Nur Lokman Samingan** Malaysian Anti-Corruption Commision (MACC) Malaysia	A
PLS01C	**Mr Khalid Khan Abdullah Khan** Chief Information Officer National Audit Department Malaysia	A

PLS02 **Wealth Creation and Prosperity**

PLS02A	Does Remote Sensing Enable Prosperity	A
PLS02B	Future Digital Mapping	A
PLS02C	From Space to People: Leveraging Technical Innovations Through Collaboration with Local Actors	A

PLS03 **Humanising Technology and Data**

PLS03A	Earth Observation Data and Products for Supporting Disaster Management and Preparedness Activities in Indonesia	A
PLS03B	Cloud Enabled Satellite Imagery – Creating New Business Models and Opportunities for Small and Medium Enterprises	A

PLS04 **Challenges in Wealth Creation and Prosperity**

PLS04A		A
PLS04B		A
PLS04C		A
PLS04D		A
PLS04E		A

2 **Special Session (SS)**

SS01 **MDA Special Session**

SS02 : **JAXA SS - Sustainable Development Using Japanese Satellites**

AB017	:	Assessing the Vulnerability of Global Tropical Coastal Cities to Flood: SpatioTemporal Analysis Based on Coincide Tides and Rainfall
AB340	:	Global Change Observation Mission (GCOM)
AB434	:	Flood Monitoring in Gampaha District Using SAR Data as a Case Study in the Lower Basin in Attanagalu Oya
AB103	:	Monitoring of 3-D Land Subsidence from PSI with GPS/Leveling Data
AB107	:	Dust Analysis and Its Effects on Solar PV Power Potential in the Asia Pacific Using MODIS Time Series from 2001-2017

AB393 : Severity of Ganoderma Boninense Disease Classification Using SAR Data

AB473 Study the Use of Multi-Temporal SAR Data in Rice Area Mapping and Monitoring for Asia-RiCE Initiative

SS03 WEBCON

SS04 White Elephant

SS05 Student Session

3 Special Topic (ST)

Groundsat (ST01) - Groundsat Station And Satellite Programme

AB071 : On-Orbit MTF Estimation for the KOMPSAT-3A Satellite Using Star Images"

AB096 : The In-house Down Converter Development Phase 1 for S-Band Satellite Control Ground Station

AB383 : Development of the National Remote Sensing Ground Station to Receive Satellite Data Based on Virtual Ground Station in Order to Support the National Remote Sensing Data Availability

AB397 : Pleiades Neo Constellation, Trusted Intelligence

AB069 : Cost Effective Communication Architecture for Real-time Commanding/Receiving of Remote Sensing Satellite Missions

AB474 : Development of Soumi National Polar-Orbiting Partnership (SOUMI NPP) Level Two (2) Data Production System Using Open Source Software

AB528 : Standard of LAPAN Remote Sensing Ground Station Towards Standardization of the Indonesian National Remote Sensing Ground Station

SOCPROS (ST02) - Societal Well-Being for Prosperity

AB099 : Survey on Performance of Information Retrieval's Strategies in Dynamic Environment

AB514 : Spatial Visualization of Voters Profile for Senator Election (Pilkada) (Study Case: Region of Bandung Raya, Province of West Java)

AB524 : Angle Based Subnetting to Avoid the Hotspot Occurrence in WSN

AB541 : Defining the Related Environmental Risk Factors for Motorcycle Theft Crimes

AB595 : The Relationship Between the University and the Size of Neighbor Tertiary Sector

4IR (ST03) - 4th Industrial Revolution

AB139 : Fourth Industrial Revolution Technologies for Data Analytics for Real Time Geospatial Dashboard

AB148 : An Open Internet of Thing Architecture Integrating oneM2M and OGC SensorThings API Standards

AB284 : A Spatial-Temporal Data Management Structure for Big Internet of Things Data

AB357 : Integration of 3D City Model and Sensor Observations based on International Open Standards

AB412 : Application of Format Based on VP8 Codec for Efficient Disaster Information Propagation

AB519 : A Novel Power Improvement Method for SDN-WSN

AB617 : A Novel Layer-By-Layer AngleBased Energy Efficient Watchman Algorithm for Wireless Sensor and Actor Networks

4 Technical Session (TS)

Participatory GIS Applications

Day 1

AB033 : Using the Geoinformatics Technology for Soil Degradation Assessment in Upper Lamchiengkrai Watershed, Nakhon Ratchasima, Thailand (TS01)

AB038 : Integration of GIS and Multicriteria Evaluation for International School Site Selection (TS01)

AB072 : GIS and Remote Sensing Approach for Transportation Planning in Southeast Asia Practices (TS01)

AB279 : Participatory Geographic Information System for the Upper Mardi Watershed Management (TS01)

AB085 : A Novel GIS Based Seismic Hazard Assessment at Odisha, India (TS01)

AB608 : Estimation of Flood Hazard Impacts on Road Network Using GIS (TS01)

AB093 : Urban Flood Evacuation Plan: A Participatory GIS Approach (TS08)

AB147 : Evaluation of Relations Between Constructions of Walking Spaces and Neighbourhood Environments Using Walkability Index: Focusing on Reuses of Discontinued Railroads (TS08)

AB168 : Visual Object Tracking with GIS (TS08)

AB037 : A Geospatial Solution Using a TOPSIS Approach for Prioritizing Urban Projects in Libya (TS08)

AB054 : Assessing the Competitiveness of the Countries Using Multiple Statistical Measures: A Geo-Spatial Application (TS08)

AB084 : Estimation of Seismic Hazard Using GIS for the State of Sabah, Malaysia (TS08)

Day 2

AB169 : Conceptual Framework of Open Parking Space Information for a Smart City (TS15)

AB173 : Examine the Spatial and Temporal Pattern of Crime Incidence in an Urban Environment Using Geographical Information Systems (TS15)

AB183 : Mapping Heavy Metal Distribution in Soil by Using GIS Techniques: A Case Study in Hooc Mon District, Ho Chi Minh City, Vietnam (TS15)

AB098 : Geographical and Metrological Analysis of Dengue Outbreak Among Females for Detection of Hotspots in Punjab, Pakistan (TS15)

AB105 : GIS-based Surveillance System to Track Geographical Flow and Intensity of Dengue Outbreak Among Males at Division Level in Punjab, Pakistan (TS15)

AB653 : The Evaluation of Coastal Erosion And Its Impact on Coastal Environment Between Kalu River Mouth And Bologoda River Mouth, Sri Lanka (TS38)

AB556 Flats Location Analysis Based on Building Density Using GIS (Case Study: Bandung City) (TS38)

AB078 : Multicriteria Analysis for Flood Mapping of Sungai Pahang (TS45)

AB511 : Assessment of Morphological Characteristics of Maduru Oya River Basin of Sri Lanka Using GIS (TS45)

AB520 : Using GIS to Identify Vehicle Crash Hot Pots and Unsafe Crossroads – A Case Study of Kolkata, India (TS45)

AB602 : Identification of Optimum Path For Service Areas Using GIS Based Network Analysis: A Case Study Of Jaipur (TS45)

AB625 : Determination of Correlation Between Street Accessibility And Crimes Using Space Syntax Network Graph Analysis (TS45)

AB652 : The Evaluation of Coast Line Movement from The Kalu River Mouth to Bolgoda River Mouth Using DSAS Tool Based on GIS (TS45)

AB551 : Driving Factor Analysis of Land Cover Change Based on Spatial Planning Zonation (Case Study: West Java Province) (TS52)

AB554 : Spatial Pattern of Land Cover Changes in Bandung Basin Using Cluster Analysis (TS52)

AB584 : Development and Dissemination of "Peta Jalur Mudik" (Homecoming Route Map) in Indonesia (TS52)

AB649 : Landslide Hazard Distribution and Zonation Mapping Using Geo Spatial Approach – A Case Study in Badulla District, Sri Lanka (TS52)

AB640 : Management of Disaster Mitigation in Health Facilities at Sumatra Island Based on GIS Analysis (Case Study in Lampung) (TS52)

AB596 : Geographical Characteristics of the City in Indonesia Using GIS-Based Spatial Pattern Approach (TS52)

Marine and Coastal

Day 1

AB236 : Cyanobacteria Blooms Caused by Aeolian Mineral Dust Deposition on the Southern Great Barrier Reef, Australia from MODIS Satellite Imagery (TS02)

AB260 : Geomorphological Mapping and Environmental Zoning Approach to Coastal Management in Havelock Island, South Andaman, India (TS02)

AB227 : Projecting Changes in Coastal Morphology by Satisfying Prerequisite Conditions of SLAMM Software in Context of Sundarban (TS02)

AB207 : GIS-Based Suitability Analysis on Hybrid Renewal Energy Site Allocation using MODIS and ASTER Satellite Imageries in Peninsular Malaysia (TS02)

AB287 : Semi-Empirical Approach on Significant Wave Height Measurement on the Transitional Water using Sentinel-1 SAR (TS09)

AB310 : The Relationships Between Mangrove Zonation Dynamics and Sea Level Change in The Deep Bay Area (TS09)

AB337 : Modeling Coastal Salinity Susceptibility in Bentota, Sri Lanka (TS09)

AB350 : Discriminating Seagrass Density from Satellite Imagery Using Pixel and Object Based Classification Method on Small Island, Spermonde Archipelago-Indonesia (TS09)

AB402 : Observing the Livelihood of Sea Nomads Using Multi Temporal Coastal Water Quality (TS09)

AB404 : Accuracy Assessment of Bathymetry Mapping from Landsat-8 for Mapping Purpose: Case Study of Port Klang (TS09)

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AB565 Mangrove Detection Using UAVModified NIR Sensor (TS24)

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AB216 : Climate Variability Assessment for Urban Growth Modelling Using Geospatial Techniques Towards Realization of the United Nations Sustainable Development Goals in Niger Delta Region, Nigeria (TS03)

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AB108 : The Impact of Desert Urbanization on Land Surface Temperature in the United Arab Emirates (UAE) (TS10)

AB201 : A Framework for Underground Utility Network Mapping for Smart City Planning (TS10)

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AB030 : An Integrated Geospatial Approach to Mangrove Vegetation Mapping on the Island of Tobago (TS18)

AB040 : Land Use Land Cover Change (LULCC) Around Taman Negara National Park (TNNP): Impact on Asian Elephant Distribution and Habitat Suitability (TS18)

AB065 : Extraction of Land Use/Land Cover Using Multi-Temporal Sentinal-1A and Landsat Integration: Case Study of Hanoi (TS18)

AB024 : Change Detection of Land Use and Land Cover by Normalized Difference Vegetation Index Differencing in the City of Chiang Mai, Thailand (TS18)

AB039 : Identification of Major Trends and Patterns of Land Use and Land Cover Change (LULCC) in Sri Lanka Using Landsat Time Series Imagery (TS18)

AB075 : Identification of Human Elephant Conflict (HEC) By Using Remote Sensing Techniques (TS18)

AB068 : Influence of Human Activities on Wetland Evolution in the Yangtze Delta (TS26)

AB113 : Land Use Change Detection Method with Object-Based Image Analysis (OBIA) Using Landsat-7 and Landsat-8 (TS26)

AB146 : Comparison of Segmentation Fusion Methods for Unsupervised Change Detection Between VeryHigh Resolution Bi-Temporal Images (TS26)

AB159 : Change Detection of Land Use from Pairs of Satellite Images Via Convolutional Neural Network (TS26)

AB343 : Remote Sensing (RS) and Geographical Information System (GIS) for Mapping and Monitoring Land Cover and Land Use Changes in Kelantan River Basin (TS26)

AB425 : Analysis of Land Use/Land Cover Change Based on Landsat Series Data in Nakhon Phanom, Thailand from 1972 to 2017 (TS26)

Day 3

AB185 : Land Use and Land Cover Change and Prediction Analysis in Inle Lake Watershed, Myanmar (TS34)

AB235 : 100-Years of Land Use Change Analysis with Old Topographic Map Using Deep Learning (TS34)

AB242 : Driving Force of Historically Land Use Changes in the Part of Tokyo City from Aerial Photography and Old Maps (TS34)

AB467 : Supervised and Unsupervised Accuracy Assessment Using SPOT Image for Land Cover and Land Use Mapping of Mangrove Species (TS34)

AB496 : A Twenty-Year Evaluation of Shoreline Changes at Barrang Caddi Island in Spermonde Archipelago from Satellite Imagery (TS34)

AB540 : Change Detection on Spatial Distribution of Coral Reef Habitat Using Landsat Image in Tinggi Island, Mersing (TS34)

AB564 : Land Cover Change Detection from Sentinel-1 Images Using Statistical Analysis and CNN (TS34)

AB513 : Change Detection Analysis Using NDVI in Bandung,Indonesia (TS41)

AB619 : Appraisal of Classification Techniques for Land Use/Land Cover Assessment Using Hyperspectral Satellite Image (TS41)

AB589 : A Study on Precise Updating Methodology of Subdivided andcover Map Based on Various Spatial Data for New Town Nonpoint Source Management (TS41)

AB607 : Quantifying Land Use Changes Using Remote Sensing and GIS (TS41)

AB638 : The Spatiotemporal Trends and Drivers of Land Cover/Land Use on an Island Protected Area: Batanes, Philippines (TS41)

AB083 : Change Detection: A Case Study (TS41)

DEM/3D

Day 2

AB049 : A Method for Estimating Video Surveillance Camera Parameters (TS21)

AB066 : 3D Reconstruction of Fragments Based on Artificial Fish School Algorithm (TS21)

AB117 : Height Accuracy Assessment of ALOS World 3d (AW3D30) DSM and Its Utility for Identifying Flood-Prone Areas of Coastal Myanmar (TS21)

AB006 : Use of Ecological and Topographic Variables Derived from Remotely Sensed Data in Determining the Complexity of an Urban Reforested Landscape (TS21)

AB013 : 3D Geomophic Prediction for Flood Risk Simulation in Monsoon Region of Kuala Terengganu Malaysia (TS21)

AB670 The Geographical Study on Site and Capability of an International Airport in Hantherwady, Bago, Myanmar (TS21)

AB214 : 3D Laser Scanning in the Renovation and Preservation of Historic Temple Architecture, Thailand (TS29)

AB062 : Assessment of SRTM Elevation Data for Landslide Susceptibility Mapping (TS29)

AB325 : Generation of Digital Elevation Model Using Cartosat-1 Satellite Data in Hilly Areas of Himachal Pradesh (TS29)

AB487 : Lahar Modelling of Mt. Agung 1963-1964 and 2017-2018 Eruptions Using Three DEM datasets: TerraSAR-X, SRTM 1-Arc Global, and DTM Derived from Indonesian Topographic Map 1:25000 (TS29)

AB443 : Potential of Coconut Plantation Management Using 3D Visualization of GIS Data: A Case Study of Southwestern eographical Region (TS29)

AB537 Assessing the Quality of Digital Elevation Model Based on Statistical Method

Remote Sensing Application

Day 2

AB294 : Application of Aerial Photograph to Analyze Conservation Activities of Plaosan Temple in Klaten Regency, Central Java Province, Indonesia (TS22)

AB432 : Crack Detection from HighResolution Aerial Triplet Images for Safer Collapse Investigations in High Mountain Areas (TS22)

AB299 : Study on Improving the Accuracy of GPS Levelling Using Genetic Algorithm Based Least Squares Support Vector Machine (LSSVM) (TS22)

AB142 : 3D GIS Modeling Techniques for Documentation and Preservation of Cultural Heritage: Southeast Asian Chapter (TS22)

AB247 : Estimating Land-Use Change Impacts on Urban Air Quality in India Using Hierarchical Bayesian Approach (TS22)

AB527 Oil Palm Vegetation Indices at Different Growing Stages Using Sentinel-2B Satellite Imagery (TS22)

AB488 : Crater Morphology and Volcanic Products Coverage Analyses at Agung Volcano Based on Polarimetric Decomposition of Sentinel-1A SAR Data (TS22)

Day 4

AB657 Google Earth Engine-ased Assessment of Expansion of Bakhawan Eco-Park Using Vegetation and Water Indices Derived from Landsat Images (TS70)

AB438 A Word Frequency Analysis for Logographic Geonames in Taiwan (TS70)

AB189		Remote Observations of Lunar Craters Using High Resolution Data	(TS70)
AB561		Potential Use of High Resolution Pleaides Image for Cadastre	(TS70)
AB022		Quantifying Pylon Route Corridor, a Remote Sensing Approach	(TS70)
AB500		Identification of Water Inundation Using Sentinel-1A Imagery (Study Case: Sub-districts of Baleendah, Bojongsoang and Dayeuhkolot, Bandung District)	(TS70)
AB671		The Spatio Temporal Analysis on the Assessment of Land Use and Land Cover Changes in Hlegu Township, Yangon Using Satellite Landsat Data	

UAS/UAV/Drone

Day 2

AB002	:	Study on the Rip Current Generation Conditions Using Incident Wave Information and Camera Images	(TS25)
AB089	:	Experiment on UAV-Based Non- survey Grade Laser Scanning for Monitoring Rice Plant Height	(TS25)
AB102	:	Fractal Analysis for the Mounded Tomb of Himiko, Yamatai	(TS25)
AB067	:	Development of Hyperspectral Imaging Sensor Launched for Drone	(TS25)
AB058	:	Composite Photograph of Road Pavement Removing Vehicles by Using Masking Function	(TS25)
AB188	:	Hydrocarbon Seepage of Oil Palm Vegetation Using Unmanned Aerial Vehicle(UAV) Multispectral Data	(TS25)
AB190	:	Primary Research on Riverbed Roughness Analysis Using UAV Images Techniques	(TS25)

Day 3

AB237	:	Application of Drones in Monitoring of Physical Conditions of Water Canal	(TS37)
AB283	:	Low-Cost Unmanned Aerial Vehicle Photogrammetric Survey and Its Application for High-Resolution Shoreline Changes Survey	(TS37)
AB384	:	A Conceptual Design of Mini Autonomous Underwater Vehicle (AUV) for Underwater Surveillance	(TS37)
AB426	:	Investigation of Solar Power Generation Facilities Using Drones	(TS37)
AB460	:	Automatic Detection of Dead Tree from UAV Imagery through Combination of Random Forest and Vegetation Index	(TS37)
AB497	:	Multi Scale Geomorphological Mapping Using High Resolution Satellite Imagery and Unmanned Aerial Vehicle Imagery	(TS37)
AB535	:	Monsoon Flood Assessment and Mitigation Through Satellite Imagery and Drone Full Motion Video (FMV)	(TS37)
AB594	:	Production of Large Scale Topographic Map Using Fixed-Wing Unmanned Aerial Vehicle	(TS44)
AB626	:	Building a Low Cost Long Range Mapping Drone	(TS44)
AB632	:	Using UAV Drone Technology in Disaster Reduction in Nepal	(TS44)
AB656	:	Land Use/Land Cover Mapping Using UAV Technology in Kilim Karst Geoforest Park, Langkawi, Malaysia	(TS44)
AB202	:	Manual Controlling of Unmanned Aircraft Syatem for Administrative Division Boundaries Identificaiton	(TS44)

AB667 : Tree Species Mapping At Royal Belum Forest Reserve Using Unmanned Aerial Vehicle Platform Multispectral Images (TS44)

CORS GNSS Technology

Day 2

AB073 : Investigations on the Performance of GPS RT-PPP Method Using TRIMBLE Centerpoint RTX (TS30)

AB172 : The Study of Using Smart Phone Combined Indoor Magnetic Map and Pedestrian Dead Reckoning for Indoor positioning (TS30)

AB261 : Basic Research on Prevention of Wandering Accident by Using GNSS (TS30)

AB282 : The Second and Third Order Ionospheric Delays Effect on the GPS Baseline Vectors (TS30)

AB406 : Performance Evaluation of Vehicle Positioning System Using Multisensor in GNSS Blockage Area (TS30)

AB466 : GFDPro: A GNSS Real-Time Kinematics Field Data Processor Application (TS30)

AB577 : Development and Implementation of GNSS Technology and DFMC 2nd Generation SBAS in Thailand (TS30)

Radar

Day 3

AB044 : Range and Intensity Dependent Quantitative Precipitation Estimation from High Resolution Weather Radar for the Tropical Rainfall (TS32)

AB056 : Subsidence Monitoring Over Reclaimed Areas in Hong Kong Using Multi-temporal SAR Interferometry (TS32)

AB079 : Assessment of Radarsat-2 Polarimetric SAR for Crop Discrimination and Classification (TS32)

AB654 : Comparison of Hybrid Polarimetric Decomposition Models for Scattering Elements Characterisation (TS32)

AB423 : Spatio-temporal Monitoring of Land Subsidence in the World Cup Landfill Park Using Radar Interferometry (TS32)

AB433 : Rainfall Characterization in Klang Valley Using Imaging and NonImaging Data (TS32)

AB088 : InSAR ISBAS and GPS Monitoring of Progressive Land Subsidence in Pekalongan, Indonesia (TS39)

AB128 : Space-Borne Synthetic Aperture Radar (SAR) Sensors in Low Earth Orbit for Real-Time Detection, Monitoring of Floods and Disaster Management (TS39)

AB154 : Mapping Major Crop Types at Field Level in Southern and Northeastern China by Fusing SAR and Optical Data (TS39)

AB645 : Spatio-temporal Variation of Surface Melting Over Greenland Ice Sheet Using Brightness Temperature, SCATSAT-1 Data-2017 (TS39)

AB646 : Mapping of Oil Palm Plantation Based on Their Age by Using Sentinel -1 (TS39)

AB650 : Radar Imager for Mars' subsurFAce eXperiment: A High Resolution Ground Penetrating Radar for MARS (TS39)

AB211 : Damage Analysis of Landslides and Bridges in Minami-Aso Village Due to 2016 Kumamoto Earthquake Using Full-Polarimetric Airborne SAR Images (TS46)

AB314 : Synergy of L and C Band Radar Data for Estimating Aboveground Biomass of Oil Palm in Peninsular Malaysia (TS46)

AB331 : Analysis of Backscattering Characteristics of Buildings from Airborne Full-Polarimetric SAR Images (TS46)

AB435 : Extraction Methods for SAR Imagery: A Review for Road Features (TS46)

AB335 : Estimation of Microwave Land Surface Emissivity Over East Asia (TS53)

AB358 : Multichannel Map Height Estimator Algorithm Forsea Surface Current Simulation from Along Track Interferometry (TS53)

AB381 : Landslide Detection using Sentinel-1 SAR Imagery in Pacitan, East Java Indonesia (TS53)

AB278 : InSAR Analysis for Monitoring Land Subsidence in Southern Sumatera Based on 32 Years of Earthquake Cycle at Ring of Fire (TS53)

AB307 : Determination of Landslides in Lao Cai Province By Sentinel -1 Time Series Radar Images (TS53)

AB379 : Oil Spills in the Persian Gulf: Main Results from Satellite Monitoring with SAR (TS53)

Day 4

AB510 : SAR Analysis of 2018-0206 Hualien Earthquake (TS60)

AB615 : Backscattering Signal (σ0) Retrieval from Microwave Synthetic Aperture Radar (SAR) Dataset Using Integral Equation Model (TS60)

AB442 : Modelling Magma Source in Mt. Baekdu Volcano Using Sentinel-1 Interferometry (TS60)

AB179 The Convective Cloud Propertise Extraction from Weather Radar Reflectivity During Sonca Tropical Storm Over the Lower Northern Thailand (TS60)

AB009 Mapping Stand Age of Indonesian Rubber Plantation Using Fully Polarimetric L-Band Synthetic Aperture Radar (TS60)

LiDAR Data Processing

Day 3

AB070 : Forest Attributes Estimation Using Discrete Return Airborne Lidar: An Individual Tree Based Approach (TS33)

AB092 : Water Seepage Detection of Subway Tunnel Based on Laser Scanning Intensity Data (TS33)

AB129 : Data Accuracy Evaluation of a Mobile Laser Scanning System in Rural Residential Areas (TS33)

AB170 : Multiple Altimeter Beam Experimental LiDAR (MABEL) Data Processing Using Statistical and Iterative Approach (TS33)

AB206 : An Ensemble Gaussian Mixture Model – Logistic Regression Approach for Identification of Potential Rockfall Source Areas Using Airborne LiDAR and GIS (TS33)

AB005 : Forest Classification and Deriving Forestry Resources Parameters from LiDAR Data (TS33)

AB449 : Optimisation of Total Number of Scanning Stations for Terrestrial Laser Scanning (TLS) Survey (TS33)

AB212 : Detection of Landslides in the 2016 Kumamoto Earthquake Using Airborne LIDAR Data (TS40)

AB228 : Three Key Processing Functionalities of the EOS LiDAR Tool (TS40)

AB297 : Urban Land Cover Mapping in Mongolia Using Optical and LiDAR Data (TS40)

AB095 : Automatic Building Model Extraction Using LiDAR Data (TS40)

AB192 : Classification LiDAR Data to Generate the Digital Terrain Model (TS40)

AB369 : Analysis of Floodplain Encroachment Using HEC-RAS 2D Unsteady Flood Flow Modeling Over an Entire River Basin (TS40)

AB043 : Forest Classification and Deriving Forestry Resource Parameters in Infanta Quezon Using LiDAR Data and Validation with Laser Range Finder (TS40)

AB563 : Forest Leaf Area Index Estimation Using Airborne LiDAR Data in Tropical Rainforest in Sabah, Malaysia (TS47)

AB530 : Relative Accuracy of Flood Modeling Using LiDAR Data and Coarser Resolution Elevation Datasets (TS47)

AB592 : Estimating Aboveground Carbon Stock Changes from Multi-Temporal Airborne LiDAR Data in a Tropical Montane Forest of Sabah (TS47)

Disaster Management

Day 3

AB010 : Building an Early Warning System for Mountains Area, Case Study in Thuan Chau District - Son La Province (TS36)

AB063 : Environmental Stressors Assessment for Tropical Urban Flood Using Earth Observation Technologies: A Conceptual Framework (TS36)

AB125 : Measuring Building Vulnerability for Seismic Hazard (TS36)

AB155 : Assessing Debris Flow Hazard with a Machine-Learning Method in EI Salvador (TS36)

AB195 : Automatic Detection of Dead Tree from UAV Imagery through Combination of Random Forest and Vegetation Index (TS36)

AB045 : Multi Scale Geomorphological Mapping Using High Resolution Satellite Imagery and Unmanned Aerial Vehicle Imagery (TS36)

AB241 : An Assessment of Landuse Effects on the Implementation of the Proposed Dams in Kuala Krai, Kelantan (TS43)

AB262 : Statistical Spatial Downscaling Technique of Global Precipitation Measurement (GPM) Precipitation Using Satellite Derived Vegetation and Topographic Data (TS43)

AB263 : Supervised Classification for Flood Extent Mapping Using Sentinel-1 Radar Data (TS43)

AB180 : Comparison of Spatial Error Structures Between TRMM Products and Aphrodite Over the Indochina Peninsula (TS43)

AB273 : Application of Geographical Weight Regression (GWR) Method for Spatial and Temporal Downscaling of Satellite Derived Precipitation Data in Kelantan Basin (TS43)

AB296 : Comparasion of Tsunami Modelling on Disaster Risk Reduction Management at Nusa Penida Islands (TS43)

AB621 Spatial Management Planning for Restoration of Small Tank Cascade System in Sri Lanka

Day 4

AB276 : Permanent and Temporary Hazards in Syria and Its Study Using Space Data (TS64)

AB304 : Disaster Situation Report Based on General Public Response: A Standardization Perspective (TS64)

AB137 : Study on Country-Based Flood Risk Index Using Global Monitoring Data (TS64)

AB327 : Applying MODIS and Landsat Images for Evaluating Urban Cool Island Effect (TS64)

AB301 : Flood Hazard Mapping in the Floodplain of Malingon River, Valencia City, Mindanao, Philippines (TS64)

AB316 : A Framework of Climate Disaster Resilience Index (CDRI) for Environmental Components in Kukup-Tanjung Piai, Johor (TS64)

AB086 : Practice and Evaluation of Science, Technology and Disaster Prevention Education Using Earth Observation Results (TS64)

AB375 : Graphical Comparison of Erosion With Multiple DEMs (TS72)

AB376 : Multiple Event-Based Landslide Modeling Method Using Artificial Neural Network (TS72)

AB598 : Development of Offline Application Utilizing Geospatial Information for Field Survey at Large-Scale Disasters (TS72)

AB582 : Near Real-Time Flood Forecasting Using IFSAR and LiDAR Derived Hydrologic Model of Tumaga River, Zamboanga City (TS72)

AB633 : The Impact of Using the Automated Waterlevel and Rain Monitoring Using Near Real-Time Observation System (ALERTO) to Local Government Units (LGU) as an Early Warning System for Flood Prone Areas in Zamboanga Peninsula, Philippines (TS72)

Web GIS Applications

Day 3

AB025 : Development of Spatial Enabled Web-Application for Governance: A Case Study of FDCA, Goverment of Gujarat (TS48)

AB026 : The Problematics of Indonesian Geoportal and Its Future Strategies (TS48)

AB060 : Development Yemen Dams Information System Using Web GIS (TS48)

AB074 : Web-Based Decision Support System to Evaluate Living Conditions: A Case Study of Colombo City (TS48)

AB209 : Integrating Geospatial Web Resources Based on Semantic Web Technology (TS48)

AB341 : Entrepreneur Centric Web-Service or Industrial and Infrastructure Development Initiatives in Odisha State, India (TS48)

AB199 : A Spatial Management System Development for Marine and Coastal Communities of Trat Province, Thailand (Trat Portal) (TS55)

AB222 : Development of Web-Based Application for Shapefile Coordinate System Conversion for Malaysia (TS55)

AB418 : ESDM One Map Indonesia: Exploring the Energy and Mineral Resources (TS55)

AB451 : Title Open Source and Freeware Web GIS and Augmented Reality Application on Social Rented Housing (TS55)

AB470 : Towards A Flood-Resilient Caraga: Integrating Numerical Model Outputs, Web Applications and Social Media in Developing A Near-Real Time Hazard Information Dissemination System (TS55)

AB636 : A Web GIS for Shoreline Changes and Projection Based on Historical Data: A Case Study at Peninsular Malaysia (TS55)

AB464 : Integration of Twitter-Based Disaster-Information Sharing System and Satellite Imagery (TS62)

AB526 : Open Source-Based and Proprietary Web-GIS Systems (TS62)

AB599 : GIS Tool for Airport Obstacle Management (TS62)

AB605 : Web-Based GIS Development for Land Use Changes (TS62)

AB471 : Smarter Decision Making During Flood Disaster: Utilization of Near-Real Time Flood Characteristics Simulation and Forecasting Systems (TS62)

Automatic Classification

Day 3

AB145 : Semi-Automated Feature Extraction for Rooftop Solar Potential Assessment (TS49)

AB559 : Identification of Land Cover Using SPOT-7 Satellite Images Using OBIA Method (Object Based Image Analysis) Case Study: Garut (TS49)

AB226 : Urban Sprawl Modeling of Lahore, Pakistan Using Machine Learning Techniques (TS49)

AB087 : Remote Sensing Road Extraction Techniques for Heritage Streets Morphology in Southeast Asian (TS49)

AB208 : Extraction of Forest Plantation Using Majority Voting Classification Fusion Algorithm (TS49)

AB290 : Automated Rat and Cockroach Repellant Using HAAR Cascade Algorithm (TS49)

AB251 : Automatic Building Footprints Extraction of Yangon City from GEOEYE Monocular Optical Satellite Image by Using Deep Learning (TS56)

AB583 : Urbanization and Population Growth in Colombo Municipal Council: Urban Growth Analysis Using Geographical Information System (GIS) and Remote Sensing (RS) (TS56)

AB281 : Using Convolutional Neural Network for Signboard Detection on Street View Images (TS56)

AB475 : Object-Based Approach for Impervious Area Detection on Various Scene of Pleiades Satellite Images (TS56)

AB046 : A Remote Sensing Model to Extract the Oil Pollution Concentration Based on the Absorption Coefficient of the Reference Band (TS56)

AB135 : Application of Time Series of Remotely Sensing Satellite Images for Characterizing Vegetation - Hydromorphology Interactions in the Arid Region Floodplains (TS56)

Day 4

AB031 : Investigation on Agent Based Models for Image Classification of Land Use and Land Cover Maps (TS63)

AB020 : Comparing Spectral Based and Object-Based Classification Using ASTER Data for Automatic Mapping: A Case Study, Basement Rock of Wadi El Alaqui, Eastern Desert, Egypt (TS63)

AB286 : Automatic Identification of Plant Species Through a Convolutional Neural Network Model for UAV Mounted Digital Cameras (TS63)

AB012 : Geospatial Object Based Image Analysis Small Format Aerial Photograph for Detailed Scale Land Cover Classification (TS63)

AB319 : Infrared Camera Assisted Optical Pattern Recognition Optimization Algorithm - Using Human Detection as an Example (TS63)

AB444 : Land Use and Land Cover Classification and Geomorphological Characterization of Kundasang, Sabah Using Object-Based Image Classification (TS63)

Calibration/Validatioon

Day 3

AB552 : Procedures and Limitations in Quality Assessment of Spaceborne Multispectral Imager (SMI) Outputs from the Diwata-1 Earth Observation Microsatellite (TS51)

AB481 : Preliminary Tests of Camera SelfCalibration by Wavelet-Based Additional Parameters (TS51)

AB042 : Stratified Random Sampling for Water and Non- Water Region Classification Using Python (TS51)

AB452 : Effective Implementation of Fisheye Lens Calibration Based on Geometric Projection Model (TS51)

AB545 : Comparison of VIIRS and MODIS Active Fire Products Over South Sumatra (TS51)

AB405 : A New Approach for On-Orbit Spatial Characterisation Based on Image Structures (TS51)

AB476 : Automatic Recovery of Camera Poses Based on Satellite Image Sequence Captured by a High Frame Rate Image Sensor (TS58)

AB104 : A Study on the Compatibility of the Sea Surface Temperatures Between Himawari-8/AHI and Landsat-8/ TIRS (TS58)

AB492 : Mapping Solar Energy Potential In Sri Lanka with the Use of Modis Satellite Data (TS58)

AB004 : Rice Paddy Dryer Using a Control System with Humidity and Temperature Sensors (TS58)

AB048 : Research on Relative Radiation Calibration Methods of Multisource Sensors in Offshore Culture Zone (TS58)

AB041 : Classification Model of Water Region Using Entropy Evaluation of Spectral and Intensity Information of Object – Based Image Analysis (TS58)

Feature Extraction

Day 4

AB014	:	UAV Image Feature Recognition Using Sift Algorithm	(TS59)
AB100	:	Integrated Use of Sentiel-2, Landsat-8 and Cartosat DEM for Automatic Lineament Extraction, to Study Active Tectonics in Parts of NW Himalayan Frontal Thrust by Using Remote Sensing and GIS Techniques	(TS59)
AB430	:	A Statistical Approach for CloudFree Mosaic of Landsat-8 Imageries (Case Study: Indonesia)	(TS59)
AB515	:	Ship Detection in Satellite Imagery Via Convolutional Neural Networks	(TS59)
AB550	:	Defining the Effects of Traffic Violations on Crash Frequency and Fatalities by Applying a Spatial Panel Model	(TS59)
AB579	:	Classification of Structure Element Using Geospatial Data for Flood Vulnerability Assessment	(TS59)
AB658	:	Application of Satellite Images Landsat-8 for Interpretation of PM10 Distribution in the Inner City of Ho Chi Minh	(TS59)

Data Fusion

Day 4

AB123	:	Data Fusion Technique for KOMPSAT-6 SAR and AIS payload	(TS61)
AB210	:	Fusion of Panchromatic and Multispectral Images Using Lagrange Optimization	(TS61)
AB429	:	Multispectral and SAR Image Fusion Based on Laplacian Pyramid and Sparse Representation	(TS61)
AB138	:	Image Fusion for Synthetic Aperture Radar, Panchromatic, and Multispectral Images Based on Random Forest Regression	(TS61)
AB558	:	Burn Scar Extraction Using Fused Landsat-8 OLI and SPOT-6 Imageries in Peat Swamp Forest	(TS61)
AB651	:	Survey on Image Fusion Techniques Used in Remote Sensing	(TS61)

Climate Change and Its Impact

Day 4

AB027	:	Fog Hazard of Indo-Gangetic Plain: Mapping, Modelling and Dispersion Techniques	(TS65)
AB035	:	Conversion of NOAA Satellite Data to ET0 with ANN Model - Case Study in Gazvin Irrigation Network	(TS65)
AB064	:	Monitoring Drought via TVDI Derived From 2000 - 2015 MODIS Data: A Case Study of Vietnamsese Mekong River Delta	(TS65)
AB265	:	Analysis and Modelling of the Seasonal Variation in UHI Over the Nine Cities of India	(TS65)
AB317	:	Climate Change and Declining Species Suitability for Endangered Garcinia Gummi-Gutta: Predicting Habitat Suitability and Conservation Planning Under Climate Change Scenario	(TS65)
AB509	:	An Improved Algorithm of Cloud Droplet Size Distribution from POLDER Polarized Measurements	(TS65)

AB178 : Study of Ice Dynamics of Totten Glacier, East Antartica Using Satellite Data (TS73)

AB219 : Multi-mission Satellite Derived Sea Level Anomaly Mapping for Tropical Cyclone Identification in South China Sea (TS73)

AB553 : Analysis of Seasonal Trends of Aerosol Optical Depth and Ground PM2.5: Impact of Relative Humidity and PBL Height (TS73)

AB604 : Assessment of Urban Green Space Landscape Structure and Function for Climate Change Adaptation in Built Environment (TS73)

AB032 : The Urban Heat Island in Kathmandu, Nepal: Spatial Distribution of Changes in Normalized Difference Vegetation Index and Land Surface Temperature 2000-2016 (TS73)

AB623 : Performance Assessment of Potential Evapotranspiration Derived from INSAT-3D Satellite Using In-Situ Measurements (TS73)

AB672 The Anselin Local Morans I Analysis on the Human Activities of Land Surface Temperature Changes in Yangon City (TS73)

2D/3D/4D GIS Applications

Day 4

AB306 : A Study of Objectivization Method for Automatic Production of 3D LOD2 Building Model (TS66)

AB324 : 3D Visualization of Building Interior Using Omnidirectional Images (TS66)

AB197 : 3D Modeling by UAV for the Mounded Tomb of Himiko. (TS66)

AB352 : Land Degradation Assessment Through Spatial Data Integration in Eastern Chotanagpur Plateau, India (TS66)

AB415 : Development of the 3D Spatial Information Visualization Techniques Using Unity 3D (TS66)

AB416 : A Study on 3D Block Technique Urban Inundation by Unity 3D (TS66)

AB392 : Correction of Topological Errors of Utility Network System (TS74)

AB427 : Towards a Real World 3D Terrain Generation and Real time Visualization Framework Using Game Engine (TS74)

AB417 : A Study on Applying Unity-Based GPU Parallel Processing Method for Disaster Information 3D Service (TS74)

AB539 : Site Suitability Analysis for a Greenfield Airport in Kolkata Using GIS and Remote Sensing (TS74)

AB566 : Integration Geospatial Elements to Estimate Military Terrain Mobility Classification (TS74)

Hyper-Spectral

Day 4

AB097 : A New Framework for Wrapper Based Feature Selection for Hyperspectral Image Classification (TS67)

AB110 : Hyperspectral Remote Sensing for Biophysical Parameter Assessment (TS67)

AB403 : Geothermal Exploration with an UAS-TIR Operation Managed by a 4D Cloud Platform (TS67)

AB576 : Utility of Hyperspectral Data in Foliar Trait Retrieval of Two Plant Functional Types of Dry Deciduous Forests (TS67)

AB115 : Dimensionality Reduction for Hyperspectral Images to Improve Object-Based Image Classification Using Feature Selection and Principal Components Analysis (TS67)

AB008 : Deep Convolution Neural Networks with ResNet Architecture for Spectral-Spatial Classification of Drone Borne and Ground Based High Resolution Hyperspectral Imagery (TS67)

AB321 : Classification of Different Varieties of Snow Based on Spectral Reflectance Using ASD Spectroradiometer from the Himalayas (TS67)

AB642 : SID-SAM Spectral Similarity Measure Applied to Build Up Crop Hyper-Spectra Repository from Hyperspectral Image (TS67)

Mobile GIS Applications

Day 4

AB243 MAARG: Geo-Processing and Information Fusion Approach for Road Condition and Surface Monitoring (TS68)

AB353 Optimization of Bus Stop Allocation and Time Scheduling Using Mobile CDR and Bus GPS Trajectory Data (TS68)

AB356 A Case Study of Domestic Tourist Travel Behavior Using Mobile CDR (TS68)

AB391 Augmented Reality Mobile Application: ITU Campus Assistant Example (TS68)

AB482 Citizen Based Tree Inventory Using Mobile Data Collector and Quick Response Code (TS68)

AB034 Development of Real Time Crop Real Time Crop Fire Alert System (TS68)

AB570 Mobile Application for Operations and Maintenance Monitoring of Irrigation and Water Allocation Structures at Chao Phraya River Basin, Thailand (TS68)

Digital Photogrammetry

Day 4

AB015 Positioning Accuracy Improvement of Terrestrial Mobile Mapping Systems Using a Bundle Block Adjustment (TS69)

AB076 Estimating Volumes and Spatiotemporal Patterns of Mud Volcano Eruption in the Wandan Region by Using UAV Photogrammetry (TS69)

AB238 Comparison and Usage of Local Feature Based Algorithms for 3D Face Recognition (TS69)

AB109 Contribution of Smartphones for Documentation of Cultural Heritage: A Case Study of Zilkale (TS69)

AB410 Image and Range-Based 3D Recording of Multi Level of Detail Solitary Vegetation Object for Landscape and City Modeling (TS69)

AB459 Aniwatch: Camera Trap Data Processor for Deep Learning-Based Automatic Identification of Wildlife Species (TS69)

AB502 Utilization of Unmanned Aerial Vehicle (UAV) for Acceleration Land Registration (TS69)

AB634 Evaluation of the Positional Accuracies from Unmanned Aerial System with PPK Capability (TS69)

Environment and Environmental Health

Day 4

AB153	Estimation of Environmental Impact to Human Health by Associating Greenness and Cancer	(TS71)
AB176	High Resolution Air Pollution Assessment for Road Transport in Yangon, Myanmar	(TS71)
AB498	The Evolution of Mesoscale Convective System (MCS) Around the Greater Jakarta Area on 9 February 2015 Using MTSAT-IR Satellite	(TS71)
AB499	A Statistical Test of Erosion Pin Measurements	(TS71)
AB503	Spatiotemporal Distribution of Wildfire in Southeast Asia Using Remote Sensing Data	(TS71)
AB151	Building Envelope Heat Loss Mapping Using Infrared Thermorgraphy	(TS71)
AB181	Environmental Implications of Wheat Residue Burning: A Case Study of Haryana State, India	(TS71)
AB597	Analyzing Relationship Between Particulate Matter (PM10), Fine Particulate Matter (PM2.5) and Ozone (O3) Using Correlation	(TS71)

5 **Poster Session (PS)**

Day 2

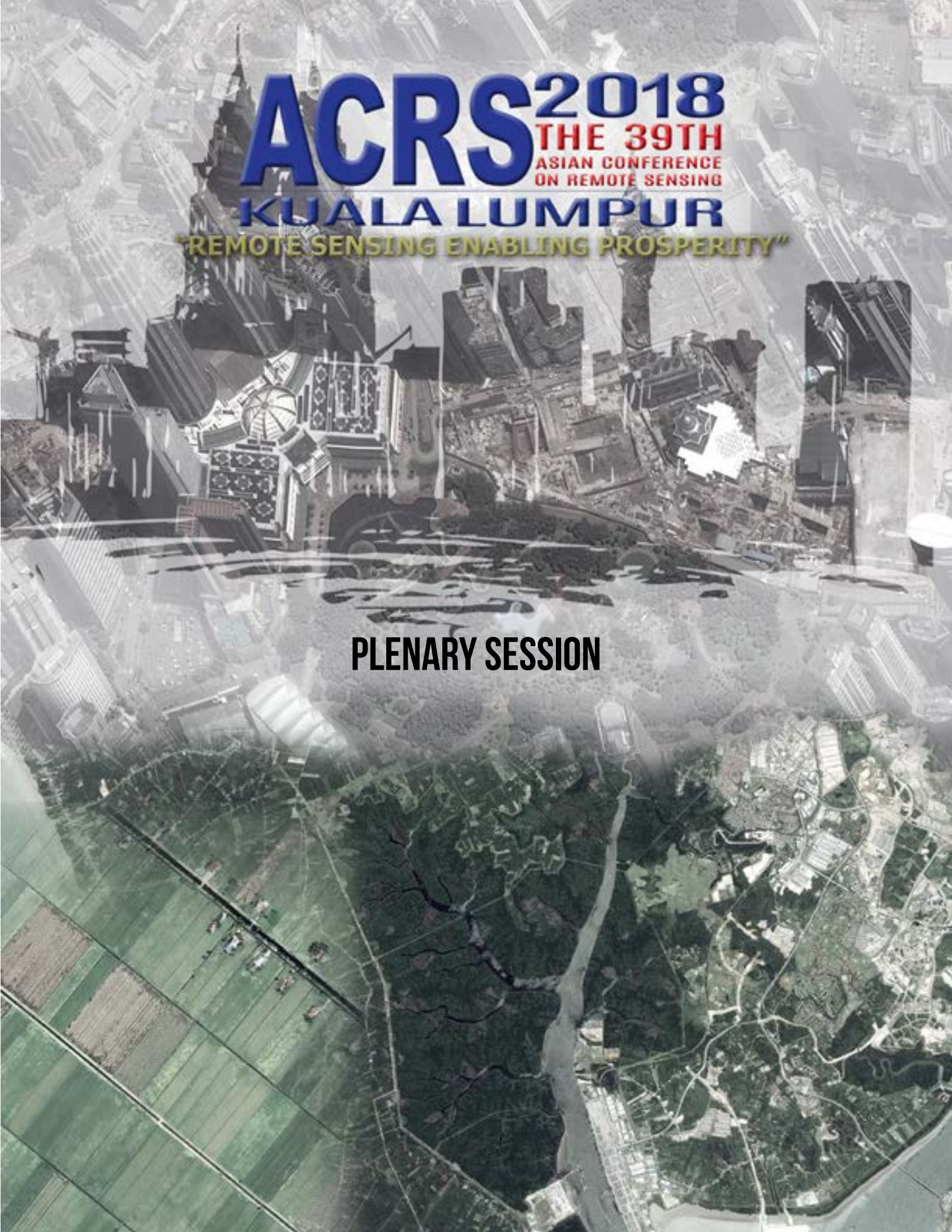
AB133	:	Transition in NDVI of Forcibly Withering Potted Trees	(B)
AB156	:	Renewable Energy Crop Recognition Based on ObjectedBased Classification Using Membership Function	(B)
AB213	:	Utilizing Unmanned Aerial Vehicle to Identify the Rice Lodging Area	(B)
AB231	:	The Effect of Temperature and Rainfall Variation on Phenology and Production of Oil Palm in Johor	(B)
AB240	:	Landsat 8 Satellite Data-Based High-Resolution Vegetation Mapping in the Island of Hokkaido, Japan	(B)
AB254	:	Sustainable Water Management for Electrical Energy Microhydro in Banjarnegara Regency Central Java Province Indonesia	(B)
AB270	:	Simple Algorithm for Land Cover Classification Using OpticalBiophysical Relationships of Vegetation Spectra	(B)
AB277	:	Seasonality Trends of Rubber Tree Canopy Observed By X-Band Synthetic Aperture Radar	(B)
AB144	:	Earthquake-Induced Building Damage Assessment Based on SAR Correlation and Texture	(B)
AB288	:	Bi-Temporal Analysis of Vegetative Cover Using Alos Palsar: Halimun Salak National Park, Indonesia	(B)
AB289	:	Soil Hypertrophication of Mung Bean Morphology Using RGB Analysis and Canny Edge Detection	(B)
AB322	:	The Rice Fields Analysis by the Seasonal Variation Tendency	(B)
AB507	:	Retrieving Nitrogen Concentration with Hyperspectral Data and Long Short-Term Memory Model	(B)
AB518	:	Water Productivity Assessment Using Remotely Sensed Data for Wheat in The Jiroft Palain, Iran	(B)
AB521	:	Treetop Detection from LiDAR Data Using Local Maxima Algorithm	(B)

AB134	:	Comparison of Land Cover Classifications Based on of Rough Set Theory	(B)
AB421	:	Multi-Temporal Analysis of Kompsat Imagery for Detecting Pitch Canker Damaged Trees	(B)
AB380	:	Feasibility Study of Normal Height System in Taiwan	(B)
AB160	:	Monitoring and Measuring the Water Surface Level Area of Mae Kham Dam in Northern Thailand Using Polarization SAR Images	(B)
AB603	:	UAV Remote Sensing Technology for Mapping Biogeography and Biodiversity of Padakembang Village, West Java, Indonesia	(B)
AB484	:	Atmospherically Corrected D-InSAR to Detect Time Series Deformation Precursor at Agung Volcano Using Sentinel-1A SAR Data	(B)
AB485	:	Temporal Surface Temperature Prior to the Eruption of Agung Volcano Using Daytime and Nighttime Observations of TIR Satellite Sensor	(B)

Day 4

AB302	:	Evaluation of Intensity and RGB Values on 3D Point Cloud Classification	(B)
AB333	:	Cloud Service Platform System of County-scale Remote Sensing Information Products Based on High-Resolution Satellite Images	(B)
AB373	:	Comparative Analysis of Edge-Assisted Image Matching Techniques	(B)
AB028	:	The Guidance Seeker Onboard Remote Sensing Satellite to Enhance Mission Effectiveness	(B)
AB315	:	Comparison of Land Cover Classification Methods for Economic Crops in Thailand	(B)
AB543	:	Automatic Paddy Growth Stage Identification Based on Convolutional Neural Network	(B)
AB198	:	Quantitative Collimation Measuring Method with Moving Theodolite	(B)
AB600	:	Investigation of the Parameter for Sea Ice Concentration from AMSR2	(B)
AB101	:	An Examination of Methods for Evaluating Differences Among Highly Accurate Land Cover Classifiers	(B)
AB175	:	The Accuracy of Eight Bi-Temporal Change Detections to Isolate Extreme Values Related to Clouds: Cases of Mountainous and Coastal Tropics	(B)
AB248	:	Land Cover Change Analysis in Brussels with the Combination of Change Detection Methods and Using Indice	(B)
AB253	:	Oil Spill Signature Variants for Optimum Detection and Tracking within Shortwave Visible to Thermal Infrared Bands	(B)
AB268	:	Application of Landsat Data for Coastline Changes Detection in South Minahasa Regency	(B)
AB326	:	The Effect of Land Use Change on Land Surface Temperature of Depok City, West Java Using Landsat Image Data	(B)
AB330	:	Error-Adjusted Point Estimation and Confidence Intervals for Estimating Area of Change in a Tropical Protected Area	(B)
AB386	:	Role of Remote Sensing and GIS Techniques to Detect Barchans Sand Dune in Some Areas of DAHNA'A Desert, Saudi Arabia	(B)
AB440	:	Multi-Temporal Land-Cover Classification of Kinabalu Eco-Linc Site and the Surrounding Protected Areas	(B)

6 **Commercial Session (CS)**
7 **Glocal Monitoring Session (GMS01)**
8 **Asian Satellite Programme Session (ASPS01)**
9 **Appendix**



PLENARY SESSION

PLENARY SESSION : REMOTE SENSING AND GOOD GOVERNANCE

Speaker: **Prof. Ir. Dr. Md Azlin Md Said**
Universiti Sains Malaysia

PLENARY SESSION : REMOTE SENSING AND GOOD GOVERNANCE

Speaker: **PPj Mohd Nur Lokman Samingan**
Malaysia Anti-Corruption Commision (MACC)

PLENARY SESSION : REMOTE SENSING AND GOOD GOVERNANCE

Speaker: **Mr. Khalid Khan Abdullah Khan**
Chief Information Officer National Audit Department Malaysia

PLENARY SESSION : WEALTH CREATION AND PROSPERITY

Does Remote Sensing Enable Prosperity

Speaker: **Prof. Dr. Bruce Forster**
Managing Director Asia-Pacific Remote Sensing Pty Ltd

PLENARY SESSION : WEALTH CREATION AND PROSPERITY

Future Digital Mapping

Speaker: **Prof. Christian Heipke**
President International Society for Photogrammetry and Remote Sensing

FROM SPACE TO PEOPLE: LEVERAGING TECHNICAL INNOVATIONS THROUGH COLLABORATION WITH LOCAL ACTORS.

Patrice Galey
Business Development ASIA, AIRBUS Intelligence

From Satellites design to national program delivery, from earth observation imagery to on-the-ground applicative solutions, AIRBUS DEFENCE AND SPACE has developed over the last years a comprehensive Portfolio for Space and Defence Applications and is recognize worldwide as a leading corporation in Innovation.

Satellites are very powerful to detect, predict and monitor changes, either natural or from human origin, over lands or at sea. Preserving our environment and ensuring people safety will be the challenge of this decade to offer a better future to the next generations. Certainly, Remote Sensing has a key part to play to understand our changing world.

But today expectations from government, from decision makers, from private companies but also from the public have grown due to recent technology improvements and new computing capabilities. Space assets are now expected to contribute significantly to day to day life and full system integration along the Remote Sensing value chain is today mandatory to meet expectations.

The AIRBUS DEFENCE AND SPACE presentation will provide the latest details on Space Innovations, but also on Innovative Imagery Services based on Cloud Computing technology aiming at delivering advance information to people with high level of automation: “Field Maps” for Agriculture, “Ocean Finder” for Maritime Surveillance, of “Massive Intelligence” for Homeland Security are some examples among others justifying the relevance of the Remote Sensing technology for the benefits of modern societies.

Technical innovations are always considered as paramount, but Innovations lies also in creating local cooperation’s to better fit with on the ground needs. Again from Satellites Programs to Online Solutions, AIRBUS DEFENCE AND SPACE has developed comprehensive partnerships and knowledge transfer program to support local actors in their markets and to ensure efficient services to users wherever located (more than 100 countries), whatever their background (from GAFA to Ministry of Defence).

PLENARY SESSION : HUMANISING TECHNOLOGY AND DATA

Earth Observation Data and Products for Supporting Disaster Management and Preparedness Activities in Indonesia

Speaker: **Dr. Orbita Roswintiarti**
Deputy Chairman for Remote Sensing Affairs
Indonesian National Institute of Aeronautics and Space (LAPAN)

CLOUD ENABLED SATELLITE IMAGERY: CREATING NEW BUSINESS MODELS AND OPPORTUNITIES FOR SMALL AND MEDIUM ENTERPRISES

Mr. Gordon Staples
Senior Analyst/Project Manager MDA

There has been a dramatic increase on the number of Earth Observation (EO) satellites in the last two decades. This increase, which includes both optical and radar sensors, is driven by a combination of user demand and the proliferation of purpose-built satellites. Computer processing power that was in the domain of high-end computers is now available in a mobile phone. The EO data have been acquired, the computing power is readily available, but how do small and medium enterprise (SME) tap into this wealth of information to create new business opportunities? The answer rests in two key facets of this data-rich Earth observation era: cloud-based analytics platforms and data price.

There are numerous platforms available on the web that are suitable for visual or qualitative analysis, but to meet quantitative application such as change detection or extraction of biophysical parameters, it is crucial that among other data pre-processing steps, the data must be accurately co-registered and share a common projection. In addition, for sensors with variable imaging geometry, only imagery acquired using the same imaging parameters should be used for quantitative analysis. DigitalGlobe's GBDX is a cloud-based environment that has been designed to provide data that is ready-for-use thus alieving users the burden of pre-processing data. Augmenting the GBDX platform is a suite of analytics tools providing the user access to well-vetted, robust, and science-based algorithms.

The second facet is data price. Data price can sometimes be a barrier to entry for SME, but cloud-based platforms can help to mitigate prices concerns via a consumption-based pricing scheme. One of the common price models for EO data is per-scene based, but in contrast, the consumption-based data pricing enables rapid prototype development and new business models to take these capabilities to the market.

This presentation will outline how the GBDX platform can be used by SME as a new business model to create information products to meet user needs. The platform architecture is described and examples of end-user application are presented.

PLENARY SESSION : CHALLENGES IN WEALTH CREATION AND PROSPERITY

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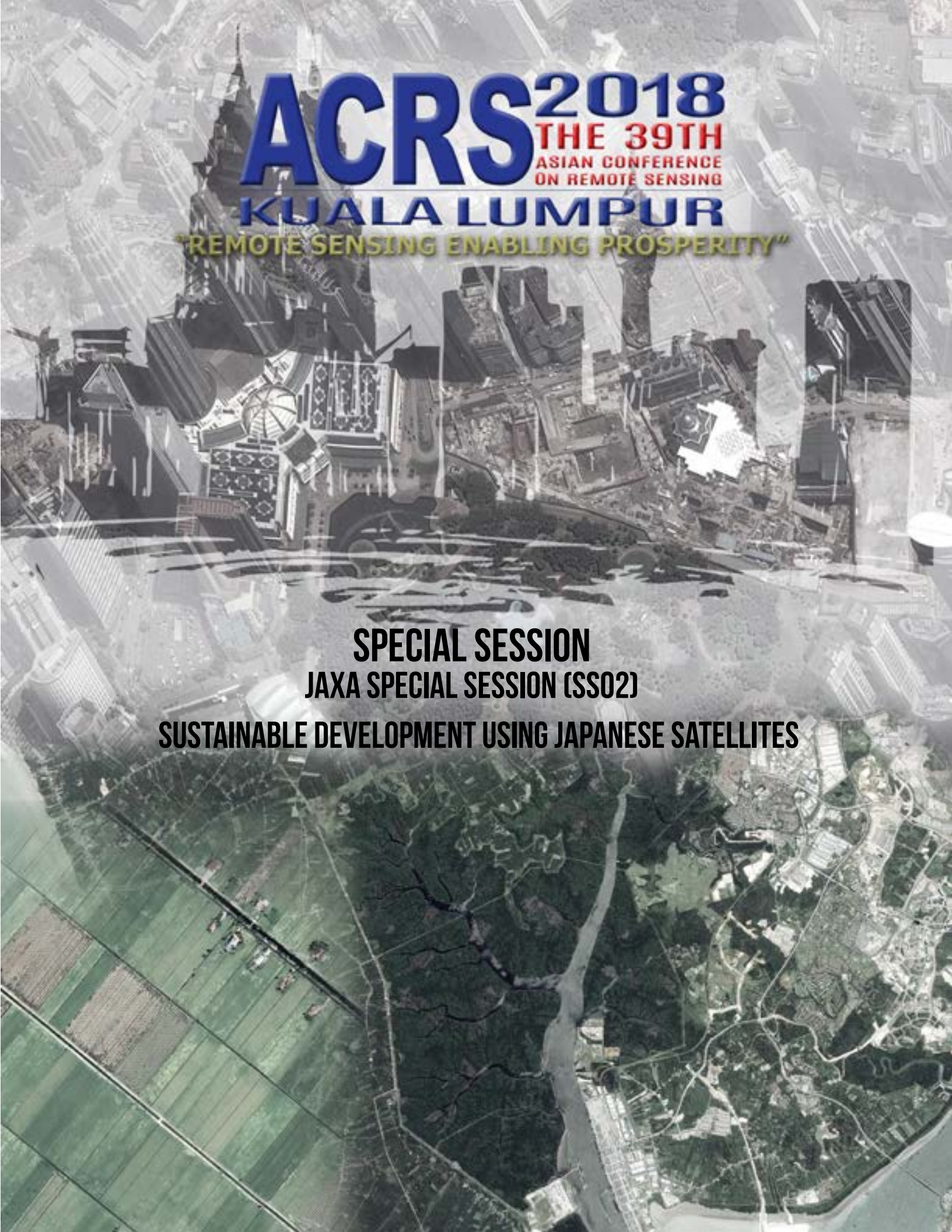


SPECIAL SESSION

JAXA SPECIAL SESSION (SS02)

SUSTAINABLE DEVELOPMENT USING JAPANESE SATELLITES

ASSESSING THE VULNERABILITY OF GLOBAL TROPICAL COASTAL CITIES TO FLOOD: SPATIOTEMPORAL ANALYSIS BASED ON COINCIDE TIDES AND RAINFALL EVENTS

Nur Fathiera Mansor (1), Muhamad Afifi Md Yatim (1), Aina Afifah bt. Mohd Yusof (1), Mohd. Nadzri Mohd. Reba (1)(2), Mohd. Rizaludin Mahmud (1)(2)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
[2] Geoscience & Digital Earth Centre (INSteG), Faculty of Geoinformation & Real Estate, Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
Email: firamansor888@gmail.com; afie0913@gmail.com; ainayusof@gmail.com; nadzri@utm.my; rizaludin@utm.my

Abstract: The coincide condition between the high tide and heavy rainfall event may constitute to severe and prolonged flood. Many coastal cities which having equatorial climate though are facing with those traits and therefore vulnerable to the catastrophe. With the recent evidences showing that the tropics is receiving heavier rainfall as a result of global climatic change, there are increasing risk to the coastal cities in facing flood. While there are global analysis on this issue, most are primarily concern with upper latitude with temperate climate cities. Prior to that situation, there is a gap of understanding the phenomena and its spatial extent. In anticipating that issue, we set up two main objectives; 1) to determine the frequency of this coincide condition occurred for all tropical cities, 2) to rank the vulnerability of these tropical cities. Rainfall data obtained from the Global Precipitation Mission (GPM) is used together with the global tidal datasets in performing the analysis. The analysis is conducted at 3-hourly scale with 0.1° operating resolution. The risk classification is defined through the coincide condition of prolonged rainfall and high tides.

Keywords: Monsoon, Marine geodesy, Climate Change, Big Geodata

GLOBAL CHANGE OBSERVATION MISSION (GCOM)

Haruhisa Shimoda (1), Yoshiyuki Otake (1),

[1] Research & Information Center, Tokai University
2-28-4, Tomigaya, Shibuya-ku, Tokyo, Japan
Email: smd@keyaki.cc.u-tokai.ac.jp; otk@yoyogi.ycc.u-tokai.ac.jp

Abstract: In order to meet the requirements of Global Earth Observation System of Systems (GEOSS) as well as to continue the ADEOS and ADEOS2 missions, JAXA is now planning the GCOM mission which is composed of a series of satellites. There are two series of satellites, and they are now called GCOM-W and GCOM-C satellites. Both series are composed of 3 satellites with 5 years lifetime. Hence, 13 years of continuous observation can be assured with 1-year overlaps. The first satellite of GCOM-W was launched on 18, May 2012 while the first one of GCOM-C was launched on 23, Dec. 2017. GCOM-W1 carries AMSR2 (AMSR F/O). AMSR2 is very similar to AMSR on ADEOS2 and AMSR-E on EOS-Aqua with some modifications. The aperture of AMSR2 is 2m, and AMSR2 has more accurate hot load than AMSR. Two kinds of modification are introduced. One is to use an actively controlled thermal reflector over the hot load. This reflector is called a temperature controlled plate (TCP). Another modification is to shield the ambient emissions. GCOM-W1 was put into A-Train orbit. GCOM-C1 satellite as well as AMSR2 are operating very well. GCOM-C1 carries GLI F/O (called the second generation GLI: SGLI). The SGLI is rather different from GLI on ADEOS2. In order to measure aerosols over both ocean and land, it has a near ultra violet channel, as well as polarization and bi-directional observation capability. The instrument is composed of several components. They are VNR (visible and near infrared)-non polarization (VNR-NP), VNR polarization (VNR-P), and IRS (short wave to long wave infrared (SWI & TMI). The VNR adopts push broom scanners, while IRS uses a conventional whisk broom scanner. VNR-NP is an 11 channel scanner. VNR-P has two spectral channels, while each spectral channel is composed of 3 polarizations. SWI has 4 channels. TMI has 2 split window channels. For, coastal zone and land observation, the IFOV of SGLI for these targets is around 250m. All channels of VNR-NP except 763 nm and 1.64 μm channel of SWI have 250m IFOV. TMI channels have 250m IFOV and all the other channels have 1000m IFOV. JAXA has now started the study of AMSR3, which is an improved version of AMSR2. We are now discussing to add high frequency channels mainly for solid precipitation measurements.

Keywords: GCOM, GCOM-W1, GCOM-C1, ADEOS

FLOOD MONITORING IN GAMPAHA DISTRICT USING SAR DATA AS A CASE STUDY IN THE LOWER BASIN IN ATTANAGALU OYA

Halpegamage Nadeeka Thushari (1), Prof. Lasantha Manawadu (2)

[1] GIS Officer, IS & GIS Division, Urban Development Authority, Sethsiripaya, Battaramulla, Sri Lanka.
[2] Head of the Department / Department of Geography, University of Colombo, Sri Lanka
Email: nadee_tusha@hotmail.com; newgisupdate@gmail.com; lasan@geo.cmb.ac.lk

Abstract: Radar image data find special application in flood monitoring due to their properties of all weather, day-and-night and cloud-piercing capabilities. However, the classification and object extraction of radar image are very difficult because their imaging mechanism is quite different from that of multi spectral image. One of the largest limitations of radar automated classification is the occurrence of speckle noise. The ALOS satellite obtained the PALSAR radar data during floods by the emergency observation requests. The PALSAR data can easily detect the water surface because its wave length is L-band. This paper presents a comprehensive methodology, with "Discrete Wavelet Transform" analysis, for identifying the flooded area. The case study of floods on 18 May 2010 at Attanagalu Oya River Basin in Gampaha District, Sri Lanka shows the effectiveness and efficiency of the developed method. The results of the analysis were timely provided to the central and local governments to help them to make decision on the reduction of flood disasters. Remote sensing methods based on optical, medium resolution imagery, such as Landsat and SPOT, are limited in their applicability. This paper presents and compares a few techniques using remote sensing data which are of use to flood mapping, which may be eventually used to analyze flood propagation. The geometric correction and typical noise smoothing methods of the PALSAR data are used here and with the "not enough satisfaction" of speckle reduction, one more reduction method called wavelet thresholding was applied. The resulting images almost coincide with the reported flood regions. Fusion of satellite images with different spatial and spectral resolutions plays an important role in visualizing information effectively. Image fusion is an application for making use of two or more complementary images/spectral bands of the same or different sensors for the same area. GIS relate technologies are very useful in flood monitoring and damage evaluation. In this study, GIS & Remote Sensing provide a better evaluation that useful for understanding overall situation & in an emergency rapid response to global disasters like flood is firmly established and flood monitoring has become an easy task with the advent of the said technology.

Keywords: Flood Monitoring, Remote Sensing, Geographical Information System, ALOS PALSAR, Speckle Reduction

MONITORING OF 3-D LAND SUBSIDENCE FROM PSI WITH GPS/LEVELING DATA

Hiroki Ito (1), Junichi Susaki (1)

[1] Graduate School of Engineering, Kyoto University,
C1-1-209, Kyotodaigakukatsura, Nishikyo-ku, Kyoto, 615-8540, Japan
Email: itou.hiroki.64v@st.kyoto-u.ac.jp

Abstract: The land subsidence has been a global serious problem due to climate change and ground water extraction, and the inexpensive land subsidence monitoring technique is highly required. Leveling and Global Positioning System (GPS) are a land subsidence monitoring tool. Leveling provides vertical ground deformation and GPS provides threedimensional (3-D) deformation with subcentimeter accuracy level, but these measurements are point observations. In order to achieve a high spatial resolution, synthetic aperture radar (SAR) is an effective approach. Differential interferometric SAR (DInSAR) technique has been widely known as wide range of land subsidence measurement method. In particular, Persistent Scatterers Interferometry (PSI) can accurately measure wide range of land subsidence by using multi-temporal SAR images. However, the estimated displacement is obtained only along the radar line-of-sight (LOS) direction. Therefore, it is expected to develop a method for measuring 3-D displacements by combining multi-directional observation. Thus, in this paper, we will merge the results from PSI and geodetic deformation measurements (GPS and leveling) to estimate the 3D displacement velocities of Kansai International Airport with high spatial resolution. First, we estimate the displacement from the ascending- and descending-orbit SAR images by PSI, individually. Second, we use an ordinary kriging in order to match the spatial resolution of GPS and leveling to that of a PSI result. Finally, we apply the least square (LS) approach to combine the interpolated result from GPS and leveling, and estimated results by PSI from SAR images observed on ascending- and descending-orbits. We used 9 ALOS2/PALSAR2 ascending images from 2014 to 2017 and 8 ALOS2/PALSAR2 descending images from 2014 to 2016 for PSI. We compared the estimated results with leveling survey data. The root mean squared error (RMSE) was 18 mm/year, and it was found that the fusion of the results from PSI and geodetic deformation measurements is more effective for land subsidence monitoring with high spatial resolution than the PSI-only or Interpolation-only. In future, we will apply the Weighted Least Square (WLS) approach to obtain the 3-D displacement velocities and further investigation is necessary to validate the estimated horizontal displacement.

Keywords: land subsidence, PSI, synthetic aperture radar (SAR), leveling, GPS

DUST ANALYSIS AND ITS EFFECTS ON SOLAR PV POWER POTENTIAL IN THE ASIAPACIFIC REGION USING MODIS TIME-SERIES FROM 2001-2017

Jeark Principe (1)(2), Wataru Takeuchi (1)

[1] Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
[2] Department of Geodetic Engineering, University of the Philippines Diliman, Quezon City, Philippines 1101
Email: japrince@iis.u-tokyo.ac.jp; wataru@iis.u-tokyo.ac.jp

Abstract: Dust negatively affects the performance of solar photovoltaic (PV) systems by blocking the incoming solar radiation, thereby preventing the conversion of sunlight to electricity by the solar cells. As output power from solar PV systems is expected to fluctuate, it is imperative to quantify the effects of dust and do adaptation techniques to mitigate its impact. This study presents a method of estimating the decrease in the output power of solar PV (P_{PV}) due to dust in the Asia Pacific Region (APR) using various satellite data including the 17 years of MOD04 aerosol data from Moderate Resolution Imaging Spectroradiometer (MODIS), shortwave radiation (SWR) from Advanced Himawari Imager 8 (AHI8), and precipitation rate (pcp_rate) from Global Satellite Mapping of Precipitation (GSMAP). Firstly, aerosol characterization was done using aerosol optical depth (τ_α) and angstrom coefficient (α) to separate fine ($\tau_\alpha \geq 1$) from coarse ($\tau_\alpha < 1$) particles and considered pixels with $\tau_\alpha > 0.2$ to be affected by dust. Secondly, a masking technique was also used where rainfall was considered as a natural cleaning agent for pcp_rate>20mm/day. The theoretical P_{PV} and power loss due to dust (ΔP_{PV}) were generated using the adjusted SWR, efficiency of solar cell, and the dust-rainfall mask. Meanwhile, validation of model outputs was done by comparing reported outputs of actual solar PV installations in Perth and Bangkok. Results show that the 23 selected cities in APR exhibit seasonal trend in AOD levels with particle size mostly in coarse mode. Moreover, the cities of Kuala Lumpur, Manila, Sydney, Taipei, Wellington, Dili, Honiara, Thimphu, Ulaanbaatar, Brunei and Muara, and central Singapore have the lowest long-term mean annual ΔP_{PV} (<1%), indicating negligible effect of dust in these areas. Lastly, results also show that Bangkok, Nay Pyi Taw, Beijing and Dhaka experienced the largest dust effect translating to a long-term mean average of about 19%, 22%, 6% and 8% ΔP_{PV} during Dec-Jan-Feb (DJF), Mar-Apr-May (MAM), Jun-Jul-Aug (JJA) and Sep-Oct-Nov (SON) seasons, respectively. Manual cleaning of solar panels is therefore recommended for these areas since rainfall alone cannot fully eliminate the effects of dust.

Keywords: solar PV, dust, rainfall, AOD, Angstrom coefficient

SEVERITY OF GANODERMA BONINENSE DISEASE CLASSIFICATION USING SAR DATA

Izrahayu Che Hashim (1), Abdul Rashid Mohamed Shariff (2), Siti Khairunniza Bejo (2), Farrah Melissa Muharam (3), Khairulmazmi Ahmad (4)

[1] Geospatial Information Research Centre (GISRC), Level 6 Tower Block, Faculty of Engineering, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia.
[2] Department of Biological and Agriculture, Level 3, Faculty of Engineering, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia.
[3] Department of Agriculture Technology, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia.
[4] Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia.
Email: izrahayu@gmail.com; rashidpls@upm.edu.my; skbejo@upm.edu.my; farrahm@upm.edu.my; khairulmazmi@upm.edu.my

Abstract: Basal stem rot disease (BSR) in oil palm plantations is caused by Ganoderma boninense fungus. BSR is a major disease attacking oil palm plantations in Malaysia and Indonesia. But for now, the only available treatment is to prolong the life of oil palm trees as there is no effective treatment for BSR. To control this disease, early detection of G. Boninense infection is a decent strategy. Many researchers have used remote sensing techniques for early detection and mapping of BSR disease in oil palm plantations based on BSR infection symptoms. The main objective of this project is to study the potential of radar backscattering for prediction of BSR disease in oil palm plantation. The processing stage involved the usage of two different machine learning models to produce BSR disease distribution map. This project uses Alos Palsar 2 image with dual polarization (Horizontal - transmit and Horizontal - receive) and HV (Horizontal - transmit and Vertical - receive) archived on March 20, 2017. Two classifier models: Multilayer Perceptron (MP) and Kstar are tested by using Weka open source software. The MP classifier modeling and HV polarization is best for predicting, classifying, and mapping of oil palm BSR in terms of overall accuracy (OA). Model MP Classifier and HV polarization reach 77.17% OA. In addition, this study can separate oil palm by severity of each TO (92%), T2 (93.3%) and T3 (54.5%).

Keywords: Basal stem rot, Radar Backscattering, Machine Learning, Classification

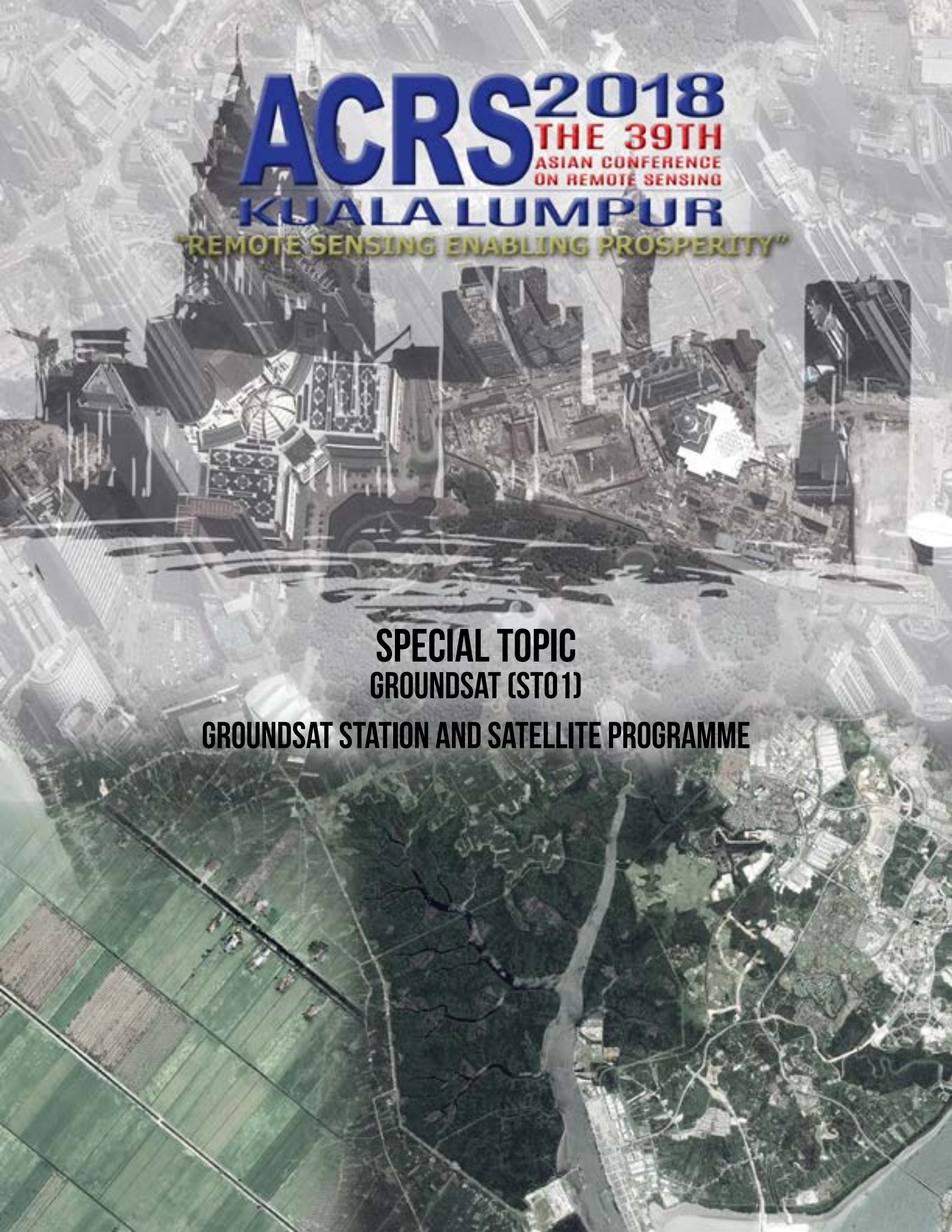
STUDY THE USE OF MUTLI-TEMPORAL SAR DATA IN RICE AREA MAPPING AND MONITORING FOR ASIA-RICE INITIATIVE

Lal Samarakoon (1), Kei Oyoshi (2), Ryo Michishita (2), Shoji Kimura (3), Shin-ichi Sobue (2)

[1] CANAsia GeoInformatics Solutions Ltd., 5777 Birney Avenue, Vancouver, Canada
[2] Japan Aerospace Exploration Agency, EORC, Tsukuba Space Center, 2-1-1 Sengen, Tsukuba, Ibaraki 305-8505, Japan
[3] Remote Sensing Technology Center, Tokyo, Japan
Email: lalsamarakoon@gmail.com; ohyoshi.kei@jaxa.jp; michishita.ryo@jaxa.jp; sobue.shinichi@jaxa.jp

Abstract: Asia-Rice Crop Estimation & Monitoring (Asia-RiCE) component of the GEO Global Agricultural Monitoring (GEOGLAM) initiative is started by an ad hoc team of stakeholders in Asia. The aim of the initiate is to develop rice-related information; paddy grown area maps, condition and outlook of the rice growth, monitoring of the growth and finally the rice yield and production, using remote sensing tools and disseminate the same at the local and global scales. This paper discusses the use of multi-temporal SAR data for the identification of rice-planted area, and the potential of growth monitoring carried out through Asia-RiCE group. An algorithm is proposed and emphasis was given to describe the custom-made software tool referred to as International Asian Harvest monitoring system for Rice (INAHOR) in processing the proposed algorithm using multi-temporal data. Tests sites were selected and collaborated was done with national agriculture agencies in Cambodia and Myanmar in applying the algorithm and testing the outcome with ground based data for accuracy verification. In both of the cases, temporal ALOS-2 data were used and acceptable accuracy levels were observed. Moreover, results were shared with decision makers during stakeholders meeting and proposed schemes to scale-up to national level including Indonesian case are presented in the paper.

Keywords: Asia-RiCE, INAHOR, ALOS-2, Rice Mapping, SAR



SPECIAL TOPIC

GROUNDSAT (ST01)

GROUNDSAT STATION AND SATELLITE PROGRAMME

ON-ORBIT MTF ESTIMATION FOR THE KOMPSAT-3A SATELLITE USING STAR IMAGES

Chi-Ho Kang (1)

[1] Korea Aerospace Research Institute, 115 Gwahangno, Yuseong-Gu, Daejeon, Republic of Korea
Email: chkang@kari.re.kr

Abstract: The KOMPSAT-3A (Korean Multi-Purpose Satellite-3A) was successfully launched on 26 March 2015, with the mission to provide high-resolution imagery for civilian and defence users. The modulation transfer function (MTF), which represents the performance of the imaging system in spatial resolution aspect, has been evaluated since calibration and validation phase of the KOMPSAT-3A program and the edge method has been adopted as the nominal method for the estimation of MTF of the KOMPSAT-3A system. Meanwhile star images, which can be treated as the representative of the point spread function, has been obtained for the application on optimization on focusing mechanism. This paper presents methods and results for the estimation on KOMPSAT-3A on-orbit MTF performance using star images observed through panchromatic band only. The two-dimensional point spread function (PSF) in sub-pixel level was established by integrating of a series of star images and applying curve fitting. The MTF and the full width at half maximum (FWHM) were finally evaluated as a function of an azimuthal angle by averaging out for the quantitative estimation. The result shows that the spatial resolution parameters show higher values than those reported by edge method and this deviation is likely to be caused by both the procedural difference such as the application of modelling and the existence of degradation by Earth's atmosphere. In the aspect of stability it is concluded that the MTF has been maintained without any noticeable degradation.

Keywords: KOMPSAT-3A, spatial resolution, point spread function, modulation transfer function, full width at half maximum

THE IN-HOUSE DOWN CONVERTER DEVELOPMENT PHASE 1 FOR S-BAND SATELLITE CONTROL GROUND STATION

Warinthorn Kiadtikornthaweeyot (1), Likit Waranon (1), Rapirat Ritronnasak (1)

[1] Geo-Informatics and Space Technology Development Agency, Bangkok, Thailand
Email: warinthorn@gistda.or.th; likhit@gistda.or.th; rapirat@gistda.or.th

Abstract: The satellite control ground station plays an important part in satellite communication between the ground and the satellite. There are main functions in the satellite control ground station, S- band station, Satellite command center, Orbit determination system and Mission planning center. This paper introduces the development and testing procedure regarding verification of the functions and the performance of the in-house down converter in the part of S-band system. For more than three decades, Thailand have accessed the EO satellite via ground station. Geo- Informatics and Space Technology Development Agency (GISTDA) uses the S-band frequency for Telemetry, Tracking and Command with the existing hands-on ground station from the THAICHOTE satellite project (2008). However, after several years of experience in operation, control and maintenance of the control ground station, GISTDA has initiated development of their own satellite control ground station. The main objectives are firstly improving the operation workflow. The second is raising the capability of the engineers through the satellite control ground program development. Since 2014, GISTDA has developed each part such as the prototype of the antenna, the automatic satellite control platform, flight dynamics and orbit analysis tools, etc. Moreover, the future plan is for GISTDA to be able to apply this knowledge and know-how to develop the whole system. In addition, operation of current satellites and in the near future 3U and small satellites. In 2018, The project "Analysis and Design of S-band Down Converter for Satellite Communication System Phase 1: Down Converter" is beginning to gain knowledge in satellite communication regarding the Down converter in the part of S-band station. GISTDA has co- operation knowledge transfer via training and hands-on development with experts from Mahanakron University of Technology. The final result is a prototype having undergone full factory testing. The focus is Down converter with a radio frequency of 70 MHz or lower. The in-house prototype Down converter is expected to be able to operate with the existing S-band ground station and be changeable as a spare part. Additionally, in this paper, the progress of the project, hands-on working procedures, knowledge transfer, preliminary circuit design and development plan are presented.

Keywords: S-band ground station development, in-house Down converter, Satellite communication, Knowledge transfer

DEVELOPMENT OF THE NATIONAL REMOTE SENSING GROUND STATION TO RECEIVE SATELLITE DATA BASED ON VIRTUAL GROUND STATION IN ORDER TO SUPPORT THE NATIONAL REMOTE SENSING DATA AVAILABILITY

Hidayat Gunawan (1), Wismu Sunarmodo (1), Nurmajid Saputra (1), Ali Syahputra Nasution (1), Andy Indradjad (1), Ayom Widipaminto (1)

[1] Remote Sensing Technology and Data Centre (Pustekdata), National Institute of Aeronotics and Space (LAPAN), Jl. LAPAN No. 70 Pekayon, Pasar Rebo, Jakarta Timur 13710, Indonesia
Email: hidayat.gunawan@lapan.go.id; ayom.widipaminto@lapan.go.id

Abstract: With the increasing need for disaster mitigation system and natural resource information for regional development from Sabang to Merauke, the need for remote sensing data in Indonesia continues to grow. This is in line with the growing development of remote sensing satellite technology, which continues to contribute in both of low, medium and high-resolution data. For integration and operational efficiency of the ground station system in Indonesia, it is necessary to develop a national ground station system for the reception of remote sensing multi mission data. The system can be built in an integrated and centralized way, consisting of 3 main components: data receiving ground station, network infrastructure and data distribution management system. In the operation of the ground station system will be done remotely access based on virtual ground station. In this case, remote sensing ground stations that have been operational in LAPAN (Parepare, Rumpin and Pekayon) as well as each agency and local government can be optimized to support the developed system. The built system is connected with the national remote sensing data bank, as a national bank node, so that the data communications network of each ground station all connected to the national remote sensing data bank. With the developed national ground station system for remote sensing satellite data reception, it is expected to improve coordination, reduce costs and make it easier for each agency and local government to obtain remote sensing data, near real time, for low resolution, medium and high-resolution data, especially for remote sensing satellites data required for disaster mitigation, natural resources information, and national remote sensing data bank.

Keywords: disaster mitigation, natural resources, remote sensing satellites, national remote sensing ground station, virtual ground station, national remote sensing data bank

PLEIADES NEO CONSTELLATION, TRUSTED INTELLIGENCE

Jérôme Soubirane (1), Fabienne Grazzini (1)

[1] Airbus Defence and Space, 5, rue des Satellites, 31030 Toulouse, France
Email: jerome.soubirane@airbus.com; fabienne.grazzini@airbus.com

Abstract: The coming Airbus' Very High-Resolution constellation, Pléiades Neo, to be launched from 2020, will ensure the continuity of the Pléiades efficient and reliable service. Upgraded reactivity will be offered to users thanks to a disruptive system architecture boosted by a direct access to the relay satellite communication service, known as SpaceDataHighway. Pléiades Neo, entirely funded, manufactured, owned and operated by Airbus Defence and Space (Airbus DS), is a scalable constellation of optical and very agile satellites, put into sun-synchronous orbits at about 620km. First launch batch of this ambitious programme is already secured with Arianespace for 2020, with satellites construction already well underway. With a starting configuration of four identical satellites, Pléiades Neo will provide intraday revisit anywhere on Earth; each satellite able to image up to 500,000km² per day at 30cm resolution, will be coupled to innovative ground segment. The SpaceDataHighway system was developed through a public-private partnership (PPP) between the European Space Agency (ESA) and Airbus DS, and actually benefits to the Sentinel satellites of the European Copernicus Earth observation programme. Pléiades Neo will be the first commercial constellation to be equipped with this technology, and therefore able to allow this unique responsiveness level. On top of increased monitoring capability and operational efficiency, Pléiades Neo offers very high-resolution information fully committed to answer users' operational and commercial needs. The next-generation and multi-mission ground segments will foster access to the information, offering machine learning for automatic objects detection, ranging from trees to planes and cars and fully automated analytics. They will also provide, using latest big-data cloud technology, flexible and scalable storage of data, as well as massive imagery processing to enable trusted intelligence.

Keywords: satellite, resolution, reactivity, accuracy, analytics

COST EFFECTIVE COMMUNICATION ARCHITECTURE FOR REAL-TIME COMMANDING/RECEIVING OF REMOTE SENSING SATELLITE MISSIONS

Jer Ling (1)

[1] National Space Organization (NSPO) F8, No 9, Prosperity Road 1, Hsinchu City, Taiwan
Email: jl@nspo.narl.org.tw

Abstract: The living earth is very dynamic. Activities happen around the earth around the clock. The remote sensing satellite is usually on the sun synchronous orbit with limited ground contacts daily. Even with the wide using of the North Pole ground stations for commanding/receiving mission operations, the time gap with the satellite still can be 50 minutes. Moreover the additional cost is spent for booking of the overseas ground station and the transmission lines. Therefore it frequently happens the imaging for special real-time events takes latency of several hours. This paper proposes the cost-effective communication architecture for real-time commanding/receiving the remote sensing satellites of special (urgent) events. The architecture based on the soon developing satellite internet service is introduced in detail. The antenna, the link budget, and data flow analysis are introduced. Taiwan electronic industry has the capability to develop the transmitter. The proposed mission design is the first-of-this-kind. The cost analysis is also studied.

Keywords: Real-time Commanding/Receiving, Communication Architecture, Satellite Internet Service, Latency Minimization, Mission Profile

DEVELOPMENT OF SOUMI NATIONAL POLAR-ORBITING PARTNERSHIP (SOUMI NPP) LEVEL TWO (2) DATA PRODUCTION SYSTEM USING OPEN SOURCE SOFTWARE

Wan Ahmad Aizzu-Din Wan Hassan (1), Arjuna Zahari (1), Jefri Mat Saad (1), Noraini Ibrahim (1)

[1] Malaysian Remote Sensing Agency (MRSA), No.13, Jalan Tun Ismail 50480, Kuala Lumpur, Malaysia
Email: aizzudin@remotesensing.gov.my; arjuna@remotesensing.gov.my, azzam@remotesensing.gov.my; nazri@remotesensing.gov.my

Abstract: The Malaysian Remote Sensing Agency (MRSA) Ground Station is capable to receive the Soumi National Polar-Orbiting Partnership (Soumi NPP) data using the existing MODIS receiving system that currently used to receive data from Terra and Aqua Satellites. However, the MODIS system not capable to produce level two (2) Soumi NPP data that is required by two important research and development projects in MRSA, which are the Fish Site Identification (FSI), and Forest Fire Information System (FORFIS) project. A study using different open source software to produce level 2 Soumi NPP data has been done to overcome this problem. The Suomi NPP data production system developed by running the script automatically that integrate the acquisition of Suomi NPP using the existing MRSA Ground Station 3.6 meter antenna and all necessary software that need to process the level two data which are Real Time – Software Telemetry Processing System (RT-STPS), Science Processing Algorithm (SPA), SeaWIFS Data Analysis System (SEADAS) and Community Satellite Processing Package Sensor Data Record (CSPP SDR) software. By using this alternative open source software, level two (2) Soumi NPP data has been successfully produce and can be used by the FSI and FORFIS project's team.

Keywords: Soumi NPP, Data Processing, Open Source Software

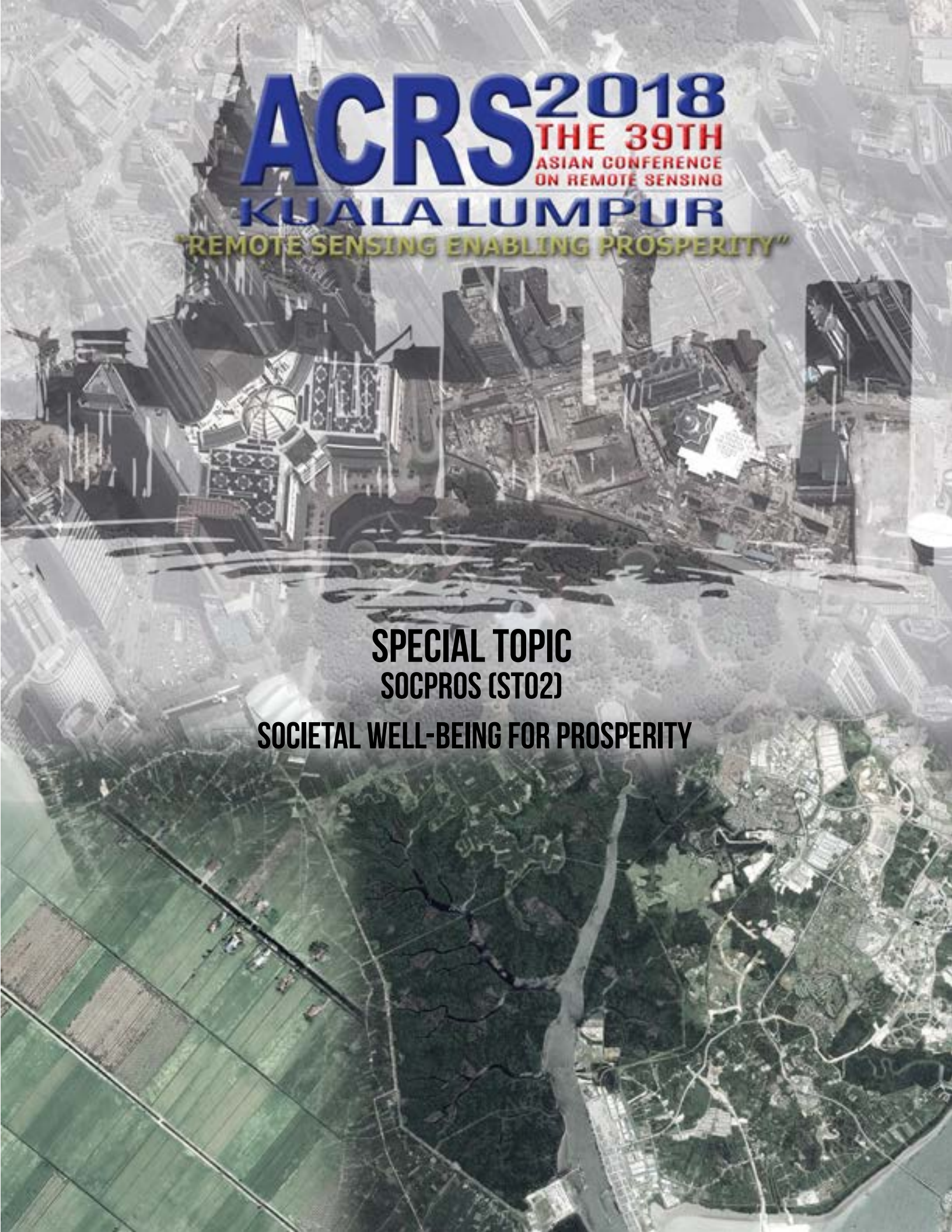
STANDARD OF LAPAN REMOTE SENSING GROUND STATION TOWARDS STANDARDIZATION OF THE INDONESIAN NATIONAL REMOTE SENSING GROUND STATION

Muchammad Soleh (1), Hidayat Gunawan (1), Ali Syahputra Nasution (1), Arif Hidayat (2) and Ayom Widipaminto (1)

[1]Remote Sensing Technology and Data Center LAPAN, Indonesia,Jl, LAPAN No.70 Pekayon Pasar Rebo, Jakarta Timur 13710, Indonesia
[2]Parepare Remote Sensing Ground Station LAPAN, Indonesia,Jl, Jend. Ahmad Yani Km. 6, Bukit Harapan, Soreang, Parepare, Sulawesi Selatan 91131, Indonesia
Email: msoleh76@gmail.com; hgun1708@gmail.com; ali.syahputra@gmail.com; arif_hidayat@lapan.go.id; ayom.widipaminto@lapan.go.id

Abstract: The acquisition and recording of satellite data through the implementation of remote sensing ground stations in Indonesia has been carried out by many government agencies including LAPAN (Indonesian National Institute of Aeronautics and Space), BMKG (Indonesian Agency for Meteorology, Climatology and Geophysics), BIG (Geospatial Information Institute), BAKAMLA (Maritime Security Coordinating Board), KLHK (Ministry for the Environment), BPPT (State Ministry for Research and Technology), Kementan (Ministry of Agriculture) and KKP (Ministry of Marine and Fish). In terms of infrastructure, LAPAN has established operational technical standards for remote sensing ground stations in receiving, recording, storing and distributing remote sensing satellite data through a national data center or national remote sensing data bank (BDPJN). The establishment of operational technical standard standards for remote sensing ground stations covers aspects of determining geolocation standards, ground station antenna technical standards, data quality standards, and delivery time and data distribution standards. Referring to the Indonesian Law of Space No. 21 of 2013, LAPAN is tasked with building and operating remote sensing ground stations in order to provide remote sensing data licensed by the Government of Indonesia for all Ministries / Institutions, TNI, POLRI, and Local Governments. The law gives authority to LAPAN to coordinate and prepare data acquisition standards, especially related to the implementation of the national remote sensing ground station. In relation to these two matters, LAPAN continues to prepare operational technical standard documents for remote sensing ground stations which will serve as a reference for all operators of remote sensing ground stations in Indonesia in order to guarantee the implementation of data acquisition and implementation. It is expected that with the compilation of standard remote sensing ground stations published by LAPAN, in the near future a standard national remote sensing ground station will be produced as a standard guide for all operators of remote sensing ground stations in Indonesia.

Keywords: Standardization, Remote Sensing, Ground Station, LAPAN



SPECIAL TOPIC

SOCPROS (ST02)

SOCIETAL WELL-BEING FOR PROSPERITY

SURVEY ON PERFORMANCE OF INFORMATION RETRIEVAL'S STRATEGIES IN DYNAMIC ENVIRONMENT

Muhammad Majid (1) Muhammad Zubair Tahir (2), Shahbaz Ahmad (3),
Hamid Mahmood (1), Madasar Maqsood (1)

[1] Department of Computer Science, Govt. Postgraduate College Samanabad Faisalabad, Pakistan
Department of Comptuers Sceince , The University of Faisalabad, Pakistan
Department of Comptuer Science, National Textile University Faisalabad, Pakistan
Email: mmajid2026@gmail.com; uafmcs@gmail.com; gpcs.faisalabad@gmail.com;
mzubair122@gmail.com; shahbaz@ntu.edu.pk

Abstract: This paper evaluates the set of measures to check the performance of the search engine over the World Wide Web that provides the plenty of information within a time pool. The tool that is called the search engine is used to find out the date effectively. The traditional ways are not sufficient to find out performance of the search engine. These involve the precision, recall etc. Search Engines that crawl the web to find out the information works in a highly distributed dynamic environment. Several algorithms and metrics are provided by many researchers to check the performance of search engine. The size of the search engine goes on increasing on daily basis shaping in the form of Cloud that`s called the cloud computing. The pages that are inserting on the daily basis increasing its weight. This paper provides the several existing and new techniques to evaluate the performance of search engines.

Keywords: Search Engines, Relevance measures, Evaluation measures, Information Retrieval techniques, and system

SPATIAL VISUALIZATION OF VOTERS PROFILE FOR SENATOR ELECTION (PILKADA) (STUDY CASE: REGION OF BANDUNG RAYA, PROVINCE OF WEST JAVA)

M. Triwahyudi Latin (1), Soni Darmawan (1)

[1] Institut Teknologi Nasional
No. 23, Jalan PKH. Mustopha, 40124 Bandung, Indonesian
Email: Muhammadtriwahyudi38@gmail.com

Abstract: Pilkada is a form of democratic party to find new leaders in the region, where the search will be determined by the people themselves. Determination was used by the candidate pairs (candidate pairs) as a place to get votes from the people, but it was very difficult to get the votes. By using this spatial visualization method, it will provide a spatial description of what problems the voter is facing. The problem of voters will later shape the profile of voters and provide convenience for the candidate pairs to make materials that are in accordance with the problems of voters in the campaign work area. In this study, the object being researched is the profile of voters in the Greater Bandung area, including: The City of Bandung, Kab. Bandung, Kab. West Bandung, and Cimahi City. The voter profile is obtained based on the village potential data from the Central Statistics Agency which is identified to be some characteristics of voters based on the social problems that occur. The purpose of this study is to identify and visualize the profile of voters in the Greater Bandung area. The final result of this study is a map of visualization of voter profiles based on the characteristics of voters obtained in the village potential data. The benefits of this study are expected to provide initial information as material for the candidate pairs in the campaign in the regional head elections.

Keywords: Campaign, Voter Profile, Pilkada, Spatial Visualization

ANGLE BASED SUBNETTING TO AVOID THE HOTSPO OCCURRENCE IN WSN

Umar Draz (2), Tariq Ali (1), Sana Yasin (2)

[1] COMSATS Institute of Information Technology, Sahiwal, Pakistan
[2] Government College University Faisalabad, Sahiwal Campus
Email: Sanayaseen42@yahoo.com; Tariqali@ciitsahiwal.edu.pk; Sheikhumar520@gmail.com

Abstract: Hotspot is a severe issue of WSN that is occurs due to the heavy transmission of data of the sink neighboring nodes. It affects the multiple parameters of the network like energy, throughput, PDR, PLR, congestion and unnecessary delay of the network. In this paper angle based subnetting techniques is purposed to resolve the hotspot issue from the network. In this technique network is divided in to multiple subnets, but this subnetting is done by using the angle based approach unlike the traditional approaches of subnetting that does not have any proper criteria of the network division to resolve Hotspot issue. Purposed angle based subnetting defines their own zone by broadcasting a message by the subnet head to the nearest nodes that are placed at the 360 degree angle from the head node. The nodes that are placed at defined angle will receive this message and reply back to the subnet head with their node id and energy consumption ratio. The major benefits of this angle based subnetting is that due to the existence of proper angle between the nodes and the subnet head node, every node can directly communicate with the head node. Due to this, the sink neighboring nodes burden will be reduced that automatically avoid the occurrence of Hotspot in the network.

Keywords: Hotspot, PDR, PLR, WSN

DEFINING THE RELATED ENVIRONMENTAL RISK FACTORS FOR MOTORCYCLE THEFT CRIMES

Pei-Fen Kuo (1), Chui-Sheng, Chiu, Cheng-Yen, Wu

[1]Geomatics Department, National Cheng Kung University, University Road, Tainan City, Taiwan, R.O.C. 70101
Email: peifenkuo@gmail.com

Abstract: Unlike burglary or other fixed property theft, stealing of motor vehicles not only increases the fear of future crime but also limits the victims' mobility, which causes significant inconvenience. In addition, motorcycle theft is a growing but neglected problem around the world. Although motorcycle theft disrupts social order and increases fear of crime significantly, it is one of the least studied forms of crime. Most studies focus on the car theft and its spatial-temporal characteristics. For example, inner cities, multi-racial areas, and disadvantaged neighborhoods (e.g., low-income, high dropout rate) or crime attractors (e.g., bars, liquor stores) tend to have higher car theft rates. However, we don't know if these are also risk factors for motorcycle theft. In addition, we will analyze if these environmental factors in the West hold true in Asia, which differs significantly in terms of crime types, motivation, land use, and lifestyle. For the reasons stated above, this study used local data and spatial regression models to define motorcycle theft hotspots and the corresponding environmental factors, evaluate whether or not existing environmental factors in the West are applicable to Asian countries, and then use this data to design local crime prevention plans. It is our hope that this study can help police officers to define related factors and more accurately predict future crime rates, which will assist in the design of corresponding policies and enforcement strategies to prevent crime.

Keywords: Spatial Regression Model, Crime Prediction, Motorcycle Theft

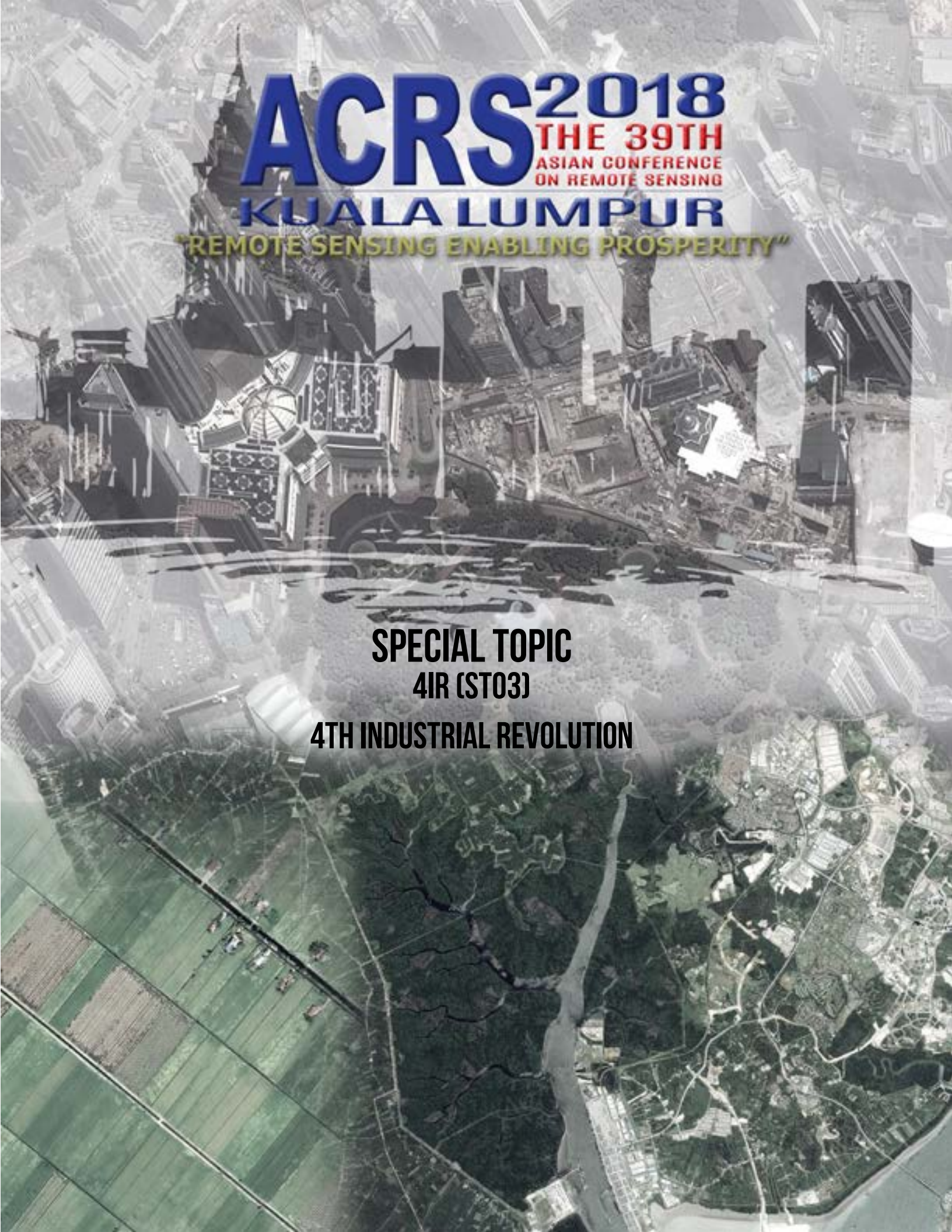
THE RELATIONSHIP BETWEEN THE UNIVERSITY AND THE SIZE OF NEIGHBOR TERTIARY SECTOR

Min-Chi Sung (1), Pin-Chieh Yu (1), Ching-Mei Pan (1), Pei-Wun Wu (1), Yun-Shan Lee (1), Jing-Chzi Hsieh (2)

[1]Junior, Department of Land Management, Feng Chia University
[2] Professor, Department of Land Management, Feng Chia University
100 Wenhaw Rd., Seatwen Dist., Taichung City 407, Taiwan
Email: d0451473@fcu.edu.tw, jchsieh@fcu.edu.tw

Abstract: The university with amounts of faculty, staff, and students, who have a considerable consumption power totally, has been a tool of development strategy to initiate area development. However, could every single university initiate neighbor tertiary sector development? How big should be a university initiating neighbor tertiary sector development? The authors review the concept of trade area and demand threshold, apply regression model to analyze the relationship between variables such as population of teachers and students, campus area, location of school, etc. and the size of neighbor tertiary sector. This study will use the data of 157 colleges and universities in Taiwan, and calculate the size of neighbor tertiary sector by Arc GIS. The findings will be a reference for government policy and the managers of neighbor tertiary sector.

Keywords: The Scale of University, Trade Area, Tertiary Sector, Regression Model, Arc GIS



SPECIAL TOPIC

4IR (ST03)

4TH INDUSTRIAL REVOLUTION

FOURTH INDUSTRIAL REVOLUTION TECHNOLOGIES FOR DATA ANALYTICS FOR REAL TIME GEOSPATIAL DASHBOARD

Iyyanki V Muralikrishna (1)

[1] Former Professor Jawaharlal Nehru Technological University,
Dr Raja Ramanna Distinguished Fellow DRDO, Hyderabad 500084 India

Abstract:
Objectives:

1. To categorize the 4th IR technologies of digital revolution accompanied by sensing revolution and earth observing systems for collecting, classifying and transferring large volume, large variety data with increased velocity, on the state of our planet
2. To appraise the tools of Artificial Intelligence (AI), which in fact propels in one way or other the Fourth Industrial Revolution technologies, for synergy of the earth data analytics through machine and deep learning, working in tandem with IoT and Drones
3. To evaluate a case of application Earth observation system integrated with IOT sensors to agriculture so as to enable AI tools to automatically optimize production planning
4. To develop data analytics-based system to progress from pixels to perspectives and to design schematically a typical real time geospatial dash board.

Methods:
The fourth industrial technologies are categorized based on their scope of application for addressing the issues of sustainable development goals and earth systems management. The method of knowledge retrieval is possibly through tools of AI. As such the algorithms of machine learning and the limitations to deal with large volumes of data and the application of deep learning for such unstructured data are discussed.

Results
In this paper, the current state of the art is reviewed along with presentation of few cases of development and schematic sketch for a real time dash board for operational applications. Yet, these approaches are still relatively in creation stage and, in the upcoming years, rapid advancement of the AI tools machine and deep learning and IOT is expected.

Conclusions:
The advances under the Fourth Industrial Revolution have scope for improving management of resources and environment. These developments are directly suitable as seen from the cases of application to smart agriculture and for monitoring and tackling land degradation including desertification, optimal exploitation of marine resources etc. The focus of machine learning is to extract information from data automatically by computational and statistical methods and progress is visible in developing further for variety of earth observation systems data analysis including land surface and aerosol products, vegetation indices etc., The 4th Industrial revolution technologies of data analytics facilitate EOS to progress from pixels to perspectives and to design schematically a typical real time geospatial dash board

Keywords: Industry 4.0, Data Analytics, AI, Remote sensing, Dash Board

AN OPEN INTERNET OF THING ARCHITECTURE INTEGRATING ONEM2M AND OGC SENSORTHINGS API STANDARDS

Liang-Yi Chen (1), Chih-Yuan Huang (1)

[1] National Central University, Department of Civil Engineering,
No. 300, Zhongda Rd., Zhongli Dist., Taoyuan City 320, Taiwan (R.O.C)
Email: 2835jifu.6@gmail.com; cyhuang@csrsr.ncu.edu.tw

Abstract: Geospatial data are commonly produced by various types of sensors, such as weather stations, unmanned aerial vehicle, resource satellites. In recent years, the concept of Internet of Things (IoT) attracts increasing attention from various fields as IoT devices can generate large amount of environmental observations from their embedded sensors. A concept similar to the IoT is the machine to machine (M2M), which indicates that devices can directly communicate with each other. Many new concepts and visions related to the IoT and M2M has been proposed, such as industry 4.0, connected vehicle, smart electricity grid, e-health, precision agriculture and smart city. However, while an IoT architecture usually includes device layer, intermediate gateway layer, web service layer, and application layer, most systems are usually using proprietary solutions. These proprietary systems cause heterogeneity issues that impede them to extend or interoperate with other systems. To address this issue, following international open standards is necessary. However, while different standards usually focus on different layers, integrating standards to achieve a complete system architecture is the current direction in IoT development. In this study, we investigate in the oneM2M standard, which establishes a common service layer platform serving as gateway connecting IoT devices, and the Open Geospatial Consortium (OGC) SensorThings API standard, which focuses on web service layer to provide a complete data model and flexible query functionalities. To integrate the oneM2M and the SensorThings API standards, we propose a SensorThings API data model profile on oneM2M that helps automatically translate oneM2M data into a SensorThings API service. In general, this integrated system can achieve an open and interoperability IoT architecture that can consequently further facilitate geospatial data transmission and integration.

Keywords: sensor network, oneM2M, SensorThings API, open standard, interoperability

A SPATIAL-TEMPORAL DATA MANAGEMENT STRUCTURE FOR BIG INTERNET OF THINGS DATA

Y.J. Chang (1), C.Y. Huang (2), T.Y. Chang (3), H.Y. Chow (4), C.C. Lin (5)

[1] Master student, Dept. of Civil Engineering, National Central University, Taoyuan 32001, Taiwan
[2] Assistant Professor, Center for Space and Remote Sensing Research, National Central University, Taoyuan 32001, Taiwan
[3] Associate Researcher, National Science and Technology Center for Disaster Reduction
[4] Junior Assistant Researcher, National Science and Technology Center for Disaster Reduction
[5] Associate Vice President, MiTAC Information Technology Co. Ltd.

Abstract: In recent year, the concept of the Internet of Things (IoT) has been attracting attention from various fields, as IoT devices can continuously monitor various environmental properties. While the number of IoT devices increases rapidly, managing large volume of IoT data faces a challenging scalability issue. To address this scalability issue, many studies have shown that the performance of key-value storages is better than traditional relational databases. However, IoT data have multi- dimensional attributes including spatial, temporal and thematic attributes. How to construct an efficient multi-dimensional index structure based on a key-value storage has become a popular topic in recent years. In this research, we consider four main types of attribute/query: spatial, temporal, keyword, and value. While each type of the attribute has its own suitable indexing method, integrating the indexing methods usually requires a certain sequence. However, this sequence of indexing structure is one of the key factors deciding the query performance. While many literatures directly present their designed sequence, this research proposes an adaptive method to decide the indexing sequence based on the query criteria and the selectivity and performance of different indexing methods. In principle, highly selective queries should be performed first to reduce the number of intermediate results, which could improve the query performance of following queries. Based on this idea, this research proposes an indexing structure considering every possible sequence and automatically identifying the most efficient one for each individual query. As a result, the proposed solution can significantly improve the query performance of multi-dimensional IoT sensor data.

Keywords: Index, data management, multi-dimensional query, selectivity, adaptivity

INTEGRATION OF 3D CITY MODEL AND SENSOR OBSERVATIONS BASED ON INTERNATIONAL OPEN STANDARDS

Yao-Hsin Chiang (1), Chih-Yuan Huang (2)

[1] Department of Civil Engineering, National Central University, Taoyuan 320, Taiwan
[2] Center for Space and Remote Sensing Research, National Central University, Taoyuan 320, Taiwan
Email: chsimon4@gmail.com; cyhuang@csrsr.ncu.edu.tw

Abstract: Smart cities effectively integrates human, physical and digital systems operating in the built environment to provide automatic and efficient applications. While 3D city and landscape modelling, Internet of Things (IoT), and domain models are essential techniques of smart cities, the integration of IoT sensor observations and 3D city models is a central information backbone for smart city cyber-infrastructures. However, we argue that most of the existing solutions integrating 3D city models and sensor observations are usually customized and lack of interoperability. Therefore, in order to improve the interoperability between smart city modules, this study first utilizes 3D city model and IoT web service open standards, and then analyzes integration strategies as well as their pros and cons. In general, we have identified three main strategies: (1) embeddedness approach, (2) external reference approach, and (3) external join approach. These strategies are implemented by integrating the Open Geospatial Consortium (OGC) CityGML and IndoorGML 3D city models and the OGC SensorThings API web service. As the CityGML and IndoorGML models provide 3D building geometry for visualization and indoor networks for navigation, the SensorThings API service provides sensor observations from IoT devices. Finally, based on the implementation, the advantages and disadvantages of each strategy are analyzed by comparing their data sizes and display performance.

Keywords: 3D City Model, Sensor observation, Open standard integration

APPLICATION OF FORMAT BASED ON VP8 CODEC FOR EFFICIENT DISASTER INFORMATION PROPAGATION

Seung-Hyeon Lee (1), Myung-Hee Jo (1)

[1] School of Convergence & Fusion Engineering, Kyungpook National University, Sangju, Republic of Korea
Email: 2ss@knu.ac.kr; mhjo@knu.ac.kr

Abstract: GIS-based disaster simulation information can more effectively and intuitively respond to disaster situations, compared to the existing disaster information text-based emergency disaster texting service, and this leads to reduced disaster rates. However, in disaster situations, data traffic surges, creating server overload, which can create the server overload in a short period of time, compared to the emergency disaster texting service, which is the limits of the GIS-based information. This can be resolved by physical methods such as the increased installation of servers, but it is very difficult to forecast the traffic of disaster situations, and given the characteristics of disaster situations, that method is deemed to be very inefficient. This study sought to efficiently resolve those limits by reducing the disaster information volume based on images and videos. To that end, this study used the VP8 codec-based format. The VP8 codec is designed to reduce the data traffic in the Web environment, and when data is compressed, it has excellent color and borderline preservation power through the mutual forecasting mode of macro blocks, and thus can perform readable compression. The same information and video have different volumes according to Web formats and codecs, and the format which has less volume in the same information is deemed to be a good compression format. The universally used JPEG and MP4 formats, and the VP8 codec-based formats, Webp and Webm, were compressed according to certain sections. It was found that the VP8 codec-based format proved to be more efficient. This suggests that the VP8 codec format can effectively prevent the overload of servers, and in the future, compression using Deep Learning should be performed.

Keywords: VP8, Python, Image Compression, Risk Map, Disaster Information

A NOVEL POWER IMPROVEMENT METHOD FOR SDN-WSN

Sana Yasin (2), Tariq Ali (1), Umar Draz (2)

[1] COMSATS Institute of Information Technology, Sahiwal, Pakistan
[2] Government College University Faisalabad, Sahiwal Campus
Email: Sanayaseen42@yahoo.com; Tariqali@ciitsahiwal.edu.pk; Sheikhumar520@gmail.com

Abstract: Wireless sensor network (WSN) turn into more admired and promising field with the arrival of the Internet of things (IoT). Variety of application of WSN in health, smart gridding ,and smart agriculture requires the deployment of thousands of sensors and actuators nodes. Conversely due to the innate challenges of the sensor and actuator heterogeneity and application enslavement creates the barriers to implement the effective WSN system. This difficulty increases as WSN size increases. Software Defined Networking (SDN) provides a potential solution to WSN for their flexible management by permitting the division of the control logic from the sensor and actuators nodes. The benefit with this SDN-based management in WSNs is that it makes possible central control of the whole WSN and making the network deployment and on demand application easy for the user. SDN is a new leading architecture of networking that is are lay on the theory of isolating and separating the network in two different lumps; the control lump that finds out the traffic paths and the data lump that sends the traffic packets. In this research, the concept of SDN is emerged with the WSN to solve the power issue that is still a puzzling issue of WSN. In this research, by utilizing the SDN features and picking the idea of powering down needless links to save energy, we originate an optimization issue for recognizing the most favorable set of active links that decrease the energy rate of the network by filling traffic demands and regarding communication and power resources. To implement this idea, SDN will continuously switch off the network elements that being attached to the central controller which provides the green networking which addresses the problem of routing with the minimum number of active elements in the network while satisfying the traffic demand of the network.

Keywords: WSN, Controller, SDN-WSN, IoT

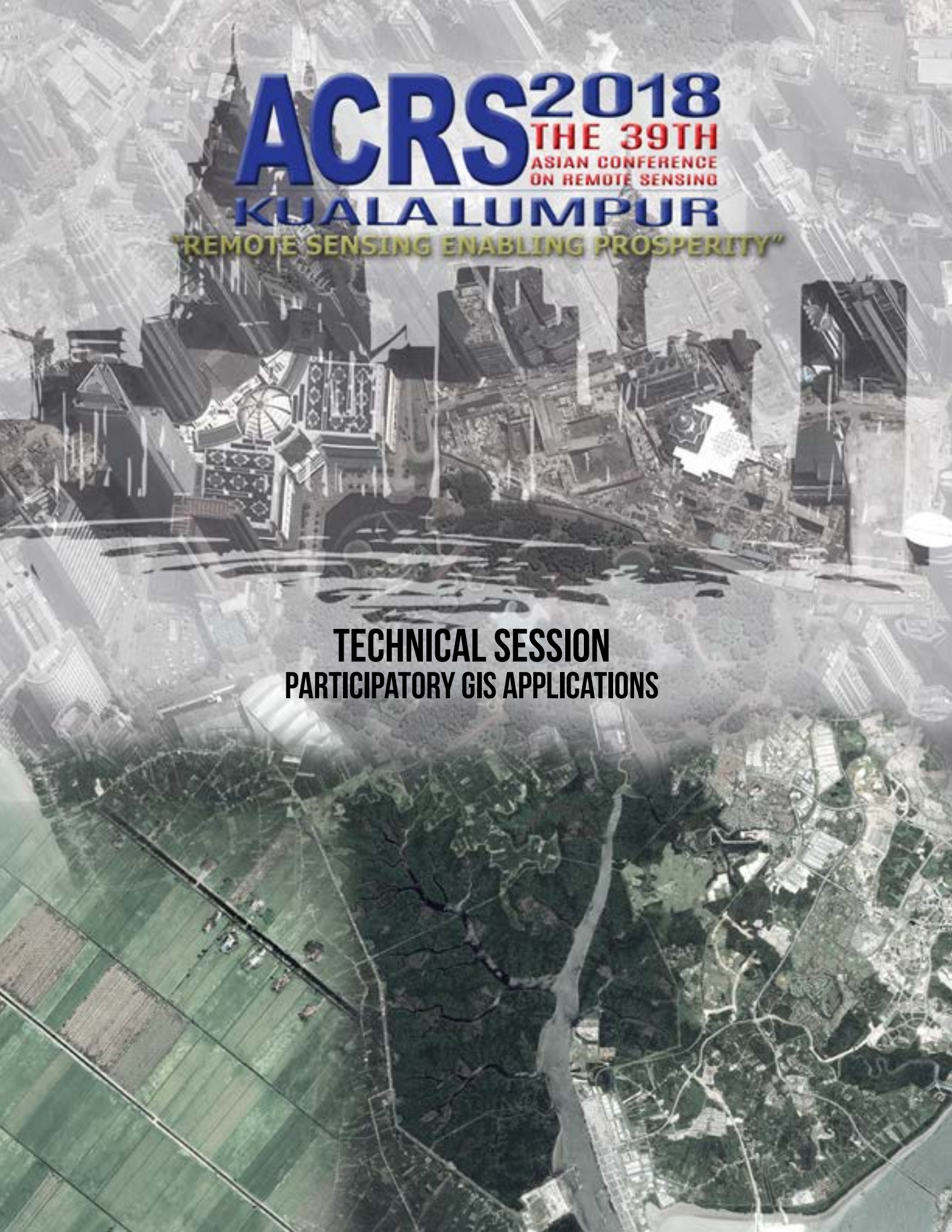
A NOVEL LAYER-BY-LAYER ANGLE-BASED ENERGY EFFICIENT WATCHMAN ALGORITHM FOR WIRELESS SENSOR AND ACTOR NETWORKS

Umar Draz (1), Tariq Ali (2), CUmair Waqas (3)

[1] Govt. College University Faislabad, Sub-Campus Sahiwal, Pakistan
[2]COMSATS University Islmabad, Sahiwal Campus
[3] Lahore garrison University, Lahore, Pakistan
Sheikhumar520@gmail.com; tariqali@cui.edu.pk; umair.waqas@lgu.edu.pk

Abstract: Due to addition of actors in wireless sensor network (WSN), this field gain much more attention from the research society. Wireless sensor and actor network (WSAN) consist of more number of actors then sensors that linked by the wireless medium to perform timely action by the given input. Sensor sense the environment and gather the relative information and pass it to the actors that takes action accordingly on the information that provided by the sensors. Due to coordination and communication of sensors-actors this field is more attractive and implemented in some real life scenario-based environments. However many significant improvement is already accomplished with the help of actors but there are still many challenges are present to overcome the issue of real time integrated applications. The major challenge is Hotspot problem in these types of networks that occur due to the fast drain rate of the sink neighboring nodes. These nodes consume more energy due to high communication and become dead early then other nodes of the network. These dead nodes cause to isolate some parts of the network. Thus, the big challenge in WSANs systems is to prolong the lifetime of the network by solving the Hotspot problem. Due to Hotspot problem many problems come into exist like uncontrolled rapid movement of mobile nodes, dying sink neighboring nodes, gradually energy consumption, shortage of network lifetime, un-necessary delays, minimum throughput and maximum packet loss ratio. Many algorithms are already addressed the issue of Hotspot inside the network but there is still need improvement in this regard like change the topology of the network and adopt some unique approach. This paper introduce novel energy efficient watchman algorithm that works with angle-based approach to rescue the Hotspot problem. The novelty of this algorithm is to deploy the network in some layer-by-layer topology so that the energy is equally distributed from all parts of the network. According to our best knowledge the layer-by-layer angle based energy efficient watchman (L2-ABEW) algorithm is first approach of wireless sensor and actors networks for Hotspot problem. Energy consumption, end-to-end delay, throughput and network lifetime is the major performance evaluation parameters for this paper. For simulation purposes, the Network Simulator (NS-2) with MIRACLE framework is used. At the end, simulation results are describing the overall performance of the proposed algorithm. For the verification and validation purposes the VDM-SL tool box is used.

Keywords: Sensors, Actors, Watchman, layers-by-layers, Energy, Hotspot problem, Verification & Validation



TECHNICAL SESSION
PARTICIPATORY GIS APPLICATIONS

USING THE GEOINFORMATICS TECHNOLOGY FOR SOIL DEGRADATION ASSESSMENT IN UPPER LAMCHIENGKRAI WATERSHED, NAKHON RATCHASIMA, THAILAND

Sasikarn Plaiklang (1), Suwit Ongsomwang (2), Sanchai Prayoonpokarach (3), Paramate Horkaew (4), Supattra Puttinaovarat (5), Intareeya Sutthivanich (6), Yaowaret Jantakat (7), Nutnaree Thongrueang

[1] Faculty of Computer Science and Information Technology, RBRU, Chanthaburi, 22000;
[2] School of Geoinformatics, Institute of Science, SUT, Nakhon Ratchasima, 30000;
[3] School of Chemistry, Institute of Science, SUT, Nakhon Ratchasima, 30000;
[4] School of Computer Engineering, Institute of Engineering, SUT, Nakhon Ratchasima, 30000;
[5] Faculty of Science and Industrial Technology, PSU, Surat Thani Campus, 84000;
[6] Center for Scientific and Technological Equipment, SUT, Nakhon Ratchasima, 30000;
[7] Faculty of 7 Sciences and Liberal Arts, RMUTI, Nakhon Ratchasima 30000;
Email: sasikarn@gistda.or.th; suwit@sut.ac.th; sanchaip@sut.ac.th; phorkaew@sut.ac.th; programmer9@gmail.com; intriya2005@hotmail.com; yjantakat@gmail.com

Abstract: Soil erosion and soil salinity are major environmental problems in Thailand that cause extremely damage on cultivation and environmental sustainability. In addition, soil erosion leads to depletion of organic matter (OM) in soil. Soil erosion, salinity and OM depletion are significant indicators for soil degradation assessment. The aims of the study were (1) to classify land use and land cover (LULC), (2) to assess soil loss and its severity, (3) to assess soil salinity and its severity, (4) to assess soil OM and its depletion, and (5) to assess soil degradation and its severity. In this study, LULC classification using Classification and Regression Trees (CART) classifier, soil erosion with Revised Morgan and Finney (RMMF) model, soil salinity and depletion of OM with linear and non-linear regression analysis were first separately analyzed and their results then were combined to evaluate soil degradation using multiplication method. As results, an optimum CART model provided an overall accuracy at 87.50% and Kappa hat coefficient at 80.10%. In the meantime, an average erosion rate in the study area was 3.37 ton/ha/year. The most dominant soil erosion severity class was very slightly eroded and it covered area of 437.70 km2 or 94.14% of the total study area. Meanwhile, soil salinity severity class was very low and it covered area of 415.55 km2 or 89.37% of the total study area. At the same time, soil biological degradation class was moderate and it covered area of 296.05 km2 or 63.67% of the total study area. According to soil degradation assessment using multiplicative method, the most dominant soil degradation class was very low and it covered area of 443.00 km2 or 95.28% of the total study area. In conclusion, it appears that geoinformatics technology can be efficiently used as tools to assess soil loss, soil salinity, and OM depletion and their severities for soil degradation assessment.

Keywords: Soil degradation assessment, RMMF model, Soil salinity, CART classifier

AB033

INTEGRATION OF GIS AND MULTICRITERIA EVALUATION FOR INTERNATIONAL SCHOOL SITE SELECTION

Alhaji Hussaini (1)(2), Kelvin Tang Kang Wee (1), Sulaiman Ibrahim Musa (1)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate,
Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia
[2] Department of Geography, Aminu Saleh College of Education Azare, PMB 044, Bauchi, Nigeria
Email: alhajihussaini88@gmail.com; alhaji2@live.utm.my; tkwkelvin2@live.utm.my

Abstract: Site selection is a complex problem that involve, technical, political social, environmental and economic demands that are difficult to satisfy via one method which may be in conflict with others. Schools need be located on safe places; these safe locations should also be optimal and economical to the public in terms of accountability. Location of these schools sometimes it has been done without use of any scientific methods and has led to sprouting of schools located in unsuitable locations. The study area, Iskandar Malaysia has 11 international schools and percentage of foreigners to population of Iskandar is projected to increase from 6.6% presently to 12-15%. The size of the existing international schools and their facilities are remaining unchanged, therefore the new schools will be required to avoid over enrolment. The research study objective was to locate the physical site for any school using GIS technology integrated with Analytical Hierarchy Process (AHP), a tool in multi criteria evaluation (MCE) for finding a suitable location of any new school. Also a weighted overlay method, a tool in ArcGIS, was used to combine all the identified criteria and the results indicated that there are suitable and economically viable areas to add new schools to the north eastern part of Iskandar which totals to 20 Ha with a small part falling in the north and south eastern part. From the results it was recommended that in locating new schools the management should embrace use of GIS technology integrated with MCE methods in locating their new schools effectively economically and socially.

Keywords: MCE, AHP, suitability analysis

GIS AND REMOTE SENSING APPROACH FOR TRANSPORTATION PLANNING IN SOUTHEAST ASIA PRACTICES

Wan Zafirah Wan Mohd Najib (1), Norzailawati Mohd Noor (1), Abdul Azeez Kadar Hamsa (1)

[1] Department of Urban and Regional Planning, Kulliyah of Architecture and Environmental Design, International Islamic University Malaysia, Jalan Gombak, 53100, Kuala Lumpur.
Email: wanzafirah.najib@gmail.com; norzailawati@iium.edu.my; azeez@iium.edu.my

Abstract: An efficient urban transportation network becomes increasingly important in order to boost economic transformation and physical development as well as to improve mobility activities. Nowadays, application of Geographical Information Systems (GIS) in urban transportation problems turn out to be one of the significant approaches of GIS technology and urban planning field. The focus of this paper is on presenting the practices and potential of GIS and remote sensing in the transportation planning modelling in Southeast Asia. The integration of GIS and remote sensing will be used to fill the gap in the smart and sustainable transport planning. The purpose of this study is to prove on how GIS and remote sensing can assist urban transportation field by obtained a critical review on various sources of literatures according to countries in Southeast Asia. The prominent sources from Scopus and Web of Science have been collected and critically analyzed in obtaining issues, the existing condition, the challenges and the future outlook for this topic. The finding shows that, GIS and remote sensing approaches are able to find the coverage area of a selected point or line to detect spatial interaction and also produced distribution analysis of transportation serving area and able to analyze on the ground features including land use and land cover with using its spatial, temporal or spectral. Finally, it is concluded that GIS and remote sensing can be effectively used in urban transportation planning in Southeast Asia. Hence, the developed data model will facilitate policy makers and transportation planners to have a reliable decision effectively, and produce high quality geospatial information to the end users.

Keywords: GIS, Remote Sensing, Urban Transportation, Analysis Technique, Urban Transportation, Southeast Asia

PARTICIPATORY GEOGRAPHIC INFORMATION SYSTEM FOR THE UPPER MARDI WATERSHED MANAGEMENT

Krishna Prasad Bhandari (1), Kapil Dev Bashyal (1)

[1] Center for Space Science and Geomatics Studies, Pashchimanchal Campus, Institute of Engineering, Tribhuvan University, 33700, Lamachaur, Pokhara, Gandaki Province Nepal
Email: bhandarikrishna@gmail.com; koshalraj.kapil@gmail.com

Abstract: This paper describes the application of Participatory Geographic Information Systems (PGIS) tools and approaches to make sustainable development of watershed using Indigenous Knowledge (IK) meaningfully in upper watershed of Mardi, Nepal. Participation by the local community in development initiatives is critical for achieving sound natural resource management to utilize the IK systems. The paper aims at making sustainable development management of upper watershed of Mardi by using PGIS tool and IK that integrate traditional participatory mapping methods directly with Arc GIS and Arc Pad and evaluate potential applications of new digital pen technology. The practice of PGIS in this setting in Nepal has encouraged broad-based participation at community levels, improved intra community communication and provided opportunities for greater social inclusion in development processes. The use of PGIS focuses on methods of knowledge 'capture', representation and communication through the graphic representation of both past and present natural resources from focus group discussion and participatory mapping process. The information gathered is then transferred into a Geographic Information System, for additional analyses, sharing with scientists and onwards transmission to decision makers and other users in a form which they recognise, can understand and reproduce. The main premise of this paper is related to the approach of integrating indigenous knowledge with Participatory Geographic Information Systems as a way of promoting participatory natural resource and watershed management of upper Mardi Watershed and giving opportunity to the local community to participate in developmental programs and decision-making both as contributors and 5 users of knowledge.

Keywords: Participatory Geographic Information System (PGIS), Indigenous Knowledge (IK), Community, Watershed Management, Decision Making

A NOVEL GIS BASED SEISMIC HAZARD ASSESSMENT AT ODISHA, INDIA

Ratiranjan Jena (1), Biswajeet Pradhan (1)

[1] School of System, Management and Leadership, Faculty of Engineering and Information Technology, University of Technology Sydney, 15 Broadway, Ultimo NSW 2007
Email: biswajeet24@gmail.com; Biswajeet.Pradhan@uts.edu.au

Abstract: This research was conducted to analyse and estimate the PGA (Peak Ground Acceleration) and seismic amplification of Odisha state in India by using earthquake events recorded by USGS (US geological survey) of the region from the year 1950 to 2015. The analysis also includes for an approximately a range of 300 km from every side of state. Many attempts have been proposed to investigate the PGA in this region during last decades. Therefore, it was a requirement to implement various methods using some recent viewpoints and methodological approaches. Furthermore, research approaches on seismic hazard analysis need to be updated for currently experienced seismic events. Therefore, the objectives of this research focusing; 1) to ensemble various attributes of seismic events for graphical investigation and, 2) to prepare hazard maps using PGA based on a distinctive GIS approach. Our results clearly showed that the region of Odisha is seismically active and there exists the hazard of ground shaking. It also provides a very accurate evaluation of seismic hazards including the seismic waves that influences surface of the ground based on the amplification map. These findings can be considered for the rapid improvement in earthquake research during recent decades that attempts to study seismic hazards and risks in Odisha.

Keywords: Earthquake, Hazard, PGA, Seismic Amplification, GIS

ESTIMATION OF FLOOD HAZARD IMPACTS ON ROAD NETWORK USING GIS

Natrah Lali@Zailani (1), Shaparas Daliman (1), Ibrahim Busu (1)

[1]Faculty of Earth Science, Universiti Malaysia Kelantan Jeli Campus, 17600 Jeli Kelantan, Malaysia
Email: natrahzailani96@gmail.com; shaparas@umk.edu.my

Abstract: Flood is a serious, common hazard and occur periodically in Kelantan due to heavy rainfall during the monsoon season. Usually, it occurred during the month of December until February. Kelantan have several federal roads that connected to other state roads. The floods caused great damage to properties and human lives including some of Kelantan federal and state roads. There are various methods used in attempt to provide the most reliable ways to reduce the flood risk and damage on road network in Kelantan. Geographic information system (GIS) spatial database was applied for analyzing the data of the main street, river and geological information on a map. This study important for identification and mapping flood area of road network that are beneficial for flood management and distributes information to society. The data have been collected from the field investigations and historical flood areas reports. A GIS software was applied for analyzing the data to demonstrate the differential zones of the flood. The result shows the area that prone to flood based on three possibilities which are low, medium and high. Based on the flood hazard map, it shows that along the Kelantan River possessed high risk of vulnerability to flood to occur compared to other area in Kelantan. The total of the high, medium and low hazard of road network area or flood to occur is 47.140 km2, 213.411 km2 and 134.220 km2, respectively. The result shows a high correlation between the flood extent extraction model and the flood factors.

Keywords: Flood Hazard, Road Network, GIS

URBAN FLOOD EVACUATION PLAN: A PARTICIPATORY GIS APPROACH

Shrawani Sable (1), Kshitija Suryawanshi (1), Ranjit Joshua (1), Samarth Barot (1), Bindi Dave (1) Shaily R.Gandhi (1), Anjana Vyas (1)

[1] Faculty of Technology, CEPT University, Ahmedabad
Email: shrawani.sable.mgeo17@cept.ac.in; kshitija.suryawanshi.mgeo17@cept.ac.in; ranjit.joshua.mgeo17@cept.ac.in; samarth.barot.mgeo17@cept.ac.in; bindi.dave@cept.ac.in; shaily.gandhi@cept.ac.in; anjana.vyas@cept.ac.in

Abstract: Floods are common natural disaster occurring in most parts of the world. This results in damage to human life and deterioration of environment. There has been immense use of technology to mitigate measures of flood disaster both structurally and non- structurally. Undoubtedly, structural measures are very expensive and time consuming which involves physical work like construction of dams, reservoirs, bridges, river diversion and embankments to keep floods away from people. The non-structural measures concerned with planning like flood forecasting, warning, flood plain zoning, relief and rehabilitation for reducing the risk of flood damage involves analysis, providing spatial information on maps with high accuracy in less time. The current study focuses on use of participatory approaches to solve issues related to waterlogging and flood like situations, by considering the inputs from people residing in affected areas, along with identification of the major flood risk prone areas through spatial vulnerability analysis, using temporal primary and secondary datasets. The study determines the possible evacuation routes depending on the road conditions, proximity to basic amenities and inputs from people, thereby proposing a local and micro-level evacuation plan in vernacular language, that could be used by the community during adverse situations. The impact assessment survey carried out in water-logged and flood affected areas helped to identify the impact of flood on daily activities, economic loss, and preparedness of the people to counter such situations.30 meters spatial resolution SRTM Digital Elevation Model (DEM) was used to calculate the elevation of study area, slope and the contour information using surface analysis module of GIS. Estimation of the runoff coefficient was done by using temporal rainfall data, obtained from IMD (Indian Meteorological Data), for West Zone of Ahmedabad city, in order to identify areas that are most likely to be flooded and those that are less likely to be flooded. The suitability of the flood evacuation route was determined on the basis of land use landcover obtained from optical Landsat-8 satellite image, soil type, soil moisture conditions and also the condition of roads in West zone of Ahmedabad. This study would help in creating awareness among people regarding their effective role in decision making processes and help government as well as other organizations to plan and assess an effective emergency response plan for any natural calamity, thereby contributing to the welfare of society.

Keywords: Waterlogging, Runoff, Impact, Vulnerability analysis, Evacuation route, Emergency response, GIS, Remote Sensing

EVALUATION OF RELATIONS BETWEEN CONSTRUCTIONS OF WALKING SPACES AND NEIGHBORHOOD ENVIRONMENTS USING WALKABILITY INDEX: FOCUSING ON REUSES OF DISCONTINUED RAILROADS

Kento Watanabe (1), Yusuke Kimura (1)

[1] Graduate School of Engineering, Kyoto University,
C1-1-209, Kyotodaigaku katsura, Nishikyo-ku, Kyoto, 615-8540, Japan
Email: watanabe.kento.52z@st.kyoto-u.ac.jp; kimura.yusuke.8m@kyoto-u.ac.jp

Abstract: There are some constructions of walking spaces through reuses of discontinued railroads in the world. One example is the High Line, a former railroad viaduct converted into a public walking space in New York City. Such spaces are expected to have good effect on neighbourhood walking environments. However, the method to evaluate impacts of constructions quantitatively in terms of walking activity has not been fully developed. In this study, we focus on the Walkability, which is an indicator for evaluating urban form or living environment where walking activities are promoted. Especially, Walkability Index (WI) indicates the degree of residents' walking activity from some geographical environmental factors. WI enables us to evaluate complex neighbourhood environments by calculating the sum of multiple factors and by comparing values among other times or areas. This study aims to analyze impacts of constructions of walking space based on WI and to evaluate the relation to neighbourhood environment quantitatively. Three walking spaces converted from discontinued railroads were selected as study areas: JR freight harbour railway promenade in Kobe City, Japan; Yamashita harbour railway promenade in Yokohama City, Japan; the High Line in New York City, USA. First, we divided the polygon within a 400 m buffer around the walking space into 50 m meshes and calculated environmental factors within 400 m buffers around each mesh using Geographic Information System (GIS). We selected land use mix, net residential density, and intersection density as the factors in reference to previous research and calculated WI at each mesh by the sum of their standardized values. In addition, we used the data on four different times: three years before the construction began; the year construction began; the year construction completed; three years after the construction completed. Second, we analyzed distribution of WI for the four times spatiotemporally and examined the impacts of walking spaces. Through the analysis of JR freight harbour railway promenade, along with the construction of the walking space, WI increased in areas where it was originally high. In the future analysis, it's necessary to analyze other study areas and compare the difference of the relations.

Keywords: Walkability Index, walking space, walking activity, reuse of urban infrastructures, GIS

VISUAL OBJECT TRACKING WITH GIS

Zhang Lishuo (1), Cheng Xiaojun (1), Cheng Xiaolong (2)

[1] College of Surveying and Geo-Informatics, Tongji University, No. 1239, Siping Road,200092 Shanghai, China,
[2] School of architectural and surveying & mapping engineering, Jiangxi University of Science and Technology, No. 86, Hongqi Ave., Ganzhou, Jiangxi, 341000, China
Email: 2009302590086@whu.edu.cn; cxj@tongji.edu.cn; 3387806400@qq.com

Abstract: Real-time video surveillance is playing an increasingly significant role in surveillance systems for numerous security, law enforcement, and military applications. Visual object tracking is an important field in visual surveillance systems. Trackers have been applied traditionally in the image, but a new concept of tracking has been used gradually, applying the tracking on the ground map of the surrounding area. Using the road network information in the tracking process is considered an asset mainly when the target movement is limited to the road. In this paper, we consider to incorporate the road information into the tracking process: Based on the assumption that the target is following the road and using a classical estimation technique, the idea is to keep the state estimate on the road. This idea is based either on the minimization of the distance between the estimate and its projection on the road or on the minimization of the distance between the measurement and its projection on the road. In this case, the state estimate is updated using the projected measurement. A plane projective transformation allows to make the tracking in real coordinates which facilitates the tuning of the tracker, gives measures in real coordinates. Experimental results from real environments proved empirically that the tracker on the ground with road constraint achieves better results.

Keywords: Video Surveillance, Visual Object Tracking Road, GIS

A GEOSPATIAL SOLUTION USING A TOPSIS APPROACH FOR PRIORITIZING URBAN PROJECTS IN LIBYA

Maruwan S.A.B Amazeeq (1), Bahareh Kalantar (2),Husam Abdulrasool H. Al-Najjar (1), Mohammed Oludare Idrees (1), Biswajeet Pradhan (3), Shattri Mansor (1)

[1] Department of Civil Engineering, Faculty of Engineering, Universiti Putra Malaysia, Serdang, Selangor, Malaysia
[2] RIKEN Center for Advanced Intelligence Project, Nihonbashi, Chuo-ku, Tokyo 103-0027, Japan
[3] Centre of Advanced Modelling and Geospatial Information System (CAMGIS), Faculty of Engineering and Information Technology, University of Technology Sydney, 2007 NSW, Australia
Email: marwanamaizig@gmail.com; bahareh.kalantar@riken.jp; husamcivil_rsgis@yahoo.com; dare.idrees@gmail.com; Biswajeet.Pradhan@uts.edu.au; shattri@upm.edu.my

Abstract: The world population is growing rapidly and as a consequence urbanization has been in an increasing trend in many developing cities around the globe. This rapid growth of population and urbanization have also led to developments in infrastructure such as transportation systems, sewer and power utilities and many others. One major problem in the developing and third-world countries is that these developments in mega cities are hindered with ineffective planning in terms of creating construction projects, and mostly developments are random. Libya also has been facing similar problem from rapid urbanization. To handle this issue, an automating process through an effective decision making tools, is needed for development in Libyan cities. This study develops a geospatial solution based on GIS and TOPSIS for automating the process of selecting a city or a group of cities for development in Libya. Overall, thirteen GIS factors were prepared from various data sources such as Landsat, MODIS, and ASTER. These factors are categorized into six groups of topography, land use and infrastructure, vegetation, demography, climate, and air quality. The suitability map produced based on the developed methodology showed that the most suitable areas are located in the northern part of the study region, especially the areas surrounding the Benghazi city and north parts of the Al Marj and Al Jabal al Akhdar cities. The Support Vector Machine (SVM) model has accurately classified 1178 samples which is equal to 78.5% of the total samples. The Kappa statistic is 0.67 and the highest and lowest success rates are 0.939 and 0.793, respectively. Validation results revealed that the highest and lowest prediction rates are 0.884 and 0.673, respectively. The outputs of this research are important since they provide a solution for reducing the subjectivity during the selection of the cities for development. The outputs also suggest an effective way to simplify the selection of cities while severing a wide range of citizens.

Keywords: Urban modelling, TOPSIS, Libya, GIS, Support Vector Machine

ASSESSING THE COMPETITIVENESS OF THE COUNTRIES USING MULTIPLE STATISTICAL MEASURES: A GEO-SPATIAL APPLICATION

Shahid Rahmat (1), Prof. Joy Sen (1), Srikanta Sannigrahi (1)

[1] Department of Architecture and Regional planning, Indian Institute of Technology, Kharagpur-721302, West Bengal, India
Email: shahidrahmat82@arp.iitkgp.ernet.in; joysen@arp.iitkgp.ernet.in; srikanta.arp.iitkgp@gmail.com

Abstract: Competitiveness of countries depends on several factors. To prioritize the intervention to improve the Competitiveness of countries, it is essential to assess relative weights and sensitivity of the factors of Competitiveness. Present set of literature does not deal with this problem very seriously. In the case when dependent and independent variables are known, the problem of improper assignment of relative weights is more crucial. Present paper tries to assign relative weights to the selected factors (Infrastructure) of Competitiveness of countries of the world with the help of six most sophisticated statistics, i.e., zero-order correlation, structure coefficient analysis, beta coefficient analysis (MRA), product measure, relative weight analysis, and commonality analysis (CA) and tries to find the most suitable technique to form the Competitiveness index of the countries of the world. The MRA assigns the relative weights and consecutively forms the index more accurately. CA best to demonstrate the interaction among variables more precisely. Common effects of variables are relatively more important than their unique effects. This leads to a policy implication of jointly targeting the factors of Competitiveness for augmentation of Competitiveness of countries of the world. We analyzed the sensitivity of the variables with the help of Artificial Neural Network (ANN) for each possible combination of variations in the infrastructure of the countries. Results are consistent with CA. Spatial statistics, including Moran's I, Spatial Autocorrelation, Cluster analysis, Getis-ord-Gi hot spot analysis, Geary's C, Multivariate cluster analysis etc. Results show very high and significant spatial clustering. Countries having better level of infrastructure coincides with the countries with high Competitiveness (per capita GDP) and are the hotspots. This methodology can be utilized in other fields of research also when there is multi-collinearity is present among independent variables.

Keywords: Competitiveness, Infrastructure, Relative weights, Artificial Neural Network, Arc GIS

ESTIMATION OF SEISMIC HAZARD USING GIS FOR THE STATE OF SABAH, MALAYSIA

Ratiranjan Jena (1), Biswajeet Pradhan (1)

[1] School of System, Management and Leadership, Faculty of Engineering and Information Technology, University of Technology Sydney, 15 Broadway, Ultimo NSW 2007
Email: biswajeet24@gmail.com; Biswajeet.Pradhan@uts.edu.au

Abstract: The state of Sabah, Malaysia is not forever immune to seismic risk from global tectonic boundaries but always under risk due to the local active faults. The patches of intersecting active faults can be found in the hilly regions of the Sabah that have resulted more than 65 earthquakes. Till date, researchers have not focused on the intersecting lineaments and faults of Sabah. Therefore, in this paper, we have proposed a critical triangular analysis on these patches of intersection to find out the zone of risk where most of the earthquakes are happening. To the end, we prepared the Peak Ground Acceleration (PGA) map and intensity map based on the historical earthquakes recorded. Both, PGA and intensity maps have been prepared using the Campbell attenuation model. The highest PGA and intensity values resulting from this study are 0.06 and 7, respectively. Our results show that the critical zone of intersecting faults is the region coming under high intensity and PGA values. It is clearly pinpointing that the intersection of faults and lineaments lead to produce a large number of earthquakes, where the highest magnitude of earthquakes can be found due to the influence of intersecting fault movements.

Keywords: Earthquake, Active tectonic zone, Intensity map, PGA map, GIS

CONCEPTUAL FRAMEWORK OF OPEN PARKING SPACE INFORMATION FOR A SMART CITY

Liang-Yu Wu (1), Yi-Hsing Tseng (1)

[1] Department of Geomatics, National Cheng Kung University,No. 1, University Rd., Tainan City 70101, Taiwan
Email: ryan@prs.geomatics.ncku.edu.tw; tseng@mail.ncku.edu.tw

Abstract: Finding a parking space is frequently a problem for a driver getting into a city. Management of parking spaces is also a critical issue of city government. Thanks to the development of sensing technology, automatic sensing systems of parking spaces have been installed in many parking lots. Some of the collected parking space information is open to public and can be accessed via internet or mobile phones. For instance, we can get the parking space information from the variable-message sign (VMS) at the entrance of the parking lots of the mall, hospital and so on, or we can have the real-time parking space information of some outdoor parking lots or even the roadside parallel parking spaces. As more and more parking information that we can access, the problem of the interoperability comes behind. Nowadays, the public cannot access all the parking information from a single platform or frame. In this paper, we review different technologies used for sensing the parking space and the spirit of the open data. Then, we employ the concept of open data and try to integrate various kinds of parking information in a frame. Considering the accuracy, detail, sampling rate, time delay, openness and format of the data, we classify them into different levels. The features of availability, redistribution and universal of the data can maximize the value of the data and create valuable profits for the society. As the development of the smart city is thriving, the situation of being the same issue but containing different types of data, like parking information, will become more and more common. We expect that this kind of concept in the paper can also apply for other issues.

Keywords: Parking, Smart City, Open Data, Integration

EXAMINE THE SPATIAL AND TEMPORAL PATTERN OF CRIME INCIDENCE IN AN URBAN ENVIRONMENT USING GEOGRAPHICAL INFORMATION SYSTEMS

(A case study of Matara police division, Sri Lanka)

H.B.T.P.Jayathilaka (1), V.P.I.S Wijerathne (1)

[1] Department of Geography, Faculty of Arts, University of Colombo, Cumarathunga Munidasa Mawatha, Colombo 03, Sri Lanka.
Email: tprathibani2014@gmail.com; sandamali@geo.cmb.ac.lk

Abstract: Over the Last Few years a new worldwide Socio-economical order lead to an increasing number of crime rates and raised the need to find new ways to handle information about criminality. In this case GIS plays an important role in crime mapping and analysis. It offers graphical representation of the crime distribution pattern and prone areas. Crime analysis also plays a role in devising solution to crime problem and formulating crime prevention strategies.This research is aimed at examine spatial and temporal variation of crimes in Matara police division, Sri Lanka. In methodological terms, this research used Crime Pattern Analysis, Hot Spot Analysis and Tracking Analysis to study the variation of crime distribution pattern in more than 50 Grama niladhari divisions for 2008 to 2017. The analysis were mainly carried out using Arc GIS 10.5 and MS Excel 2013. As well as more than 2,000 crime incidence were analyzed. The findings reveal that the crime incidence distribution shown as a clustered pattern and house braking crime were highly distributed in this area. According to the hot spot analysis, spatial heterogeneity represents by "Hot Spot" (High-High Spatial association) and "Cold Spot" (Low-Low spatial association). As well as some clusters with negative spatial association (high-low and low-high) were identified. Mainly crime hot spots were located in southern part of the study area and high population density, accessibility of road, high dense settlement areas can be identified as the main causes of this pattern. The temporal based analysis of data reveals that almost 1,200 crimes reported in April to September in each year and 340 incidences were happened in 2012. It is shown as the highest number of crime incidents in the study area. Matara town area was identified as the most criminal Hot Spot and 76% crime incidence reported near to the police station. The population density in this area is relatively high and prevention and mitigation of crimes distribution is very important. Therefore, analytical and theoretical result will undoubtedly lead to enhanced crime prevention strategies of Matara police division in the future.

Keywords: Crime, GIS, Spatial and Temporal, Hotspot

MAPPING HEAVY METAL DISTRIBUTION IN SOIL BY USING GIS TECHNIQUES: A CASE STUDY IN HOOC MON DISTRICT, HO CHI MINH CITY, VIETNAM

Tran, T.Q. (1)(2), Chou, T.Y. (1), Hoang, T.V. (1), Yeh, M.L. (1), Chen, M.H. (1), Danh, M. (2), Tung, L.H. (2)

[1]Geographic Information Systems Research Center, Feng Chia University, Taiwan No. 100, Wennhwa Rd., Seatwen, Taichung, Taiwan 40724
[2]Department of Land Resources, HoChiMinh City Institute of Resources Geography 01 Mac Dinh Chi St., Dist., 1, Ho Chi Minh City, Vietnam
Email: tqtuanvast@gmail.com; jimmy@gis.tw; van@gis.tw

Abstract: Metal concentration in urban soil is one of environmental problem that contributes directly or indirectly to the general life quality in city areas. The study site is located in Hooc Mon district, Ho Chi Minh City, Vietnam where is the home to many industrial activities and is the populous area. An investigation was conducted to determine the concentration of metals in urban soil; to perform an interpolation method for mapping the spatial distribution of heavy metal and understanding their contamination characteristics. There are 120 soil samples were collected by surveying for chemical analysis and determining amount of heavy metals. The Ordinary Kriging technique was applied to estimate the spatial distribution of metal concentrations at unknown points using a linear weight function of adjacent data points. The results showed that the spatial distribution of heavy metals is well interpolated. There are 4 major heavy metals contaminated in the study site including Cu, Pb, Zn and Cd. The highest contamination is found for Cu and following are Pb, Zn, Cd. Distribution patterns of the metal suggest that vehicle traffic represents the important pollutant source for the urban environment. Since spatial distribution and localization are the keys in controlling negative impacts of heavy metal of an area. Determination of heavy metal levels and their spatial variations is essential for a better understanding possible risk for environment and human health.

Keywords: Heavy Metals, Kriging, GIS Technique, Spatial Interpolation

GEOGRAPHICAL AND METROLOGICAL ANALYSIS OF DENGUE OUTBREAK AMONG FEMALES FOR DETECTION OF HOTSPOTS IN PUNJAB, PAKISTAN

Shahbaz Ahmad (1), Dr. Muhammad Asif (1), Manazza Iqbal (2), Muhammad Adeel (1), Muhammad Asad Javed (3), Muhammad Wasim (4)

[1] Department of Computer Science, National Textile University, Faisalabad, Pakistan
[2] Department of Computer Science Government College University, Sahiwal
[3] Department of Computer Science and Technology Beijing Institute of Technology, Beijing China
[4] Department of Computer Science and Technology Chenab College Faisalabad
Email: shahbaz@ntu.edu.pk; asif@ntu.edu.pk; Manazaiqbal786@yahoo.com; adeel@ntu.edu.pk; muhammadasadjaved@bit.edu.cn; Wasim_am99@yahoo.com

Abstract: Dengue fever is a viral communicating disease which penetrated all over the world especially in tropical and sub-tropical countries. It is a female mosquito, Aedes aegypti causes dengue fever by injecting her virus. It literally sucks blood as a meal from human, mammal, reptile, and bird to help itself for reproduction system. Frequent travelers made it possible to disseminate the virus from one part of the world to another part. It is difficult to overcome this viral disease with limited resources, especially for developing countries. We used Arc View an active spatial tool to track the viral disease and hotspots, by developing thematic maps. It can timely alert the administrative authorities to take pre-emptive measures in suspected geographical areas. The outbreak in Punjab Province 2011, infected 21225 people among them 66 92 patients were female in ten epidemiological months. Results revealed that 31.52% female infected during the outbreak. While 5790 female patients were from Lahore division, so 89.18% outbreak load executed in division Lahore. The worst infected female age group proved 16-30 while least infected was 61-75 years. First register patient was female at age 55 years on 19 March 2011. Meteorological analysis showed that temperature, humidity, and rainfall stimulate the dengue outbreak to occur abruptly. This research work can be expressively supportive for higher authorities of Punjab provincial Government for future decision making, alert the public and travelers from future suspected hotspots areas by observing these thematic maps, geographic al flow, intensity, and hotspots.

Keywords: Dengue Fever, ArcView, Outbreak, Meteorological factor

GIS-BASED SURVEILLANCE SYSTEM TO TRACK GEOGRAPHICAL FLOW AND INTENSITY OF DENGUE OUTBREAK AMONG MALES AT DIVISION LEVEL IN PUNJAB, PAKISTAN

Muhammad Asif (1), Shahbaz Ahmad (1), Manazza Iqbal (2), Osama Sohaib (3), Muhammad Asad Javed (4)

[1] Department of Computer Science, National Textile University, Faisalabad, Pakistan
[2] Department of Computer Science, Government College University, Sahiwal
[3] School of Systems, Management and Leadership, Faculty of Engineering and Information Technology University of Technology Sydney, Australia
[4] Department of Computer Science and Technology Beijing Institute of Technology, Beijing, China
Email: asif@ntu.edu.pk; shahbaz@ntu.edu.pk; Manazaiqbal786@yahoo.com; Osama.Sohaib@uts.edu.au; muhammadasadjaved@bit.edu.cn

Abstract: Dengue fever is bone breaking pandemic-prone viral disease which is spread in a major part of the world particularly in tropical countries. Fast and dynamic traveling made it possible to fly over national and international boundaries through patients. Most of the countries with the inadequate technical resources are fighting this disease with poor throughput. In these conditions, Geographical Information System (GIS) is a ray of technical hope to crack dengue fever problem by generating alerts for the administrative authorities and Government official in advance before an outbreak occurs, So that precautionary measures can be taken, and the effective trigger can be fired quickly to minimize the financial and human loss. GIS can how the effect of intensity and Geographical flow along with hotspots in the form of thematic maps. This research tries to investigate the intensity and flow of dengue outbreak in males at division level in Punjab in a disaster of dengue outbreak. We used Arc View tool to show male patients data who were infected during this disaster. These significant thirty-seven epidemiological weeks infected 14448 male patients all over the Punjab. The analysis shows that capital city Lahore was severely affected by this disaster infecting 81.74% of the total, while 18.25% was distributed among rest of the geographical area. This research work can be significant for Punjab health department and administrative authorities for future decision making keeping in view the Hotspots areas, Intensity and Geographical flow of Dengue.

Keywords: Dengue virus, Punjab division, Outbreak, Geographical pattern, Aedes aegypti

ASSESSMENT OF THE RELATIVE WEIGHTS AND SENSITIVITY OF THE FACTORS OF REGIONAL COMPETITIVENESS

Shahid Rahmat (1), Prof. Joy Sen (1)

[1] Department of Architecture and Regional planning, Indian Institute of Technology, Kharagpur-721302, West Bengal, India
Email: shahidrahmat82@arp.iitkgp.ernet.in; joysen@arp.iitkgp.ernet.in; srikanta.arp.iitkgp@gmail.com

Abstract: To prioritize the intervention to augment regional competitiveness, it is essential to assess relative weights and sensitivity of the factors of competitiveness. Available literature in the field of competitiveness does not address the problem precisely. Improper assignment of relative weights is prominent in the case when both the independent and dependent variables are known. This paper identifies economic infrastructure as an important component of factors of competitiveness and selects critical components of economic infrastructure with the help of expert opinion survey followed by RIDIT analysis. Present paper assesses the relative weights of the factors of competitiveness with zero-order correlation, structure coefficient analysis, beta coefficient analysis, product measure, relative weight analysis and commonality analysis and tries to find the most suitable technique to form the index. Multiple regression analysis assigns the relative weights and consecutively forms the index more accurately. Commonality analysis is best to demonstrate the interaction among variables more precisely. Programming language Python with the help of Pandas data frame and Mat-plot-lib was utilized to visualize the distribution of the cumulative coefficients and cumulative percentage value of commonality matrix. Analyses reveal that rural infrastructures are more important than urban. Common effects of variables are relatively more important than their unique effects. This leads to a policy implication of jointly targeting the factors of competitiveness for augmentation of regional competitiveness. We analyzed the sensitivity of the variables with the help of Artificial Neural Network for each possible variation. Results are consistent with commonality analysis. Spatial statistics, including Moran's I, Spatial Autocorrelation, Cluster analysis, Getis-ord-Gi hot spot analysis, Geary's C, Multivariate cluster analysis etc. Results show very high and significant spatial clustering. Districts having better level of infrastructure coincides with the districts with high Competitiveness (per capita GDP) and are the hotspots. This methodology can be utilized in other fields of research also when there is multi-collinearity is present among independent variables.

Keywords: Regional Competitiveness, Economic Infrastructure, Relative Weights, Multiple Regression Analysis, Artificial Neural Network

ASSESSMENT OF UNDERGROUND WATER IN DEHRADUN CITY, UTTARAKHAND, INDIA USING GEO-SPATIAL TECHNOLOGIES

Anoop Kumar Shukla (1), Chandra S. P. Ojha (1), Rahul D. Garg (1), Satyavati Shukla (2)

[1] Civil Engineering Department, Indian Institute of Technology Roorkee, Roorkee, 247667, Uttarakhand, India
[2] Center of Studies in Resources Engineering (CSRE), Indian Institute of Technology, Bombay, 400076, Mumbai, India
Email: anoopgeomatics@gmail.com; cspojha@gmail.com; rdgarg@gmail.com; satyageomatics@gmail.com

Abstract: Ground water is a major source for all purposes of water requirements in India and it plays a vital role to human life and economic activity. The unplanned and non-scientific development of ground water resources has led to sharp depletion of the resources and degradation of quality at many places. In this research paper Dehradun city is part of the Doon valley, located in the western part of the Uttarakhand state, India has been taken. The prime focus of this study is for a holistic understanding of ground water occurrence, resources and quality in the study area by mapping prospective zones, estimating recharge and by evaluating the ground water quality parameters and their spatial distributions using geo-statistical methods. Land Use Land Cover (LULC) map of the Dehradun city has been prepared from merged satellite imagery data of LISS- IV and Pan for 2007 using ERDAS Imagine and Arc-GIS. Six numbers of wells were monitored during the year 2004, 2005 and 2008 and groundwater table behavior was observed. The observed groundwater table data has been used to prepare the depth to water table and water elevation contour maps. The groundwater table contour maps of the area indicate the persistence of subsurface flow from North to South direction. The historical data of well hydrographs for period 1997 to 2008 has indicated that the ground water levels in the majority of the wells show a declining trend. Ground water quality has been analyzed in Dehradun city at six sites where installed hand pumps were available at the borings tapping shallow unconfined aquifers. The chemical analysis results were compared with BIS: 10500 (2004) standards to examine the suitability for drinking purpose. Heavy metals like lead, nickel, copper and manganese were found to be within the desirable limits of BIS: 10500 (2004) standards. The pH value of ground water in the study area varies from 7.1 to 7.5, which is near to the neutral pH and suitable for the drinking water. This has increased the concern on groundwater resource assessment and its management for sustainable development.

Keywords:

GEO-SPATIAL FACTORS FOR WATER RESOURCE DISPARITY IN THAILAND

Woranut Chansury (1), Mingkwan Khanta (1), Chaowalit (1), Silapathong (1)

[1] Geo-Informatics and Space Technology Development Agency (Public Organization) 120 Goverment Building Complex 6th and 7th Floor,Cheng Wattana Road, Lak Si, Bankok 10210, Thailand
Email: woranut@gistda.or.th; mingkwan@gistda.or.th; chaowalit@gistda.or.th

Abstract: Social disparity in access to natural resources and environment such as land, water, forests, marine and coastal is a crucial and urgent issue in all communities and regions. Many factors of this problem combine together to affect local people and society on sustainable development that are their geography, place, population status, unique norm and culture including consequence of imbalanced development. The main objectives were defined as factor analysis and index development of water resources contribute to social disparity, so the component approach was applied to resolve into main elements about physical landscape, meteorology, hydrology and social aspect. The disparity geodatabase stores spatial data of the primary and secondary parameters which are adopted and assigned factor weights by the experts. The factor results found that the population density, rainfall intensity, water storage and water resource project, site and distance of soil erosion and also irrigation zone and system are the primary factors for assess social disparity in water resources solution. Moreover, the index from expert weighting indicates 80 % of social disparity in Thailand and sequential result shapes to the highest disparity in 10 local communities in northeast region of 2 provinces 3 districts. This information has led to better benefit and actually operates for decision making in all levels and sectors. It is suddenly used for water resources equalization management of economic and social demand including environmental balance in crisis community and implemented other area afterwards.

Keywords: Geo-Spatial, Disparity, Factor Weights

FLOOD INUNDATION MAPPING USING GIS AND HEC-RAS

Norasyikin Mehat (1), Nor Aizam Adnan (1)

[1] Center of Studies Surveying Science and Geomatics, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor Darul Ehsan, Malaysia
Email: nor_aizam@salam.uitm.edu.my

Abstract: Flood inundation is very important to determine flood prone area and to provide initial information for researchers for their study including flood risk assessment, flood mitigation, flood hazard mapping and other improvement to achieve high accuracy of flood study. This study addresses the affected flood prone paddy area along *Merbok River* in *Kuala Muda (MRKM), Kedah*. The method used for this paper is by an integration of Geographic Information System (GIS) and hydraulic modeling approaches. Generally known, GIS is an essential tool widely used for mapping but with the aids of its analysis tools will provide huge information to any other studies. Meanwhile, hydraulic modelling will provide an estimated velocity and water surface elevation at a given discharge (Q) values also known as steady flow analysis. Two inter-compatible softwares'of ArcGIS and HEC-RAS were used to model the flow inundation and flood depth for 2014 flooding event in *MRKM* area. The study found that the flood depth modeled in the range of 0 m to 2.039 m with highest flood depth recorded in the *Bedong* area. Most of land uses inundate is mangrove area which located along the *Merbok River*. This study able to provide comprehensive view and suitable to be adopted by various flood management agencies in Malaysia especially for flood hazard mapping.

Keywords: Flood Inundation, GIS, Hydraulic Modeling, HEC-RAS

TOWARDS THE DEVELOPMENT OF RDF-BASED STATISTICAL DATA: AN OPEN DATA PERSPECTIVE

Yu-Wei Hsu (1), Jung-Hong Hong (1)

[1] Department of Geomatics, National Cheng Kung University, No. 1, Da-xue Rd., East District, 70101 Tainan City, Taiwan
Email: p66064023@mail.ncku.edu.tw; junghong@mail.ncku.edu.tw

Abstract: The revolution of GIS technology in the past 30 years have successfully transformed how information with location is used in science, technology and even human being daily lives. Nowadays we enjoy the luxury for using innovated applications via WebGIS to improve the quality of lives. Facilitating a better application environment for transparently accessing and integrating information from various domains becomes a challenge that should receive close and continuous attentions. With the increasing volume of data sharing in internet, the lack consideration of semantics to the distributed data apparently becomes impediments hindering the development of cross-domain applications. This paper intends to examine the use of the Resource Description Framework (RDF) for enriching the semantics of distributed geographic data and explores the advantages of developing internet-based sharing environment with Linked Open Data (LOD). Statistical data is chosen in this paper for analysis because it is a widely used type of data for understanding the changing status of the real world, even before GIS spatially enabled its geographic illustration. Furthermore, a variety of domains may generate and publish their statistical data. A comprehensive mechanism that can effectively conquer the semantic heterogeneity issue and correctly link statistical data from different domains can hence improve the interoperable use of cross-domain statistical data. After proposing the fundamental structure of RDF-based statistical data, we use the real data based on the statistical units from the Taiwan Geographic Statistical Classification to demonstrate its use for linking data from different domains and developing integrated applications. The research results contribute to the future strategies for developing cross-domain data sharing mechanism at the nation level.

Keywords: Open Linked Data, RDF, statistical data

ORNAMENTAL FISH FARMING AND SPATIAL DISTRIBUTION IN LAYANG-LAYANG KLUANG DISTRICT USING GEOGRAPHIC INFORMATION SYSTEM (GIS)

Eleanor Daniella Lokman (1), Adnan Hussain (1), Mohd. Mohtar Mahamud (1), Pang Ak Nyukang (1)

[1] Department of Fisheries, Ministry of Agriculture and Agro-Based Industry Malaysia, Wisma Tani, Level 1-6, Blok Menara 4G2, Precinct 4, 62628 Putrajaya
Email: eleanor@dof.gov.my; adnan@dof.gov.my; mohd.mohtar@dof.gov.my; pang@dof.gov.my

Abstract: This paper presents a new structure of research in ornamental fish farming among the ornamental fish farmers in Malaysia. The potential for further expansion of the industry in Malaysia is extensive. However, importing activities are intermittent due to export restrictions made by the European Union (EU) in 2015 until now. The objective of this study is to map the 19 ornamental aquaculture farmers farm in Layang-layang, Kluang by creating the compartmentalisation system as requested by EU in order to meet the Fisheries biosecurity requirements for the purpose of exporting ornamental fish using Geographic Information Systems (GIS) and drone images. A total sample population comprised of 19 ornamental fish farmers in Layang-layang, Kluang. Non-spatial data (survey) and spatial data (GIS) were used in the study to capture farm location effect on the farm operational activities especially in fisheries biosecurity terms. Respondent's socio-economic profile were described using the descriptive analysis. Further, the relationship between fish farming activities and the independent variables were cross-tabulated and chi-square analysis was used to test the null hypothesis. The integration of both vector and raster data was used to determine the spatial characteristics on farming activities spatially. The descriptive analysis shows that majority of the farmers were male and married. 34.8% from the farmers are 41-50 years old. Thus, the results shows most of the farmers had secondary education level, SPM holders with 41.6%. Majority of the respondents with 7 (36.8%) had a farm scale more than 10ha of farm size. Average total production with 2 millions a year. The goldfish (29%) and tiger barb (8%) are most favorable type of fish reared. A very significant relationship between farming participation and age, education level, total of production and income. The spatial analysis shows that most of the farmers live near the town, Kluang, with less than fifteen (15) kilometres from house and farm. Creating the spatial database of the compartmentalized farm is the best solutions for EU requirement that help farm monitoring by Department of Fisheries, particularly Fisheries Biosecurity Division, in the management of aquatic animal health for the country's export trade value for ornamental fish.

Keywords: Ornamental Fish, Drone Images, Spatial Analysis, GIS, Fisheries Biosecurity

EVALUATION OF SPATIAL MODELLING APPROACHES TO SIMULATE URBAN GROWTH DYNAMICS

Suman Chakraborti (1), Biswajit Mondal (1), Dipendra Nath Das (1)

[1] Jawaharlal Nehru University, New Delhi, India
Email: suman87_ssf@jnu.ac.in; niluelu@gmail.com; dipendra02@gmail.com

Abstract: Assessment of past and future urban growth process helps the decision makers to evaluate and formulate the policy documents. In an attempt to make such assessments, this study compares three commonly used urban growth models: MCCA-MC, MLP-MC, and the SLEUTH. The KAPPA index of agreement indicates that the MCCA-MC, MLP-MC and SLEUTH models avoid errors by 94%, 93%, and 92% respectively. Models forecasted about 156.96 km^2, 157.43 km^2, and 142.43 km^2 built-up areas will emerge through the process of urbanization by 2031 in the city of Udaipur. However, this assessment identified that all the models are embodied with their own advantages and disadvantages while serving specific purposes. While the MCCA-MC and MLP-MC well accounted the urban spread, whereas SLEUTH identifies the new isolated growth centers more accurately. The findings of this study would supplement the selection of urban growth models in developing countries.

Keywords: Urban Growth, Cellular Automata, Multi-Layer Perception, Markov Chain, SLEUTH

REMOTE SENSING AND GIS-BASED ANALYSIS OF EVOLVING PLANFORM MORPHOLOGY OF THE MIDDLE-LOWER PART OF THE GANGA RIVER, INDIA

Raghunath Pal (1)

[1] Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi-110067
E-mail: raghunath.geo17@gmail.com

Abstract: Channel dynamics and meandering are perhaps the most investigated planform morphology in geomorphological research for decades. The present work addresses the planform dynamics of the Ganga River in the middle-lower portion over the last six decades and the evolution and transformation of the channel and its floodplain with the help of remote sensing and GIS techniques. The methodology of the study has been incorporated into topographic sheet and satellite image processing & mapping and geomorphic analysis. Three geomorphic technique have been incorporated here for the geomorphic analysis: braid-channel ratio, sinuosity index and water-bar covered area ratio. The major findings are: i) the channel has shifted considerably throughout the study reach especially in the up and downstream of Farakka Barrage, ii) the channel bank open facies indicate silt and sand deposit, the base level changes at different places and interruption in deposition, iii) The significant changes in the summer season discharge in the downstream of Farakka Barrage because of the low discharge release from the barrage and to keep continue the flow of the Bhagirathi River, iv) The prominent flood events are annual and decadal that make the changes in the channel morphology as well as the active floodplain structure, v) The autogenic evolution of the channel and the active floodplain is controlled by the various factors, particularly, annual and decadal flood events, Farakka Barrage, floodplain accretion etc. and vi) the channel evolution concerns with the annual- decade scale whereas the active floodplain evolution maintains the decade-century scale.

Keywords: Remote Sensing, Planform Morphology, Floodplain Evolution, Ganga River

WIND ENERGY POTENTIAL MAPING POWER IN COASTAL AREA OF TOMINI BAY IN GORONTALO

Ahmad Syamsu Rijal (1), Risman Jaya (1), Daud Yusuf (2), Karina Meiyanti Maulana (2)

[1] Universitas Muhammadiyah Gorontalo, Department of Geografi, Jl. Prof. Dr. H. Mansoer Pateda, 96181 Gorontalo Regency, Indonesia
[2] Universitas Negeri Gorontalo, Department of Earth Science and Engineering, No.6, Jl. Jenderal Sudirman, 96128 Gorontalo City, Indonesia
Email: ahmadsyamsurijals@umgo.ic.id; rismanjaya@umgo.ic.id; daud@ung.ac.id; karinmaulana21@gmail.com

Abstract: The growing electricity demand along with the human population in Gorontalo is a driving force for conducting research as an environmentally friendly alternative energy development. This research can provide potential area information for wind power in Gorontalo as an environmentally friendly alternative energy. The research location was conducted in the coastal area of Tomini Bay south coast of Gorontalo. Sampling was conducted at 4 (four) measurement stations with purposive sampling method and spatial analysis of Gorontalo region. Geographic Information System (GIS) Approach integrated with WindRose as wind direction and wind direction analysis. The result showed that the average wind speed in the Tomini Bay that spread on the station which average 6.79 knots with 3.49 m/s speed converter was found in the coast of Gorontalo city, 4.25 knots with a speed of 2.18 m/s in Bilato sub-district, 6.16 knots with 3.168 m/s convention speed is available in coast of Randangan sub-district, 2.48 knots with a speed converter of 2.304 m/s in the coast of Popayato sub-district. Based on these results, wind power with the largest energy capabilities on the scale of 201-1000 kWh/m^2 can be built in the coast of Randangan sub-district and coast of Gorontalo city. While the lowest scale 0-200 kWh/m^2 in the coast of Bilato sub-district and the coast of Popayato sub-district. Research can be a recommendation for the development of wind energy as the renewable energy.

Keywords: Wind Energy Potential, Maping, GIS

USING OPENSTREETMAP DATA FOR THE LOCATION ANALYSIS ON PUBLIC BICYCLE STATIONS – A CASE STUDY ON THE YOUBIKE SYSTEM IN DOWNTOWN TAIPEI CITY

Chia-Yun Chao (1), Sendo Wang (1)

[1] Department of Geography, National Taiwan Normal University No. 162 HePing East Road Sec.1, Taipei City 10610, Taiwan, R.O.C.
Email: 140323207L@ntnu.edu.tw; 2sendo@ntnu.edu.tw

Abstract: The first public bicycle system of Taipei City, YouBike, has provided service since August 2012. The system currently has 9,423,651 active members, and the total rented number is about 106,895,634. There are also some other bicycle-sharing systems introduced into Taiwan, in Taipei or in other cities. The two biggest public bicycle systems in Taipei city are the YouBike system which is basically owned by the city government and the oBike system which is owned by a private company from Singapore. The biggest difference between these two systems is the requirement of the docking stations. The YouBike system is classified as the "automated stations" system, which means the bicycle can be rented from a docking station and returned to itself or the other station under the same system. The oBike system is classified as "dockless bikes" system, which means each bicycle has a lock integrated in the frame, and therefore, it does not require a docking station. Although the YouBike system is restricted by the location and the limited number of docking stations, it is still the most popular choice of citizens. This paper will put its emphasis on analyzing the location of docking stations to improve the efficiency the circulation of bikes. OpenStreetMap (OSM) is a crowd-sourcing mapping platform. Its volunteered geographic information (VGI) is completely open to the public. In this study, we extract geographic data from OSM, such as roads, sidewalks, bicycle lanes, and the popular destinations in Taipei city. These data are treated as the influence factors for location analysis of docking stations. A model is established to evaluate the efficiency of the circulation of bicycles. The archived usage data is used to verify and modify the model. Hopefully the suggested location of the docking stations will improve the efficiency and stimulate more usage.

Keywords: OpenStreetMap, Location Analysis, Public Bicycle System, YouBike, Volunteered Geographic Information

ASSESSMENT OF LAND SUITABILITY FOR TEA CULTIVATION USING GEOINFORMATICS IN THE MANSEHRA AND ABBOTTABAD DISTRICT, PAKISTAN

Nasir Ashraf (1), Adeel Ahmad (2), Sajid Rashid Ahmad (3)

[1] Wateen Telecom Limited, Walton Road, Lahore, Pakistan
[2] Department of Geography, Forman Christian College (A Chartered University) Ferozpur Road, Lahore, Pakistan
[3] College of Earth and Environmental Sciences, University of the Punjab New Campus, Canal Road Lahore, Pakistan
Email: gisnasir@gmail.com; adeelahmad@fccollege.edu.pk; sajidpu@yahoo.com

Abstract: Pakistan is a major tea consumer country and ranked as the third largest importer of tea worldwide. Tea is one of the most consumed beverages in Pakistani cuisine with consumption of 1 kilogram per capita. Pakistan fulfills its demand of tea by importing from abroad. Therefore the total annual import of tea was 260,000 metric tons in 2,000 which coasted approximately 12 billion Rupees to the national exchequer. Being an agrarian country Pakistan should cultivate its own Tea and save the millions of dollars cost from Tea import. So the need is to identify the most suitable areas with favorable weather condition and suitable soils where Tea can be planted. This research is conducted over District Mansehra and District Abbottabad in Khyber Pakhtoonkhwah Province of Pakistan where the most favorable conditions for tea cultivation already exist and National Tea Research Institute has done successful experiments to cultivate high quality tea. High tech approach is adopted to meet the objectives of this research by using the remotely sensed data i.e. Aster DEM, Landsat8 Imagery. The Remote Sensing data was processed in Erdas Imagine, Envi and further analyzed in ESRI ArcGIS spatial analyst for final results and representation of result data in map layouts. Integration of remote sensing data with GIS provided the perfect suitability analysis. The results showed that out of all study area, 13.4% area is highly suitable while 33.44% area is suitbale for tea plantation. The result of this research is an impressive GIS based outcome and structured format of data for the agriculture planners and Tea growers. Identification of suitable Tea growing areas by using remotely sensed data and GIS techniques is a pressing need for the country. Analysis of this research lets the planners to address variety of action plans in an economical and scientific manner which can lead tea production in Pakistan to meet demand. This Geomatics based model and approach may be used to identify more areas for tea cultivation to meet our demand which we can reduce by planting our own tea and our country can be independent in Tea production.

Keywords: Agrarian Country, GIS, Geoinformatics, Suitability Analysis, Remote Sensing

TRAFFIC CONGESTION AND ROUTE CHOICE ANALYSIS BETWEEN TWO ROUNDABOUTS BASED ON GIS ROAD NETWORK DATA MODEL

Lin Zarni Win (1), Kyaing (1), Ko Ko Lwin (2), Yoshihide Sekimoto (2)

[1] Deprtment of Civil Engineering, Yangon Technological University, Ministry of Education, Insein 11011, Yangon, Myanmar
[2] Institude of Industrial Science, The University of Tokyo, Komaba 4-6-1, Meguro Ku, Japan
Email: linnzarni2017@gmail.com; kyaingkyaing63@gmail.com; kokolwin@iis.u-tokyo.ac.jp; sekimoto@ii.u-tokyo.ac.jp

Abstract: Nowadays, Yangon with a population of 5.24 million becomes a largest commercial city and a hub of international trading center in Myanmar. The population and traffic demands has significantly increased in Yangon City due to government policy changed in 2010. The main objective of this study is to analyze traffic congestion and route choice behavior between two roundabouts, the most traffic congested area in Yangon City. We used roadside interview method for one thousand and five hundred vehicles to collect their origin-destination, route choice. We also collected existing road characteristics such as width, numbers of lanes and signal timing of between two roundabouts to calculate Level of Service (LOS) using HCM 2000. After that, we converted our roadside paper-based traffic survey data into geospatially enabled traffic survey data by utilizing GIS road network data model and geocoding method. We used this geospatially enabled traffic survey data to measure travel distance, road usages and then compute link count or volume for individual road segment. Finally, we analyze drivers' route choice behaviors and traffic congestion by road segments. We hope that this study will help to solve current traffic congestion problems and support future transport planning in Yangon City.

Keywords: GIS road network data model, geocoding, link count, traffic congestion

IDENTIFYING THE MOST SUITABLE REPRESENTATION METHOD FOR HETEROGENEOUS TIME SERIES DATA

I-Sheng Tseng (1), Chih-Yuan Huang (2)

[1] National Central University, Department of Civil Engineering, Jhongli District, 32001 Taoyuan City, Taiwan
[2] National Central University, Center for Space and Remote Sensing Research, Jhongli District, 32001 Taoyuan City, Taiwan
Email: asd2712329@gmail.com; cyhuang@csrsr.ncu.edu.tw

Abstract: A time series data is a collection of measurements obtained sequentially, which is common in many application domain, e.g., fluctuations of stock market, observations from sensor networks, medical and biological signals. Since time series data usually contains large number of data points, i.e., high-dimensionality, directly dealing with such data in its raw format is very expensive in terms of processing and storage loading. To effectively and efficiently manage time series data, several representation methods were discussed. Representation methods can reduce the dimensionality of a time series data while preserving its fundamental characteristics. However, each method has its own drawbacks and is most suitable for certain time series data types, which means no single method is efficient enough for all possible types. To address this issue, this study aims at proposing a system that can identify the most suitable representation method for different types of time series. To be specific, this study first uses time series clustering approach to cluster sample time series datasets, and each cluster represents one type of time series. We then conduct an extensive performance evaluation by testing the performance of different representation methods on the clustered time series types. Based on the evaluation, the most suitable representation methods for certain time series types can be identified. With a new time series input, we first classify this time series by compute its similarities with clustered time series types, which indirectly helps us identify the representation method that is the most suitable for this new time series data. Finally, evaluation result shows that the proposed solution can identify the most suitable representation method for different types of time series data.

Keywords: Time series, representation, data compression

ERROR PROPAGATION OF WEIGHTED OVERLAY ANALYSIS ON LANDSLIDE SUSCEPTIBILITY MAPPING

Wahyu Nurbandi (1), Projo Danoedoro (1)

[1] Department of Geographic Information Science, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang, Sekip Utara, Sleman, 55281 Special Region of Yogyakarta, Indonesia
Email: wahyunurbandi.ipa130@gmail.com; projo.danoedoro@geo.ugm.ac.id

Abstract: Overlay analysis of geographic information system (GIS) is a method applied in suitability modelling by a number of maps for specific phenomenon. One of problem in overlay analysis is error propagation. It is the effect of maps uncertainties/errors on the uncertainty of final map. Error propagation of map overlay analysis can be applied in geometric or thematic/attribute errors. This research focus in attribute error which is represented as attribute accuracy. Landslide susceptibility map can be produced by overlay analysis using a number of maps as influential parameters. Objective of this research is to analyze error propagation of overlay analysis in landslide susceptibility mapping. The research area is conducted in Kayangan Catchment, Kulon Progo Regency, Special Region of Yogyakarta, Indonesia. In this research, some used parameters for landslide susceptibility are elevation, slope, aspect, curvature, rainfall, and land cover/use. Every parameter is determined of its accuracy using error confusion matrix. It is also manipulated to be three kinds of accuracy, they are high ($\geq$0.9), middle (0.8 – 0.9), and low ($\leq$ 0.8). Method of landslide susceptibility mapping is weighted overlay by bivariate statistical analysis. It is a quantitative method to determine weight of class parameter and overall parameter based on landslide occurrences. Accuracy assessment of landslide susceptibility map use ROC-AUC method. Error propagation analysis is done by analyze relationship between accuracy of map parameters and resulted map of overlay analysis by multivariate regression. High, middle, and low accuracy of elevation: 0.931, 0.852, 0.764; slope: 0.946, 0.857, 0.774; aspect: 0.950, 0.863, 0.764; curvature: 0.949, 0.869, 0.763; rainfall: 0.957, 0.849, 0.957; and land use/cover: 0.909, 0.862, 0.753. Thirty-six landslide susceptibility maps are resulted by various combination randomly of parameters accuracy with accuracy about 0.680 to 0.764 and average 0.721. Error propagation analysis show that accuracy of resulted map is not higher than accuracy of parameter maps. Based on multivariate regression, some parameters with highest contribution of error are elevation, curvature, and land use/cover.

Keywords: weighted overlay analysis, error propagation, landslide susceptibility

ANALYSIS ON THE SPATIAL REASONING OF HISTORICAL PERAK SULTANATE

Illyani Ibrahim (1), Nor Zalina Harun (2), Alias Abdullah (1)

[1] Department of Urban and Regional Planning, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Selangor, Malaysia.
[2] Institute of the Malay World and Civilisation (ATMA), Universiti Kebangsaan Malaysia, Selangor, Malaysia
Email: illyani_i@iium.edu.my; nzalina@ukm.edu.my; dralias@iium.edu.my

Abstract: The pattern of buildings location can reflect the identity of the historical buildings to the social relations. The aim of this research is to elucidate the spatial relationship of the historical Sultanate of Perak physical features with the orientation and distance with the other historical buildings in continuous spatial scales. The objective of this paper is; i) to analyse the spatial orientation and distance between all features obtained from the map and ii) to identify the relationship between the palace and locations' analysed. Using this notation, the interaction between space and distances are derived to understand the reasoning such location of the historical features. The findings show that i) Istana Iskandariah are located at the hill top of Kuala Kangsar, ii) Istana Iskandariah are facing Qiblah, iii) 90% of Rumah Pembesar (except of Baitul Anor) are facing to the Istana Iskandariah.

Keywords: distance, GIS, historical, orientation, Perak Sultanate, Spatial Reasoning

DEVELOPMENT SUITABILITY ANALYSIS OF FREQUENTLY FLOOD AFFECTED AREAS IN SRI LANKA: CASE STUDY OF RATHNAPURA MUNICIPAL COUNCIL AREA

C.L.Jayasekara (1), G.M.W.L. Gunawardena (1)

[1] Department of Town & Country Planning University of Moratuwa
Email: chathujcl@gmail.com; w.lakpriya@gmail.com

Abstract: Flood is a natural phenomenon that is difficult to avoid. However, flood hazard tends to shoot up into a disaster, especially in urban areas, due to the conversion of natural land into an impervious surface. Flood has become a curse to the people who are affected by it and who converted the natural land into an impervious surface. With the human development this disaster has become a serious issue which cannot be overcome such easily. Therefore, different advanced flood mitigation measures have become one of the main discussing point in the society. Nowadays there has been a significant move from flood protection to flood risk management. (Matsuo, Natainia, & Yamada, 2013) Spatial planning has been identified as one of the fundamental flood management measures, because it can influence the incidence of flooding and its consequential damage, by regulating the locations of activities, types of land use, scales of development and designs of physical structures.(Ran & Nedovic-Budic, 2016) In other words people tend to live with flood. In order to regulate the living with flood, it is important to identify the suitability of the land for the development. However, adequate attention is not still paid to develop a proper mechanism for evaluating this development suitability. The main objective of this research is to identify the suitability of frequently flooding areas to different development activities, which measure the "Development suitability" of the lands, considering both Emergency Evacuation Easiness and the flood risk level of the land. This development suitability analysis will be useful to develop a set of guidelines for the future development activities. The research has used the Geographical Information System based approach to analyze the development suitability of the lands. Two main aspects were assessed to achieve this objective: flood risk level and emergency evacuation easiness. It is assessed by taking the Rathnapura municipal council area as the case study area and the flood as the uncertain event.

Keywords: Development suitability, Emergency Evacuation Easiness, Flood risk management, Spatial planning, Vulnerability & Risk Assessment

DEVELOPMENT OF PANCHYAT RESOURCE INFORMATION SYSTEM IN HIMACHAL PRADESH USING GEO-INFORMATICS

Meher Kaushal (1), Sunil Sharma (2) & Brijesh Saklani (3)

[1] Department of Electronics & Communication, SRM Institute for Science & Technology
Chennai, Tamil Nadu, India
[2] Haryana Space Application Centre (HARSAC), Hisar, Haryana, India
Aryabhata Geo-informatics & Space Application Centre
[3] State Council for Science Technology & Environment, Shimla, Himachal Pradesh, India
Email: meherkaushal15@gmail.com

Abstract: The process and practice of planning are getting decentralized to lower area units to make them area specific and responsive to the needs of local people. It is extremely important to empower panchyats, the foundation and grass root institutions in India in terms of resource database creation and use of the same for better future. The spatial information of the available resources is a pre-requisite for generating developmental plans and their time bound completion/monitoring/evaluation. Recent technologies have made considerable positive impacts in providing effective and meaningful direction to decentralized rural development planning. The Space technologies (Remote Sensing, Geographic Information System (GIS) & Global Positioning System (GPS) in conjunction with Information Technology (IT) are tool par excellence for generating, visualizing and sharing information on distribution of local resources present naturally as well as created under various central and state sponsored development schemes/programmes. To harness benefits of Space Technology and Geoinformatics for developmental planning, a project was carried out to develop Panchyat Resources Information System (PRIS) of Chamyanna, Malyanna and Pujarali panchyats of Himachal Pradesh. The panchyat resources information system is designed for the identification and mapping of the local resources spatially and understanding the problems and potentialities of each resource. It provides the basic details in GIS format for the planning the development activities of panchyats. The Indian Remote Sensing Satellite Cartosat – 1 images are the basic remote sensing data which has been used for mapping the panchyats. The spatial resolution is 2.5m and thus amenable for 1:10,000 scale mapping. The ancillary/collateral Data used was collected from panchyat asset registers and district census handbook. The location of various natural and manmade resources was collected with the help of maps and Global Positioning System. The mapping & creation of geo-database was done using Arc GIS software. The geo-visualization of geo-database has been done by developing desktop applications by cutomization of Map Window open source GIS Software. This will be a supportive system for e-governance at micro level. The output is in digital format and will serve as a base for planning the development activities in rural areas.

Keywords: Panchyat Resources Information System (PRIS), Panchayat, Geo-database, Desktop applications, Cartosat – 1

A REAL-TIME PERSPECTIVE TOWARDS THE FUSION OF GEOGRAPHIC INFORMATION

Han-Wen Liu (1), Hung-Jung Hong (1)

[1] National Cheng Kung University, Department of Geomatics, Tainan, Taiwan No.1, Daxue Rd., East Dist., Tainan City 701, Taiwan (R.O.C.)
Email: kevin103202010@gmail.com; junghong@mail.ncku.edu.tw

Abstract: The rapid growth of sensor and IoT technology brings revolutionary impacts on the improvement of the quality of humans' daily lives. A tremendous volume of sensed data is continuously collected and distributed via mobile network all over the world. However, the availability of data does not necessarily mean the data can automatically fit together. Especially for applications in smart cities which often demands the fusion of real-time data from different resources for making prompt decisions, the comprehensive understanding about the data being used is extremely important. As current applications rarely address the "real time" issue in an appropriate manner, we pay our attention to the modelling and interpretation of GIS data from a temporal perspective in this paper. A conceptual model specifically modelling the various properties of real-time GIS data is proposed. The design aims to provide necessary real-time considerations for both observations and alert information to ensure all the data acquired from different resources can be processed and fused together in a standardized and interoperability way. Based on the standardized modelling framework, we further propose a status-aware interface with four working modes, namely, latest available, all historical, validated and ideal, for presenting GIS data based on the consideration of real-time, data type and quality. The interface design is augmented with cartographic knowledge to enable users to visually distinguish data with different real-time status and avoid wrong decision making. In addition to the map interface, analysed outcomes are also presented with textual or quantitative measures to provide additional guidance. As real-time GIS applications often operate under extremely high time pressure, the proposed standardized approach proves to be able to provide a feasible solution to improve the accuracy and efficiency of data fusion in GIS applications.

Keywords: real-time; data fusion; sensing data; data heterogeneity

DEVELOPMENT OF GIS BASED MODEL FOR LOCATING SUSTAINABLE CONSTRUCTION AGGREGATE MINING SITES: CASE STUDY FROM SRI LANKA

H. M. Ranjith Premasiri (1), T. Dahanayake (2)

[1] Department of Earth Resources Engineering, University of Moratuwa, Moratuwa, Sri Lanka.
[2] Geological Survey and Mines Bereaue, Epitamulla Road Pita Kotte Sri Lanka.
Email: ranjith@uom.ac.lk; hmranjith@yahoo.com

Abstract: One of main raw materials for construction industry in Sri Lanka is rock aggregates. During the last decade construction industry has boomed in Sri Lanka and the mining for the construction materials increased dramatically too. Though Sri Lanka has rules and regulations imposed to manage and control the mining activities in Sri Lanka, several social and environmental issues are uncounted at many rock quarrying sites all over the island. Most of the issues faced by quarry mining industry are due to prevailing heterogeneous land use pattern in Sri Lank. As mining activities always cause some negative impact on the environment, it is important to find a solution to minimize such impact. Present study aimed to develop a model to locate most appropriate sites for sustainable quarry mining where impact on the surrounding environment is minimum. GIS model was developed to locate most suitable and sustainable quarry mining site. The model was tested using two districts, Anuradhapura and Gampaha in Sri Lanka representing most rural and urbanized areas respectively. Five Land use classes such as Home-Land, Agri-Land, Forest-Land, Scrubs/Vacant- Land and Rocks were used for the model giving weights based on the distance to the site and their impact on the environment. (From the developed model, cumulative weight index calculated) Calculated cumulative weight index using the developed model in 12 locations in Anuradhapura district shows minimum score of 250 and maximum score of 394. However, in Gampaha district from 10 locations studied it shows 116 as minimum value and 591 as maximum. Though Anuradhapura district has relatively low population density, mining location scored higher weighted index within a narrow range and Gampaha district where population density is higher and mostly covered by urbanized areas, some locations scored very low weighted index from the model and few locations show very high scores. GIS model gave higher average weighted index have been operated with less complains on environmental and social issues. The developed model can be used to locate new mining sites with minimum impact on the environment.

Keywords: Quarry Mining, Land-use, Weighted index,

URBAN AIR POLLUTION & IDENTIFICATION OF VULNERABLE AREAS IN CITY OF COLOMBO USING GIS TECHNOLOGY

P.R.Thamara Kumari Dissanayake (1), D.M. Karunadasa (2), L.Manawadu (2)

1 GIS Division, Urban Development Authority, 7th Floor, Sethsiripaya, Battaramulla, Colombo, Sri Lanka
2 Department of Geography, University of Colombo, Colombo 07, Sri Lanka
Email: thamaradisa@gmail.com; karu@geo.cmb.ac.lk; lasangeo@gemail.com

Abstract: Air pollution is one of the environmental problems which has increased due to urbanization all over the world as well as it is becoming a serious issue in the South and East Asian region such as China, India Bangladesh and Sri Lanka. **I**t has created number of problems in its capital city of Colombo. Private and Government sector have conducted various studies in order to evaluate the air quality in relation to the changes associated with socio-economic factors. The study has examined the spatial variation in No2 ,So2 and PM10 concentration pertaining to air pollution and some areas was identified as vulnerable areas. Mapping of air quality over the study area is a difficult task due to lack of instruments. With regard to analysis, GIS model, spatial analysis, Regression analysis and many algorithms were used to represent the air pollution by using secondary data and Images using Arc Map 10.2. The methods of analysis of air pollution are very useful because of high resolution images, influential thermal bands which can detect the urban heat of the area. Other visible range sensors have been used for the Normalized Difference Vegetation Index (NDVI). highly vulnerable sites were identified by using multi criteria analysis. According to the results No_2 & So_2 concentration level is very high. The study was concluded that land use pattern & volume of traffic, Seasonal variation generated more pollution flumes in the central part of the City. Strong relationship can be seen between traffic flow and air pollution and directly effect to the health of people. This study has been identified that highest vulnerable areas, have shown the relationship with air quality. It can be categorized into five zones such as Highly vulnerable Zone, Moderate vulnerable, Marginally vulnerable, Less vulnerable & Free Zone. The highest vulnerable areas are having more risk due to air quality. As a result of socio economic factors such as population density, building floor area, surface temperature and Land Use directly contributed to enhance the problems. GIS technology are useful to analyze these variations in spatial terms as well as examine the vulnerability of the city.

Keywords: Air pollution, Spatial Analysis, Surface Temperature, GISTechnology, Vulnerable Zone

BUILT-UP AREA EXTRACTION USING CROWD SOURCING IN STATE OF UTTARAKHAND, INDIA

N. Lakmal Deshapriya (1), Dr. Kavinda Gunasekara (1), Dr. Manzul Hazarika (1)

[1]Geoinformatics Center, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani, 12120, Thailand
Email: lakmal@ait.ac.com; kavinda@ait.ac.th; manzul@ait.ac.th

Abstract: In case of multi-hazard risk assessment, built-up area is an essential component. Usually, each country conduct national population and housing censuses to gather related information including building information. But, those data are limited by Census Tracks (similar to village boundaries) which are quiet large when it comes to detailed multi-hazard risk assessment. To overcome this, extraction of built-up area from high resolution Satellite Images were considered. After assessing feasibility of using automatic image processing methods including pixel based and object based classification, crowd sourcing approach was selected for extraction of built-up area. Study area of this study (State of Uttarakhand, India) is a considerably large state in India covering 53,483 km^2. Considering the large scale of the work, we have developed dedicated crowd sourcing application for this task. To manage large area of the state, state was divided in to around 60,000 grids covering ~ 1km2 (600m x 1200 m) area per grid. And, each grid was randomly feed to GIS digitizers for digitizing through the application, allowing many GIS sigitizers to work simultaneously. In this paper, we are discussing development of the crowd sourcing application and experience gathered during the crowd-sourcing of built-up area in State of Uttarakhand, India.

Keywords: Crowd Sourcing, Built-up Area, High Resolution Satellite Images

HIGH ALTITUDE WETLAND INVENTORY OF DRY COLD AGRO-CLIMATIC ZONE OF HIMACHAL PRADESH USING GEO-INFORMATICS

Alka Sharma (1), Sushma Panigrahy (2), T. S Singh (2), J. G. Patel (2) and H. Tanwar (1)

[1] State Council for Science, Technology & Environment Himachal Pradesh, India
[2] Space Application Centre, Indian Space Research Organization, Ahemdabad India
Email: dr_alkasharma@rediffmail .com

Abstract: High Altitude Wetlands (HAWs) are very special wetlands and play significant role in the hydrological cycle and water resources of state of Himachal Pradesh besides harbouring unique biodiversity. They store water from rain and glacial melt, feed aquifers, trap sediments and recycle nutrients, enhancing both the quantity and quality of water. Their ability to promote vegetation growth lessens soil erosion and buffers water flow, providing a steady flow of water downstream while reducing the severity of disasters such as landslides, floods and droughts. The Dry cold agro-climatic zone of Himachal Pradesh comprising mainly of Kinnaur and Lahaul Spiti districts is abound with numerous small size wetlands which have significant value to local environment. Despite their benefits, these wetlands are the first target of human interference and are among the most threatened of all natural resources. This calls for a long term planning for preservation and conservation of these resources. An updated and accurate database is prerequisite for developing conservation plans. This study is part of project executed by Himachal Pradesh Remote Sensing Centre in collaboration with Space Application Centre, Indian Space Research Organization sponsored by Ministry of Forest & Environment, Government of India. An attempt has been made to map the wetlands using remote sensing data from Indian Remote Sensing Satellite P6 Linear Imaging Self Scanner (IRSP6 LISS3). The results are organized at 1: 50,000 scale using Geographic Information System (GIS). Two season satellite data captured the freezing and melting scenario of lakes. A classification system based on International Union for Conservation of Nature (IUCN) /RAMSAR definition and amenable from remotely sensed data was used to categorise the wetlands. A Total of 19 types of wetlands were delineated using a hierarchical system. High Altitude Wetlands (HAWs) is one of the classes mapped, which is first such attempt in the country. A total of 160 HAWs were delineated constituting 3.68 Sq. Km area. Maximum number of lakes (137) is of very small size (< 0.0225 Sq. Km). Altitudinal distribution of these wetlands showed that almost all (103) lakes are distributed in the elevation range of 4000 to 5000 m and above.

Keywords: High Altitude Wetlands (HAWs); Digital Elevation Model (DEM); Indian Remote Sensing; LISS3; Himachal Pradesh

A STUDY ON BUILDING A GIS-BASED FUTURE ROAD DB FOR DEVELOPING INTERGRATED STREAMFLOW DEPLETION EVALUATION SYSTEM

Gi-Hun Lee(1), Kye-Hyun Kim(1), Yong-Gil Park(1), Jae-Hyun Yoo(1)

[1]Dept. of Geoinformatic Engineering, Inha University, 100 Inha-ro, MichuHall-gu, Incheon (21222), South Korea
E-mail: blue_space7@inha.edu

Abstract: In recent years, with climate change, the trend of using water resources has changed due to an increase in the area of Impervious cover such as urbanization and road construction. This changes are causing the streamflow depletion. In order to manage this streamflow depletion, an evaluation system based on time series and future forecast data on the factors of streamflow depletion is required. Therefore, this study was intended to lay the groundwork for developing an integrated streamflow depletion assessment system by collecting time series and future forecast data for roads, one of the causes of streamflow depletion. GIS -based road DB for streamflow depletion analysis was defined by defining the order of study in the current status of available data, data collection and processing, and the order of database construction. First, a survey was carried out on the road information provided by the Korea Highway Corporation and the Regional Land Management Agency, as well as the planned construction roads that can be found in the national road comprehensive plan and urban construction and management plan. A time-series DB was established through the extraction of road layers and conversion of shp files in the national DB, and the mapping function was used to generate additional data for new and planned areas according to the plan. In this study, we intend to prepare the basic data for an integrated streamflow depletion evaluation system by establishing a GIS-based time series and future road DB, and we need to study the enhancement of the evaluation system to enable future analysis of streams.

Keywords: Impervious Cover, Streamflow Depletion, Future Road DB

THE EVALUATION OF COASTAL EROSION AND ITS IMPACT ON COASTAL ENVIRONMENT BETWEEN KALU RIVER MOUTH AND BOLOGODA RIVER MOUTH, SRI LANKA

P.Kirishanthan (1)

[1] Department of Geography, University of Colombo, 00300, Colombo, Sri Lanka
Email: krishanth153@gmail.com

Abstract: Geographical Information System (GIS) can be identified as a comprehensive technology that has unique power to analysis and understand the environmental phenomena. It has wide range of capabilities for study of disaster management such as floods, landslides and Coastal erosion. Sri Lanka, Being an Island costal erosion is one of the major environment issue especially in southern and western coastal areas of the island. Recent years the highest intensity of shoreline erosion in Sri Lanka is recorded from South Western coastal zone. This coastal belt is most important in terms of geographical location, social, economic, cultural and all other aspects. Due natural and anthropic activities the coastal area of southwest became threat. Therefore the study focused on coastal erosion between Kalu River Mouth and Bologoda River Mouth in the south western coastal zone. The main objective of this study was to evaluate the coastal geomorphological and environmental changes due to coastal erosion using Geographical Information System (GIS). The data was collected through both primary and secondary especially from web based data base, survey data and etc. In addition to that Enhanced Thematic Mapper Plus (ETM+), Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS) images were collected from United State Geological Survey (USGS) online data base 2003 to 2015. The Digital Shoreline Analysis System (DSAS) is one of the developed tool for evaluate and compute shoreline changes. It was used for the determination of the coastal changes of the study area. According to the computation of shoreline changes of the selected coast area were identified positive correlation between shoreline change and time at the 0.05 confident level. 4.5m/yr was recorded at the Kalu River mouth area. Meanwhile some areas were protected with natural coastal forest cover in the Kelido Beach area. The middle part of the study area was eroded with human activities such as construction of tourist hotels etc. however coastal erosion is one of the main environment problem in the study area. It is a time to conserve the coastal region of the south western coastal zone. Especially Kalu River mouth area, because of that the main city of Kaluthara and historical stupa of Kaluthara were located very close to coast area.

Keywords: Coastal erosion, Shoreline change, DSAS

FLATS LOCATION ANALYSIS BASED ON BUILDING DENSITY USING GIS (CASE STUDY : BANDUNG CITY)

Boby Arianto (1), Albertus Deliar (1), Riantini Virtriana (1)

[1]Institute of Technology Bandung, Geodesy and Geomatics Engineering,
Jalan Ganeca 10 Bandung, 40132, Indonesia
Email: bobyarianto27@gmail.com; albertus.deliar@gmail.com; riantini.virtriana@gmail.com

Abstract: Population growth in Bandung City, which is very rapid every year, causes residential area in Bandung become narrower. There are several points in Bandung City that have a very high building density and make the quality of residential areas not neatly arranged. The problem of urban planning in Bandung City needs to be found a solution. In the current era, due to the limited residental area, the policy of making flats is used to arrange the spatial arrangement. The increasing number of people who stay in Bandung causes some region to have a dense building. The regions causes some problems, such as a sordid housings and settlements. The purpose of this research to create optimization criteria and locations of flats in Bandung city according to the regions that have dense building to lose the sordid based on GIS, impressions in those regions and may be used to assist in decision making process to create residential areas which are complete, congenial, and balanced by paying attention to sustainable and environmentally friendly principle of development in Bandung city. The location of this research covers the urban areas located in Bandung city such as Kelurahan Lebak Gede, Cipaganti, Taman Sari, and Lebak Siliwangi. In this research, the data that will be used are the buildings/settlements data and literature review related to this research. The method of flat location identification is based on the density of building that identifies solid seen from building density. The results obtained are 17 blocks area identified as dense areas of buildings and blocks are suitable and suitable to build flats. The identification of the GIS-based flats is expected to lead to a harmonious, balanced, efficient and productive urban development.

Keywords: Bandung City, Building Density, Flats, GIS

MULTICRITERIA ANALYSIS FOR FLOOD MAPPING OF SUNGAI PAHANG

Illyani Ibrahim (1), M Zainora Asmawi (1)

[1] Department of Urban and Regional Planning, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia.
Email: illyani_i@iium.edu.my; zainora@iium.edu.my

Abstract: The occurrence of floods is a natural disaster incidence that depends on the geographical, physical and local factors, which is due to rainfall. This study aims to investigate the geospatial analysis of flood in Sungai Pahang, Pahang. The objectives of the study are i) to analyse the use of factors for multi criteria analysis, and ii) to prepare a flood hazard mapping in Sungai Pahang, Pahang. Method used for this study is a multicriteria analysis using Geographical Information System. Four important factors were used in this research; distance from the river, gradient, land cover and height of the land form. The results show that xxx. The finding show that the highly dense areas located close to the river are located inside the susceptible area, which can give a high loss to the inhabitants in those particular areas. Thus, the recommendation suggests that determination of flood-prone areas of flood level 1 (high), level 2 (moderate) and level 3 (low) can be implement by the local authority in practice of development planning work.

Keywords: flood map, multi criteria, Geographical Information System

ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS OF MADURU OYA RIVER BASIN OF SRI LANKA USING GIS

Nisansala S. Withanage (1), Dhammika K. Dayawansa (2), Ranjith P. De Silva (2), Chithrangani W. M. Rathnayake (1)

[1] Uva Wellassa University of Sri Lanka, Faculty of Animal Science and Export Agriculture, Second Mile Post, Passara Road, Badulla, 90000, Sri Lanka
[2] University of Peradeniya, Faculty of Agriculture, PO Box 55, Peradeniya, 20400, Sri Lanka
Email: nisauwu@gmail.com; dammid@pdn.ac.lk; ranjith@ageng.pdn.ac.lk; chithrauwu@gmail.com

Abstract: River basin is the entire land area supplying its water into a river and thus river network and its drainage area which can be explained through morphological characteristics control the hydrological processes occurring within the river basin. Hence, the present study attempted to assess the morphological characteristics of Maduru Oya river basin to upgrade the knowledge base of morphological characteristics of Maduru Oya River Basin of Sri Lanka and to identify its flood characteristics based on morphological characteristics. The study was carried out using spatial data analysis with Geographical Information Systems (GIS). Linear, areal and relief aspects of morphological characteristics of the basin were assessed and then soil, land use and terrain conditions of the basin were examined to elaborate the findings. Results revealed that the Maduru Oya river basin has 6th order river network (as per the Strahler's classification) with a dendritic drainage pattern and moderate drainage texture. The obtained higher values of bifurcation ratio and all lower values of drainage density, stream frequency, elongation ratio, circularity ratio, form factor, length of overland flow, drainage intensity, relief ratio and relative relief revealed that this basin would generate a flatter peak of direct runoff for a longer duration and thus there is a less risk for both soil erosion and flooding within the basin. Further, permeable nature of main soil type, good vegetation and low relief which cover a major extent o the basin supportedthe findings on the morphological characteristics.

Keywords: Flood Characteristics, Geographical Information Systems, Maduru Oya River Basin, Morphological Characteristics, Soil and Topographical Conditions

USING GIS TO IDENTIFY VEHICLE CRASH HOT POTS AND UNSAFE CROSSROADS – A CASE STUDY OF KOLKATA, INDIA

Md Saddam Hussain (1), Dharini Jha (2), Arkopal Kishore Goswami (3)

[1] Research scholar, RCG School of Infrastructure Design and Management, Indian Institute of Technology, Kharagpur, 721302 Westbengal, India
[2] Junior Research Fellow, Banares Hindu University, Varanasi, 221005 Uttar pradesh, India
[3] Assistant Professor, RCG School of Infrastructure Design and Management, Indian Institute of Technology, Kharagpur, 721302 Westbengal, India

Abstract: India has the second largest road network in the world, which is undergoing a continuous expansion. There has been an increase of 32 % deaths since 2007, and a tenfold increase as compared to 1970, owing to vehicle-pedestrian conflicts in India. Therefore, road safety has become one of the most urgent as well as challenging issues that demands maximum priority in India. Kolkata, accounted for over 4000 crashes in 2016, making it the fifth city with most road crashes in India. In 2016, North division (with eight police station) saw total of 316 crashes of which 46 were fatal, and 142 were serious. This paper presents a GIS approach based on the spatial autocorrelation of pedestrian–vehicle crash data for identification and ranking of unsafe crossroads. The analysis took into consideration both the number and severity of the vehicle crashes to identify the most critical crossroads in the North division in Kolkata. The accident data along with various other statistics were obtained from the official annual review report of Kolkata traffic police for the year 2016. Crash data was uploaded in the North zone boundary. Fatal, Serious, Minor, and collision crash data were added separately to show their spread over the area. The Severity index at each location was then calculated using Equivalent Property Damage Only (EPDO) method and the statistical significance for Moran's I statistics was calculated using z-score methods. Consequently, through spatial correlation statistical tool, the maximum distance threshold was identified where the z-score is maximum and statistically significant. Hotspots points were identified using Getis-Ord Gi* statistics. Further, based on the hotspot points, hotspot areas were identified on the map. From, the map the major crossroads in the hotspot areas were identified and subsequently their severity indices were calculated and ranked. The whole analysis was repeated with only fatal and serious crash points, and the obtained results were then compared. The results obtained from the analysis of the vehicle crash data indicate that the approach is capable of statistically detecting spatial pattern of crash data which can be further used to detect and rank unsafe crossroads in the vehicle crash hot spot areas. The study overall provides a sound basis for identifying vehicle crash hotspots and identifying the critical unsafe crossroads, which can be further used to study the causal factors, determine effective mitigation strategies and policy changes.

Keywords: Pedestrian crashes, Remote sensing, GIS, Hotspot analysis, Severity Index

IDENTIFICATION OF OPTIMUM PATH FOR SERVICE AREAS USING GIS BASED NETWORK ANALYSIS: A CASE STUDY OF JAIPUR

Shaik Mohammad Nayaz (1), Anul Haq (2)

[1] M.Tech GIS, NIIT University, Neemrana-301705, Rajasthan, India
[2] Associate Professor, NIIT University, Neemrana-301705, Rajasthan, India
Email: shaikm.nayaz@st.niituniversity.in; Anul.haq@niituniversity.in

Abstract: Network Analysis aims at finding solutions to routing problems related to Transversibility, rate of flow, and network connectivity. It helps in identifying optimum locations for services to be provided. The current work basically is a smart city road network analyses and only OSM (open street maps) data of approximately accuracy has been used for this study. In the present study, distribution of ATMs of different banks, Hospitals, fire stations and police stations of Jaipur city area have been selected for network Analysis. This kind of study is very uncommon for even highly developed metro cities of India like Hyderabad, Patna, Bangalore, Jaipur etc., During data observation noticed that Axis Bank ATMs and HDFC Bank ATMs are well distributed while that of UCO & ICICI ATMs are poorly distributed. The Fire Station Services are well distributed through-out the city but most of the North West area has no availability of emergency fire station service with in the radius of 3.5 km approximately. The security of citizens which depends on police service is very high in the centre of city but north and south portion of city is not well covered with police stations. The road network and connectivity in the study area is of appreciable standard. If this sort of study is undertaken for the area with very high resolution data of fine accuracy level and supplemented with extensive field surveys costly enterprise, the study can be of immense applicability to Public Transport Corporations, Health service providers, Emergency Response agencies, security services.

Keywords: GIS, Network Analysis, Service Area, Road Network and Optimal Route

DETERMINATION OF CORRELATION BETWEEN STREET ACCESSIBILITY AND CRIMES USING SPACE SYNTAX NETWORK GRAPH ANALYSIS

Dipen Sahajramani (1), Sabyasachi Purkayastha (1), Joshua Ranjit (2)

[1] Center for Environmental Planning and Technology Faculty of Technology Kasturbhai Lalbhai Campus, University Road, Navrangpura, Ahmedabad, Gujarat 380009
[2] Environmental Planning and Technology Faculty of Technology Kasturbhai Lalbhai Campus, University Road, Navrangpura, Ahmedabad, Gujarat 380009
Email: dipen95.ds@gmail.com; route2sabya@gmail.com; ranjit.joshua.mgeo17@cept.ac.in

Abstract: Vancouver is the most densely populated city in Canada. Urban planning in Vancouver is characterized by high-rise residential and mixed-use development in urban centers, as an alternative to sprawl. The style of planning has been termed as Vancouverism. Vancouver is classed as a Beta global city with very high scores for liveability. However, it has one of the highest numbers of crimes in Canada. As the city expands, crimes tend to increase with the increase in population which is one of the key challenges addressed by the urban planners and policymakers. Crimes should reduce along with the improvement of the living standard of the people. Questions such as what could be the causes of this phenomenon or the unsafety on the streets arise. Moreover, many prior researches have shown the presence of a spatial influence in crime incidents. Researchers also suggest that more accessible areas with high public awareness have a high probability of a criminal offense. Sometimes the results can be contradictory as seen in previous researches. In the present study, an effort has been made to test the hypothesis that crime takes place in an area less accessible or streets which are less connected and hence carry fewer pedestrians and to determine how pedestrian-street accessibility and connectivity influence crime rates. The study uses the space syntax street network method along with standard GIS workflows such as spatial join, nearest neighbour search and network graph analysis to bring the data to a common platform for the correlation analysis.Further on, Moran's I scores are also tested to check for a clustering or dispersal effect in the distribution of crimes. Pearson's coefficient tests have been used to show the correlation between the high/low accessible streets and crime incidents for the same streets. Positive clustering effects were observed in downtown Vancouver. A positive correlation ranging from 0.36 to 0.44 with 95% confidence was found between the crime incidents and the types of the street (arterial, secondary arterial, collector & residential). Further research can be carried out to determine how different types of crime incidents and types of streets are correlated.

Keywords: Geographic Information System, Space Syntax Network Analysis, Pearson's Coefficient, Urban crimes, Pedestrian Accessibility

THE EVALUATION OF COAST LINE MOVEMENT FROM THE KALU RIVER MOUTH TO BOLGODA RIVER MOUTH USING DSAS TOOL BASED ON GIS

P.Kirishanthan (1)

[1] Department of Geography, University of Colombo, Sri Lanka
Email: krishanth153@gmail.com

Abstract: Geographical Information System (GIS) can be identified as a comprehensive technology which has a unique power of understanding environmental phenomena. It has wide range of capabilities for evaluate environmental issue such as pollution, erosion and also numerous disasters. As an Island and county of tropical region the Sri Lanka is face to several environmental disasters such as sea level change, coastal erosion, flood, landslide etc… According to this situation study about the environmental hazard are most important. Anyway this study was mainly focused coastal erosion on West Coast of the Sri Lanka form Kalu River mouth to Bolgoda River mouth thirteen kilometers along the coastal zone. The main objective of this study is to identification of coastal geomorphological changes and environmental changes using developed tools of Geographical Information System (GIS). The Digital Shoreline Analysis System (DSAS) is one of the developed tool for evaluate and compute shoreline changes. The data was collected using both primary and secondary data collection methods such as web based data base, survey data etc… In additionally Enhanced Thematic Mapper Plus (ETM+), Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS) images were collected from United State Geological Survey (USGS) online data base 2003 to 2015. According to the computation of shoreline changes of the selected West coast area were identified positive correlation between shoreline change and time at the 0.05 confident level. 4.5m/yr was recorded at the Kalu River mouth area. But some areas of there was protected with natural coastal forest cover as example Kelido Beach area. The middle part of the study area was eroded with human activities such as construction of tourist hotels etc… Anyway now time to conserve the coastal region of the west coast. Specilly Kalu River mouth area, because of that the main city of Kaluthara and historical stupa of Kaluthara were located very close to coast area.

Keywords: coastal erosion, shoreline change, DSAS

DRIVING FACTOR ANALYSIS OF LAND COVER CHANGE BASED ON SPATIAL PLANNING ZONATION (CASE STUDY: WEST JAVA PROVINCE)

Qonita R. Muzdalifah (1), Albertus Deliar (1), Riantini Virtriana (1)

[1] Remote Sensing and Geographic Information Science Research Group, Faculty of Earth Science and Technology, Institut Teknologi Bandung, No. 10, Jalan Ganesha, 40132 Kota Bandung, Jawa Barat, Indonesia
Email: qonitarahmamz@gmail.com; albert@gd.itb.ac.id; riantini@gd.itb.ac.id

Abstract: Land demands continue to increase while land supply is constant. These conditions will cause land cover change phenomenon. Land cover change is one of the important factors that affect global environmental change. The phenomenon of land cover change in a region is caused by certain factors and it depends on the characteristics of its region. This research aims to identify the driving factors of land cover change in each zonation of West Java Province spatial planning through spatial analysis process. The driving factors and land cover change phenomenon were modeled using binary logistic regression method through spatial analysis process using GIS. The analysis process was carried out on 7 different spatial planning zones, those are conservation area, wetland agriculture area, dryland agriculture area, industrial area, industrial zone, urban area, and metropolitan area. The result of this research explains that the driving factors of land cover change in each zonation of West Java Province spatial planning are different. However, in general, the driving factors of land cover change in each zonation of West Java Province spatial planning are distance to the main road, distance to the province capital, distance to Bandung Region central business district, and distance to Bekasi City central business district.

Keywords: Land Cover Change, Spatial Planning, Binary Logistic Regression.

SPATIAL PATTERN OF LAND COVER CHANGES IN BANDUNG BASIN USING CLUSTER ANALYSIS

Titin Naipospos Sibagariang (1), Albertus Deliar (1), Riantini Virtriana (1)

[1]Remote Sensing and Geographic Information Science Research Group, Faculty of Earth Sciences and Technology, Institute of Technology Bandung,
No. 10, Jalan Ganeca, 40132 Bandung City, West Java, Indonesia
Email: titin.sibagariang@gmail.com; albert@gd.itb.ac.id; riantini@gd.itb.ac.id

Abstract: Land cover in the Bandung Basin had been changed from the year 2006 to the year 2011. Those changes are spread unevenly in the Bandung Basin. This paper's problem is what kind of pattern that is formed by the distribution of land cover changes in Bandung Basin, whether it was clustered, randomly spread or even dispersed. This paper uses cluster analysis as an approach to solve that problem based on its spatial statistic. There are four methods of cluster analysis used to analyse the spatial pattern of that land cover changes. The test results from those methods show that the land cover changes has a clustered pattern. After the pattern is known, there are two others cluster analysis method that can be used to identify the cluster area that is formed by the land cover changes. As the result of those two tests, known that there are 18 clusters of land cover changes formed in Bandung Basin. Therefore, it can be concluded that the spatial pattern of land cover changes in the Bandung Basin using cluster analysis method is a clustered pattern, and there are 18 clusters of land cover changes spread in that basin.

Keywords: Spatial Pattern, Land Cover Changes, Cluster

DEVELOPMENT AND DISSEMINATION OF "*PETA JALUR MUDIK*" (HOMECOMING ROUTE MAP) IN INDONESIA

Soni Darmawan (1), Sumarno (1), Dewi Kania Sari (1), M.H. Danang (1), Kenny Anesya (1)

Geodesy Engineering Department, Faculty of Civil and Planning Institut Teknologi Nasional
PHH. Mustafa No. 23, Bandung 40124, West Java Indonesia
Email: Soni_darmawan@itenas.ac.id

Abstract: "Mudik" (homecoming) is an important part of Indonesian culture. It's that busy time, crowds and traffic jams of every year as millions of Indonesians are leaving the big cities to return to their hometowns and villages to celebrate Lebaran in the end of the holy month of Ramadan. In this case needed a material can be in the form of homecoming route map for planning the route to the hometowns and villages. There are many variations of homecoming route map that has been published by various institutions but without considering of source of map and cartography rules. The purpose of this study is to developt and disseminate homecoming route map which can be the homecoming trip to the hometowns and villages can be safe, comfortable, no crowds and no traffic jams. The methode including evaluation of data needed that will show on the homecoming route map, collecting of point of interest, development of geodatabase and GIS format, designing of cartography, reporting and dissemination. The result of this study has been created homecoming route map that was used people in Java and Bali Island.

Keywords : Geospatial Information, Tematic Map, GIS And Cartography.

LANDSLIDE HAZARD DISTRIBUTION AND ZONATION MAPPING USING GEO SPATIAL APPROACH – A CASE STUDY IN BADULLA DISTRICT, SRI LANKA

P.Kirishanthan (1), M.A.D. Samanmali (1)

[1] Department of Geography, University of Colombo, 00300, Colombo, Sri Lanka
Email: krishanth153@gmail.com

Abstract: Landslides are one of the common geomorphological hazards in Sri Lanka. Especially in the central parts of the island faced severe landslides in every year. It has significant adversely effect on lives, economy, environment, infrastructure, development, and growth of the country. Based on geographical distribution, most landslides appear to occur only in the Southern, Uva and Central province within the districts of Badulla, Nuwara Eliya, Kegalle and Rathnapura which are the most landslides prone districts having the highest incidences. Badulla is one of the most landslides prone district in Sri Lanka. The main objective of the present study was to analysis the geographical distribution of landslides occurrence in Budulla district and to develop landslide hazard zonation map of Hali Ela District Secretariat Division, Badulla using geospatial approach. Geo spatial and statistical approaches were followed for this study. Zonal statistical analysis tool was applied to generated map of geographical distribution of landslides occurrence and Normalized Landslide Index (NLI) was used to identify the risk area and to develop hazard map. LHZ map was developed based on relative influence of various causative factors namely lithology, geomorphology, land use and cover, slope, aspect and rainfall of the study area. The analysis of geographical distribution of landslide occurrence was identified that Bandarawela, Haldummulla, Hali Ela and Lunugala district secretariat divisions as high hazard areas, Passara, Ella and Uva Paanagama as moderate hazard and remained areas were falls under low or safe areas in Budulla district. The prepared landslide hazard zonation map revealed that 46.5% of the study area identified under very high hazard, 53.1% as high hazard, 0.19% as moderate hazard, 0.01% as low hazard, and the remain 0.2% as no hazards. Present study shows that the most of the areas in the Budulla district are more prone to landslides hazard. Thus landslide hazard zonation map would be useful to the local administrative bodies for hazard mitigation activities.

Keywords: Landslides, Hali Ela, Hazards Zonation

MANAGEMENT OF DISASTER MITIGATION IN HEALTH FACILITIES AT SUMATRA ISLAND BASED ON GIS ANALYSIS (CASE STUDY IN LAMPUNG)

Chusna Meimuna (1), Arliandy Pratama (2), Yoga Jatra (2), Achmad Ardy (3), Purnawan Junadi (1)

[1] Department of Public Health, University of Indonesia, Jl. Margonda Raya, Pondok Cina, Beji, 16424 Depok, Indonesia
[2] Department of Geomatics Engineering, Sumatera Institute of Technology, No. 13, Jalan Terusan Ryacudu, 35365 Lampung Selatan, Indonesia
[3] Dept. Agroechotchnology, Lampung University, Jl. Prof. Dr. Ir. Sumantri Brojonegoro No.1, Bandar Lampung, Indonesia
Email: chusna.meimuna@ui.ac.id

Abstract: Sumatra Island is one of the areas located in areas prone to the natural disaster, such as earthquake, landslide and tsunami. Sumatra is flanked by two main epicenter Great Sumatran Fault throughout of the Bukit Barisan and two subduction zones both the Indo-Australian Plate and the Eurasian Plate. The shape and location of the Sumatran fault and the active volcanic arc are highly correlated with the natural disaster in Sumatra. The aim of this research is how to improve the health facilities due to natural disasters by the GIS analysis in southern Sumatra Island. We have to know first a brief historical overview of disaster management planning, findings and show that they urge the field of disaster management to shift its focus from response and recovery to sustainable hazard mitigation. This paper discusses the use of the Geographic Information System (GIS) at the local level and the need for integrating the technology, human habits and indigenous knowledge into management of disaster mitigation in health facilities. The greatest potential for reducing -related deaths in health facilities is wider implementation of the current guidelines built around a few core activities: training, safety location and knowledge of disaster. This requires investment in human resources and in equipment for the optimal disaster mitigation management. It is important to provide data from a variety of disaster simulation for formal cost-effectiveness analyses. Improvements in the quality of disaster mitigation management can be a vehicle for overall improvements in local people health and safety-care practices.

Keywords: Disaster Mitigation, Management, Public Health, GIS

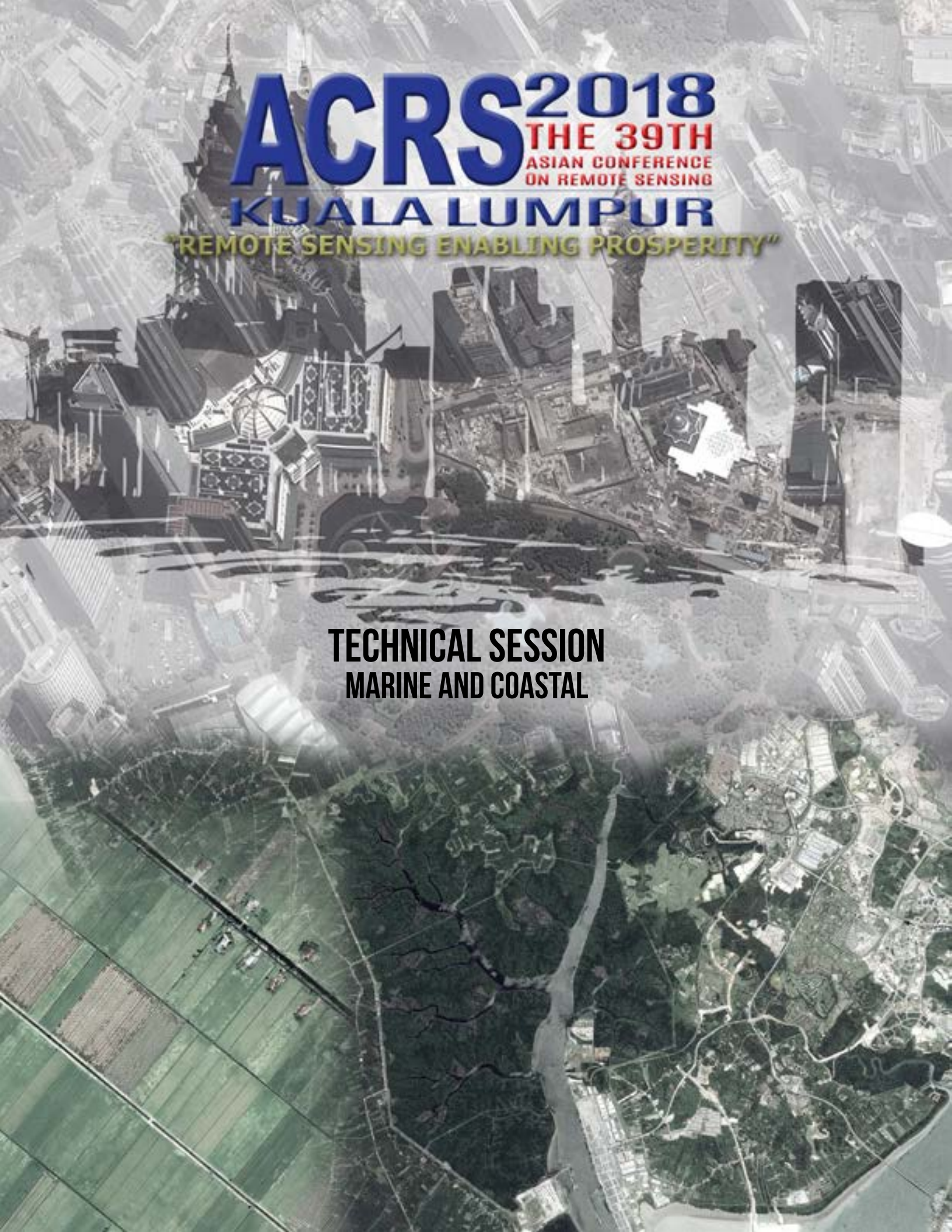
GEOGRAPHICAL CHARACTERISTICS OF THE CITY IN INDONESIA USING GIS-BASED SPATIAL PATTERN APPROACH

Dyah Lestari Widaningrum (1), Isti Surjandari(1) and Dodi Sudiana (2)

[1]Department of Industrial Engineering, Faculty of Engineering, Universitas Indonesia, Kampus Baru UI Depok, Depok 16424, Indonesia
[2]Department of Electrical Engineering, Faculty of Engineering, Universitas Indonesia, Kampus Baru UI Depok, Depok 16424, Indonesia
Email: dyah.lestari61@ui.ac.id; isti@ie.ui.ac.id; dodi@ee.ui.ac.id

Abstract: This study aims to discover the geographical characteristics of the city in Indonesia using GIS-based spatial pattern approach. The temporal analysis is conducted on several cities in Indonesia, primarily related to the population growth. Spatial analysis is also performed to explore the geographical characteristics of the city. There are three categories of data from three different sources that are using in this study: 1) district boundaries from Geospatial Information Agency of Indonesia; 2) public facilities location which is represented by POIs data from OpenStreetMap; 3) demographic data from Central Agency on Statistics of Indonesia. The density of the public facilities is estimated using the kernel density estimation (KDE) technique, using the heatmap plugin feature in QGIS. The contribution of this study is to provide an overview of the time series comparison between several cities in Indonesia. This study also clarifies an indication of the relationship between population density and the density of public facilities. Further study is needed to quantify this relationship. Thus this knowledge can be utilized as a foundation for city planning and business strategy development.

Keywords: Spatial Pattern, GIS, City, Public Facility



TECHNICAL SESSION
MARINE AND COASTAL

CYANOBACTERIA BLOOMS CAUSED BY AEOLIAN MINERAL DUST DEPOSITION ON THE SOUTHERN GREAT BARRIER REEF, AUSTRALIA FROM MODIS SATELLITE IMAGERY

Dien V. Tran (1)(2), Albert Gabric (1), Roger Cropp (1)

[1] Griffith School of Environment and Science, Griffith University, 170 Kessels Road, Nathan QLD 4111, Australia
[2] Institute of Marine Environment and Resources, Vietnamese Academy of Science and Technology 246 Da Nang Street, Hai Phong City, Vietnam
Email: vandien.tran@griffithuni.edu.au; dientv@imer.vast.vn

Abstract: Aeolian mineral dust input is thought to be a critical source of dissolved iron (dFe) for phytoplankton growth in some oceanic regions. Dust deposition has been considered a cause of coral reef demise in some sea regions. Several studies have shown a moderate correlation between the modelled flux of dust-derived iron and satellite-derived chlorophyll-a (Chl-*a*) in the Southern Ocean south of Australia and off the Queensland coast. However, there is no long term high resolution study on the influence of mineral dust deposition (and associated iron) on subsequent marine primary productivity and cyanobacterial blooms along the Queensland coast. Such an analysis is particularly relevant during the prolonged millennium drought of the 2000s in Eastern Australia when dust storm activity was above average. A simple binary method was applied to the selected MODIS Aqua images after the severe dust storms in October 2002 and September 2009 to detect if there was a presence of *Trichodesmium* blooms in the southern Great Barrier Reef (GBR) lagoon. *Trichodesmium* blooms were found in early November 2002 in Hervey Bay (off Bundaberg) and in late November 2002 off Rockhampton. A huge bloom was found in the southern GBR lagoon in late December 2002. *Trichodesmium* bloom was found a week immediate after the severe dust storm in September 2009 and subsequent huge blooms in next three months after the dust event. The blooms of *Trichodesmium* may reduce light penetration, increase nutrients and subsequent phytoplankton and macro-algal blooms. These blooms may lead to coral reef degradation and algal-coral phase shift in GBR.

Keywords: Dust Deposition, Dissolved Iron (Dfe), *Trichodesmium* Blooms, MODIS Satellite, Great Barrier Reef

GEOMORPHOLOGICAL MAPPING AND ENVIRONMENTAL ZONING APPROACH TO COASTAL MANAGEMENT IN HAVELOCK ISLAND, SOUTH ANDAMAN, INDIA

Anurupa Paul (1), Dr. Jatisankar Bandyopadhyay (1), Dr. Ashis Kumar Paul (2)

[1] Department of Remote Sensing and GIS, Vidyasagar University, Midnapore-721102, West Bengal, India
[2] Department of Geography and EM, Vidyasagar University, Midnapore-721102, West Bengal, India
E-mail: anurupapaul2017@gmail.com; jatib@mail.vidyasagar.ac.in; akpaul_geo2007@mail.vidyasagar.ac.in

Abstract: Havelock Island of South Andaman District is located as the part of Archipelago group of Andaman Formations with the distinct geomorphological units, mostly covered by forests and fringed by wide shore platforms and coral banks in Andaman Sea. Geomorphologically, the island units may be categorized as coastal hill ranges of limestone, calcareous sandstones, claystones and mudstones; intermontane valleys and valley flats; coastal wetlands; reef terraces; promontories, headlands, cliffs, embayments and shore platforms; occasional sea beaches and shore fringed coral banks. The carbonate sediments are widely distributed in the shore platforms and associated reef terraces of the island. Thicker alluviums are only available along the intermontane valleys and valley flats, and in the wetlands around the fringe of a few drainage channels fed by hill streams and salt water inflows of tides. Forests of the island surface units are classified as mangrove and marshes, littoral vegetations, moist deciduous, semi-evergreen and evergreen vegetations. From the sections of exposed ill cliffs it is visible that rocks of Neogene formations are jointed, tilted, fractured and faulted with products of weathered debris and soils under Tropical Marine Environment. The hill slopes without forest cover areas are vulnerable to soil erosion under heavy rain in the prevailing North-east and South-west monsoon of the humid tropics. Settlement habitation started in valley flats and shore fringes in the decade of 1970's to reclaim the lands for further habitation, vegetable gardening and plantation, but expanded tourism activities with infrastructure development after tsunami year (2004) the present island become exposed to visitors pressures for attractive destination sites (scenic hills, forests, seashores and coral banks). The present paper discuss about the significance of geomorphological mapping, forest mapping and environmental zoning approach to the coastal management particularly for the vulnerable parts of the island for its sensitivity to tropical rainy and marine environments. Detail mapping of geomorphological units, forest types and zonation, temporal land use – land cover changes and environmental zoning classifications using geospatial techniques will be useful output for the coastal managers to develop the island units in a sustainable manners against the expanding tourism pressures at present.

Keywords: Carbonate Sediments, Environmental Zoning Map, Forest Mapping, Geomorphological Mapping, Tropical Marine Environtment

PROJECTING CHANGES IN COASTAL MORPHOLOGY BY SATISFYING PREREQUISITE CONDITIONS OF SLAMM SOFTWARE IN CONTEXT OF SUNDARBAN

Anasua chakraborty (1), Kankana chakraborty (1), Dr. Navendu chaudhary (2)

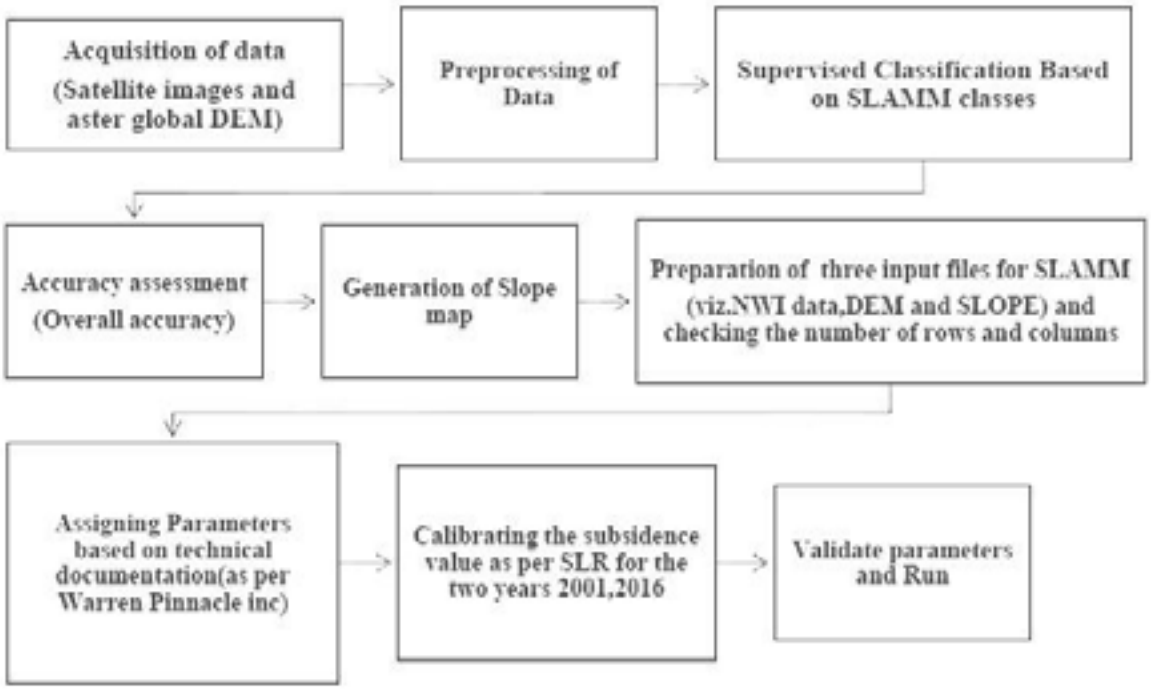
[1] Symbiosis institute of geoinformatics, symbiosis international university, 5th and 6th floor, atur centre, gokhale cross road, model colony, Pune –, 411016, Pune, Maharashtra 411016
[2] Symbiosis institute of geoinformatics, symbiosis international university, 5th and 6th floor, atur centre, gokhale cross road, model colony, Pune –, 411016, Pune, Maharashtra 411016
Email: anasua40chakrborty@gmail.com; ckankana1995@gmail.com

Abstract: The Sea Level Affecting Marshes Model (SLAMM) is a platform designed for the micro tidal regions which is used to simulate the dominant processes involved in wetland conversions and shoreline modifications during long-term sea level rise.

Objective:

- To see the change in coastal area of Sundarban along with the SLR using Landsat for the year 2001 and 2016. SLAMM is used to speculate the change of the area and predict its further level of changes up to the end of 21$_{st}$century.
- The principle aim of this project is to analyze the applicability of a platform called SLAMM or Sea Level Affecting Marshes Model to predict the changes related to the different kinds of ecosystems in the Sundarbans with the eustatic rise in sea level.
- Attempt has been made to create the morphological changes to the ecosystems up to the year 2016 using SLAMM.

Methodology:



Results and Discussions:
The results were appreciable. It portrayed an erosion of around 1 sq.km at a subsidence rate of 5 mm/year which is approximately equal to the original scenario. However, SLAMM failed to depict any depositional changes associated with the estuarine sand. The effect of coastline changes on the tidal range can be taken as an example. However, it can be said that SLAMM on a period of 20 to 30 years can give appreciable results for the Sundarbans. This will reveal the potential areas of erosion and as such can help us to take precautionary measures to protect an island.

Conclusion:
The results were satisfactory provided we have the required data for the region. If we are provided with the varying subsidence rates within the region, SLAMM can project some appreciable results in the case of erosion. However, it fails to depict depositional changes. On a period of 20 to 30 years can give appreciable results for a dynamic region like the Sundarbans effect of coastline changes on the tidal range can be taken as an which will reveal the potential areas of erosion and can help as precautionary measures to protect an island.

Keywords: Sea Level Affecting Marshes Model (SLAMM), Sea Level Rise (SRL), National Wetlands Inventory (NWI) from US Fish and Wildlife Service, High Definition Digital Elevation Model (HD DEM)

GIS-BASED SUITABILITY ANALYSIS ON HYBRID RENEWAL ENERGY SITE ALLOCATION USING MODIS AND ASTER SATELLITE IMAGERIES IN PENINSULAR MALAYSIA

Hossein Mojaddadi Rizeei (1), Biswajeet Pradhan (1)

[1]School of Systems, Management and Leadership, Faculty of Engineering and IT, University of Technology Sydney, CB11.06.217, Building 11, 81 Broadway, Ultimo NSW 2007, Australia
Email: biswajeet24@gmail.com; Biswajeet.Pradhan@uts.edu.au

Abstract: Renewable Energy (RE) is widely accepted as a major economic growth sector that can address energy security besides reducing greenhouse gas emission and mitigate climate change. Solar panel and wind turbine are primary sources of RE which have attracted the authorities' attention as a cleaner alternative to fossil fuels. Establishment of multi-purpose RE site where solar panel and wind turbine are implemented together, is the efficient method to reduce the cost of energy distribution, site maintenance and labour force. However, allocation of the most suitable land that has high magnitude of solar irradiance and wind power at the same time, is a challenging issue. This study attempts to find the most suitable place to establish RE site in Malaysia where richly endowed with resources such as diverse form of biomass and solar energy. We used Satellite-derived solar irradiance estimation which is useful and accurate approach for solar resource calculation. To do so, MODIS Terra and Aqua satellite were assessed to extract values of Aerosol Optical Depth (AOD) at 550 nm, water vapor column and angstrom alpha advocate. Additionally, sixteen different metrological stations were utilized to calibrate the solar irradiances achieved from MODIS satellite and provide daily wind data over the entire Peninsular Malaysia. Subsequently, other related contribution factors were derived from ASTER satellite imagery; including, duration of solar radiation, altitude, distance from roads, distance from Rivers, land use/land cover. Support vector machine (SVM) algorithm was applied to develop the hybrid RE suitability model. MODIS solar irradiance results showed a high coloration with field observation. The result of hybrid RE suitability analysis revealed that coastal areas of Hulu Terengganu and Kedah, have high potential for allocating RE sites. This country scale research can be used as a guidance/preliminary assessment to narrow down the scope of new potential hybrid RE in reginal scale.

Keywords: Hybrid Renewal Energy, Country Scale, Suitability Analysis, MODIS and ASTER Satellite Images

SEMI-EMPIRICAL APPROACH ON SIGNIFICANT WAVE HEIGHT MEASUREMENT ON THE TRANSITIONAL WATER USING SENTINEL-1 SAR

Fabian Surya Pramudya (1)(4), Jiayi Pan (1)(2)(3), Adam Thomas Devlin (2)

[1] Institute of Space and Earth Information System, The Chinese University of Hong Kong
[2] School of Marine Sciences, Nanjing University of Information Science and Technology, Nanjing, Jiangsu, China
[3] Shenzhen Research Institute, The Chinese University of Hong Kong, Shenzhen, Guangdong 518057, China
[4] Centre for Remote Sensing, Institute of Technology, Bandung, Indonesia
Email: fabian.surya@link.cuhk.edu.hk; panj@cuhk.edu.hk; adam_devlin@cuhk.edu.hk

Abstract: As the waves propagate closer to the shoreline, the decreasing water depth may result a bottom drag effect, causing changes on wave propagation mechanism, including the wave shape. In the transitional waters, known as the areas between the deep and shallow waters, the linear wave theory is widely used to describe the hyperbolic increment of wave height. Sentinel-1 SAR system is one of the most recent satellite system known for its capability of resulting a robust estimation of the Significant Wave Height (H_S). Yet, the estimation performs inferior on the transitional and shallow water. We improved a previously developed a semi- empirical algorithm to estimate a transitional water, by integrating the in-situ bathymetric information with the state of the art parameters such as azimuth cut-off wavelength, peak of dominant wavelength, and the wave propagation deviation from the radar-looking direction. We also proposing the utilization of cross-polarization to enhance the wave pattern contrast on the co- polarization. To improve the dominant wavelength peak on the two dimensional wave spectra, adaptive statistical fitting and parameterized median filtering method are applied ensures a statistically robust determination of the filtering parameter, resulting in a higher contrast SAR image that allows clearer wave patterns and more efficient dominant wave peak identification. The bathymetric and standard meteorological information from National Buoy Data Centre (NDBC) measurement buoy are used in development of the semi-empirical model, from the water depth input through validation process. This research employs Level-1 GRD Sentinel-1A SAR around Hawaii water for the open-water scenario, and the Channel Islands on the West Coast of the USA for the transitional water scenario, for the year of 2017. Extreme sea states are not considered due to the limitation of our algorithm, image repository and buoy data availability.

Keywords: Significant Wave Height, Semi-Empirical Algorithm, Azimuth Cut-off Wavelength, Transitional Waters

THE RELATIONSHIPS BETWEEN MANGROVE ZONATION DYNAMICS AND SEA LEVEL CHANGE IN THE DEEP BAY AREA

Mingfeng LIU (1)(2), Hongsheng Zhang (1)(2), Hui Lin (1)(2)

[1] Institute of Space and Earth Information Science, The Chinese University of Hong Kong, New Territories, Hong Kong, 999077, China
[2] Shenzhen Research Institute, The Chinese University of Hong Kong, Shenzhen, 518000, China
Email: mingfengliu@link.cuhk.edu.hk; stevenzhang@cuhk.edu.hk; huilin@cuhk.edu.hk

Abstract: Zonation of in mangrove forest has often been formed through different responses of each mangrove species to the spatial variation of environmental and biotic factors in intertidal zone. However, the complex mechanism that influence the zonation pattern is still not clearly understood. Water depth and duration of inundation have been proven to exert a primary control on mangrove species establishment in the costal wetland ecosystems by previous studies. Hydroperiod, or the duration of inundation, is an important driven factor to form the zonation pattern of a mangrove community. Since sea level change will significantly influence hydroperiod in intertidal zone, in this paper we aimed to quantify how sea level change influenced mangrove zonation in the Deep Bay area in the past 26 years. Time series zonation pattern of mangrove forest in the Deep Bay area were mapped based on SPOT-1, 4, 5, QuickBird-02, GE-02, and WordView-02, 03 data from 1991 to 2017 including three types of native dominant mangrove species: *Kandelia obovate, Avicennia marina* and *Acanthus ilicifolius*. Spatial features of mangrove zonation pattern in each selected year were analyzed through Standard Deviational Ellipse (SDE) spatial analysis method and several landscape metrics. The annual mean high tide level, annual mean low tide level and annual mean tide range were calculated by Pearson correlation coefficient with mangrove zonation spatial features, and a linear regression model was used to calculate the relationship between sea level indicators and mangrove spatial index.

Keywords: Remote sensing, Mangroves, Zonation, Sea level, Hydroperiod

MODELING COASTAL SALINITY SUSCEPTIBILITY IN BENTOTA, SRI LANKA

T.K.G.P. Ranasinghe (1) and R.U.K. Piyadasa (2)

[1] Department of Town and Country Planning, Faculty of Architecture, University of Moratuwa, Katubadda, Moratuwa, Sri Lanka
[2] Department of Environment Technology, Faculty of Technology, University of Colombo, Sri Lanka
Email: gayaniprasadika@gmail.com; ranjana@geo.cmb.ac.lk

Abstract: Coastal salinity defines as the salinity condition, which is resulted by seawater intrusion in coastal areas. Salinization in coastal land is the one of the major symptoms of the problem of pressure on land resources due to increasing trend of climate change and sea level rise. Seawater intrusion is increasing in Bentota area, Sri Lanka while diminishing the land productivity which yielding poor food production and making several socio economic issues for the community in the area. Modeling coastal salinity susceptibility based on the future scenario of climate change is essential to avoid further land degradation. The level of coastal salinity susceptibility in Bentota area was evaluated based on two climate change scenarios. The temporal and spatial distributions of five parameters of soil (moisture, EC, pH, chloride, nitrate) and eleven parameters of ground water and surface water (pH, EC, TDS, DO, chloride, nitrate, sulfate, calcium, magnesium, sodium and SAR) were monitored considering the sample data collected from July 2016 to June 2017 and analyzed applying Arc GIS software. Water quality was assessed in terms of index based on the standards of World Health Organization. Soil parameters were reclassified in to respective salinity classes based on acceptable standards. Spatial distribution of soil salinity, ground and surface water quality were integrated using weighted overlay technique to determine level of coastal salinity. The multi-criteria evaluation approach was used in weighted overlay analysis. Using a pairwise comparison matrix in Analytic Hierarchy Process, the weight values for each soil parameters and coastal salinity factors were calculated by comparing two parameters with each other for their relative importance in evaluating the coastal salinity susceptibility. Results of this analysis vigorously indicate that highly salinized, moderately salinized and slightly salinized land extent with respect to the total land extent were 3.4%, 39.6% and 57% respectively being entire area is facing the threats of seawater intrusion and coastal salinity effects by year 2025. This salinity susceptibility model will facilitate for the spatial planning of future land use of this area by providing guidance to local authority in the process of allocating salinized lands for development activities.

Keywords: Sea Level Rise, Coastal Salinity

DISCRIMINATING SEAGRASS DENSITY FROM SATELLITE IMAGERY USING PIXEL AND OBJECT BASED CLASSIFICATION METHOD ON SMALL ISLAND, SPERMONDE ARCHIPELAGO-INDONESIA

M Safah Thalib (1), Nurjannah Nurdin (1)(2), Sarah Hamylton (3)

[1] Research Center for Regional Development and Spatial Information, Hasanuddin University, Jl.Perintis Kemerdekaan km.10, Makassar, 90245. Indonesia.
[2] Department of Marine Science, Hasanuddin University, Jl. Perintis Kemerdekaan 10, Makassar, 90245, South Sulawesi, Indonesia
[3] GeoQuest Research Centre, Faculty of Science, Medicine and Health, University of Wollongong, Australia.
Email: msafahthalib@gmail.com; nurj_din@yahoo.com; shamylto@uow.edu.au

Abstract: Remote sensing technology provides a reliable means of creating an inventory of coastal natural resources to assist with their management. The purpose of this study was to discriminate seagrass density using medium and high-resolution satellite imagery. The field survey was conducted on Bahuluang island, Spermonde archipelago. Imagery of Sentinel-2A as medium resolution (10 m) and SPOT 6 as high resolution (1.5 m) were used to discriminate the seagrass. Both pixel-based (k-Means) and Nearest Neighbour objected based classification method. Ware applied, employing multiresolution segmentation, using seagrass patch scale, shape, and compactness. Pixel-based classification methods provides better overall accuracy than object-based classification and can be used as a reference for seagrass mapping in the Spermonde Archipelago. However, it is necessary to conduct a more detailed assessments for sites at different water depths.

Keywords: SPOT 6, Sentinel-2A, Lyzengga, Seagrass, Spermonde

OBSERVING THE LIVELIHOOD OF SEA NOMADS USING MULTI TEMPORAL COASTAL WATER QUALITY

Dewayany Sutrisno (1), Ati Rahadiati (2)

[1] Geospatial Information Agency, Center for research, promotion and cooperation
Jalan Raya Jakarta Bogor Km 46 Cibinong, Indonesia
[2] Bogor Agricultural University, IPB Graduate School Jalan Raya Darmaga, Bogor, Indonesia
Email: dewayany@gmail.com; arahadiati@gmail.com

Abstract: The development of human socio-economic activities sometimes has a major impact on the sustainability of natural and cultural heritage. One of the most visible cultural heritages is the shifting livelihood of sama-bajau, the sea nomads, which is highly correlated with the availability of marine natural resources in the vicinity. Remote sensing is one tool that can provide initial information related to the sustainability of natural resources and a group of people, in this case the sama-bajau, whose lives are dependent on these marine resources. Therefore, this paper aims to discuss the correlation between natural resources and the shifting livelihood of the sama-bajau. The multi remote sensing analysis included ocean colors, water change detections, lyzenga and image fusion was used for the coastal water observation. Meanwhile, the socio-economic analysis from the sama-bajau was assessed base on visual interpretation of multi temporal remote sensing data and field data survey analysis. The coastal area of Southern Konawe district – Southeast Sulawesi province, Indonesia was selected as the study case. The result of the study illustrates the livelihood of the sama-bajau that depend on the quality of the sea waters, which shifting form capture fisheries to marine culture to capture fisheries as the majority source of living.

Keywords: coastal water, remote sensing, sama-bajau, livelihood, earth observation, marine culture

ACCURACY ASSESSMENT OF BATHYMETRY MAPPING FROM LANDSAT 8 FOR MAPPING PURPOSE: CASE STUDY OF PORT KLANG

Kasypi Mokhtar (1), Mohd Azhafiz Abdullah (2) Jasrul Nizam Ghazali (3)

[1] School of Maritime Business & Management, University Malaysia Terengganu, 21300, Kuala Nerus, Terengganu, Malaysia
[2] School of Marine Science & Environment, University Malaysia Terengganu, 21300, Kuala Nerus, Terengganu, Malaysia
[3] Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, 18500, Kelantan
Email: kasypi@umt.edu.my; azhafiz88@gmail.com

Abstract: Bathymetry is the science of determining the topography of the seafloor. Bathymetry data has been widely used in various applications such as to generate navigational charts, seafloor habitat mapping and seafloor profile. A number of methods are available for determining ocean bathymetry, using either active sensor such as sound navigation and ranging (SONAR), Light Detection and Ranging (LIDAR) or passive multispectral imagery such as Ikonos, WorldView and Landsat. While determining the bathymetry from SONAR, LiDAR, Ikonos, Quickbird and Worldview are comparatively expensive, Landsat provides a free and global coverage of satellite imageries that can be used for generating bathymetry data together with in situ data. Therefore, the present study makes an attempt to produce bathymetry map of the Port Klang using Landsat imageries. The band ratio a technique of the blue and green bands of Landsat 8 data has been used. The statistical indices, the coefficient of determination and Root Mean Square Error (RMSE) were used to evaluate the accuracy of the bathymetry derived from Landsat and the hydrographic chart sounding value. The result shows a good correlation with hydrographic chart sounding value data ($R^2 = 0.960$) .This research provides us with an insight of the capability of Landsat imagery in detecting bathymetry information in Port Klang.

Keywords: Bathymetry Mapping, Landsat 8, Satellite-derived Bathymetry, Remote Sensing

REMOTE SENSING MODELS USED FOR MAPPING AND ESTIMATION OF BLUE CARBON BIOMASS IN SEAGRASS-MANGROVE HABITATS: A REVIEW

Dalhatu Aliyu Sani (1)(2)(3), Mazlan Hashim (1)(2), Mohamad Shawkat Hossain (4)

[1] Geoscience & Digital Earth Centre (INSTEG), Research Institute for Sustainable Environment (RISE), Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[2] Faculty of Geoinformation &Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[3] Department of Geography, Yusuf Maitama Sule University, Kano, Nigeria
[4] Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia
Email: mazlanhashim@utm.my

Abstract: Blue carbon ecosystems (seagrasses, mangroves and salt marches) play important role in the global carbon cycle. This makes them crucial and as such, more attention should be paid to these ecosystems. Recent studies revealed that remote sensing system has been utilised to map and estimate seagrass-mangrove biomass over large areas to circumvent time consumption and excessive cost of conventional techniques. Several remote sensing models have been successful applied for detecting seagrass-mangrove biomass and carbon. In this article, acoustic remote sensing and models with their strength, limitations and location applied were reviewed to enable users have the holistic view of their competences. While the recent advancements in seagrass-mangrove biomass estimation using remote sensing, techniques were also investigated. Thus, achievements and gaps in the research domain were likewise highlighted in the article with a view to presenting the future prospects in suitable remote sensing models for mapping and estimating seagrass and mangrove biomass, and other biophysical parameters towards realising the United Nations Sustainable Development Goals (SDG 14).

Keywords: Blue carbon, acoustic methods, remote sensing, water column correction, seagrass, mangrove

PARETO OPTIMAL SOLUTION FOR DETECTION OF MH370 DEBRIS USING REMOTE SENSING SATELLITE DATA

Maged Marghany (1)

[1] School of Humanities, Geography Section, Universiti Sains Malaysia,
11800 USM Penang, Malaysia
Email: magedupm@hotmail.com

Abstract: Regardless of the superior area, marine, and communication technologies, the mystery of the Malaysia Airline flight MH370 cannot be explicated. Excluding twelve countries that allied for the search and rescue efforts of missing the flight MH370 on March 8th, 2014, it is very sophisticated to analyze the dramatic situation of the flight MH370 that non-existent from secondary microwave radar. The core objective is to develop a multi-objective optimisation via Pareto dominance to scale back the uncertainties for the debris automatic detection in satellite information like China satellite. Additionally, multi-objective optimisation, supported the genetic algorithmic rule is developed to forecast the debris flight movements from Perth, west of Australia i.e. the crashed claimed space. The Pareto optimization proved that within a water depth of 3000 m the remain debris of 60% of total debris would sink down with highest cumulative percentage of 95%. As the debris would undergo the impacts of turbulent across the Southern Indian Ocean. Moreover, The detritus has been found in Réunion Island do not seem to belong to MH370. In fact, the detritus would sink below the ocean surface of 3000 water depths at intervals less than a few months as explained above. It can be said that the flight MH370 detritus can doubtless travel up to 50 km/day with massive eddies of a dimension of 100 km wide.

Keywords: Multi-objective algorithm. Pareto optimization, Indian Ocean circulation, MH370 flight, debris.

CHARACTERISTIC ANALYSIS OF WIND SPEED AND WAVE HEIGHT USING JASON-2 ALTIMETRY SATELLITE DATA (STUDY CASE: KARIMATA STRAIT)

Yohana Christ Threcia H. (1), Soni Darmawan (1)

[1] Geodesy Engineering Department, Faculty of Civil Engineering and Planning,
Institut Teknologi Nasional
No. 23, Jalan P.K.H. Mustopha, Neglasari, Cibeunying Kaler, Bandung, Jawa Barat 40124
Email: threcia.hutabarat@gmail.com; soni_darmawan@yahoo.com

Abstract: Indonesia is a geographical country located between Asia and Australia, also between the Indian Ocean and the Pacific Ocean. Indonesia's strategic position makes Indonesia as a country that is on international cruise lines, one of which is the Karimata Strait. However, in the safety and cruise safety levels there are some less 1avourable physical condition parameters, such as wind speed and wave height. Using data from altimetry satellite recordings, information about comfort and safety levels of the voyage can be obtained quickly and easily. This research aims to determine the accuracy of data from the results of satellite altimetry Jason-2 recording and to determine the characteristics of wind speed and wave height using Satellite Altimetry Jason-2 data. The data were GDR (Geophysical Data Record) Satellite Altimetry Jason-2 in 2016 pass 64, 153, 229, 242. The data was then exported into txt format in order to perform process of data quality control based on the provision of data quality control satellite altimetry. Unqualified data was not used. Further, the qualified data was used to calculate the wind speed and wave height monthly. The results were then classified according to Beaufort Scale to determine the level of safety and comfort in the cruise in Karimata Strait. The next process was validating satellite altimetry data using wind speed and wave height data from Meteorology, Climatology and Maritime Geophysics Agency (BMKG Maritim). Through this research, Jason-2 Satellite Altimetry accuracy information was obtained in measuring wind speed and wave height in Karimata Strait, those were 2.41 m / s for wind speed and 0.42 m for wave height. In addition, through this research can be seen that the Karimata Strait in 2016 was on a scale of 3 to 5 Beaufort Scale. This scale means that generally the wind speed and wave height conditions were in a safe condition to be passed as a cruise line.

Keywords: wind speed, wave height, Satellite Altimetry Jason-2, BMKG, Beaufort Scale

ASSESSMENT OF WAVE RENEWABLE ENERGY IN MALAYSIA FROM SATELLITE ALTIMETRY: ISSUE AND CHALLENGE

Nurul Hazrina Idris (1)(2), Marith Banati Barata (1)

[1] Tropical Map Research Group, Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 Skudai, Malaysia
[2] Geoscience and Digital Earth Centre, Research Institute for Sustainability and Environment, Universiti Teknologi Malaysia, 81310 Skudai, Malaysia
Email: nurulhazrina@utm.my; marithbanati@gmail.com

Abstract: Malaysia is a developing country which is rising in the electricity demand with increasing the urbanization and rapid industrialization. To date, various resources of renewable energy had been used in Malaysia such as biomass, solar and hydro energy for power generation. Yet, Malaysia still left far behind in the wave optimization for the similar purpose. The potential of this eco-friendly and unlimited resources had been explored by several researchers in Malaysian seas. The assessment of the wave energy potential has been explored using various technologies including from the ocean modelling system, the field measurement of buoys, and satellite altimetry data. Of the technologies, satellite altimetry offers comprehensive assessment due to the advantages of the spatio-temporal data. However, several issues arose when using satellite altimetry for wave renewable energy resource assessment. The issues can be categorised into two:1) the accuracy of satellite altimetry data for coastal oceans; and 2) the modelling of wave energy from satellite altimetry data. A precise and accurate significant wave height data is a vital component in the assessment of wave energy production in Malaysia. Although satellite altimetry offers spatio-temporal coverage of data, it suffers from data loss due to land contamination. Conventional satellites were have made with large size of footprint (about 7km) to detect the pattern of the ocean waveform signals. This affects the estimation of significant wave height in coastal zones, where the altimetric signals are corrupted by the simultaneous view of both oceans and lands. An accurate and appropriate wave energy model that fit the physical characteristic of coastal waves need to be identified. Issues occur in the coastal areas where the waves start to break and lose their energy constantly due to the changes of bathymetric, thus affecting the wave energy assessment. These issues and challenges will be further discussed comprehensively in this paper.

Keywords: Satellite Altimeter, Wave Energy, Malaysian Seas

EVALUATING THE EFFICIENCY OF PLEIADES AND SPOT 6 MULTI-SPECTRAL FUSION IMAGE FOR MAPPING CORAL REEF SUBSTRATES IN SELINGAN ISLAND, SABAH, MALAYSIA

Hazil Sardi Soliano (1) Roslinah Samad (1), Shimatun Jumani Ibrahim (1), Md. Nazri Safar (1)

[1] Malaysian Remote Sensing Agency, Ministry of Energy, Science, Technology, Environment and Climate Change, No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: roslinah@remotesensing.gov.my; shimatun@remotesensing.gov.my; nazrisafar@remotesensing.gov.my; hazil@remotesensing.gov.my

Abstract: Mapping coral reef substrate using traditional ground base method is inefficient and very costly. However, satellite remote sensing is one of the technologies that have the potential to map accurately the distribution of coral reef substrates at landscape scale. On the basis that different coral reef substrates has distinctive optical properties, the spatial component of the coral reef can be delineated using high resolution of satellite imagery. Coral reef diversity has rapidly degradating over the last decade so the need for an accurate distribution coral reef substrates map is very important for better planning, management and monitoring of coral reef area. The objective of this study was to determine and compare the accuracy of coral reef substrate classification between multi-spectral and fusion image of Pleaides and SPOT 6 data. Multispectral data of high resolution satellite imagery Pleaides (2 meter resolution) and SPOT 6 data (6 meter resolution) were used in this study. Several enhancement techniques such as radiometric correction, atmospheric correction, water column correction and sun glint correction were applied to the individual of Pleaides and SPOT 6 multi-spectral and fusion images. The enhanced imageries then were classified using maximum likelihood classification in order to generate coral reef substrates map. The accuracy of each coral reef substrates classification map then were derived from the accuracy assessment for each classification. In this study, coral reef substrates which surrounding Selingan Island were classified into nine classes namely live coral, dead coral, rubble, mix dead coral with live coral, mix dead coral with rubble, mix rubble with live coral, mix sand with live coral, rock and sand. High accuracy of coral reef substrates classification map that generated from this study can be used by the user agency in the planning, management and monitoring of coral reef areas efficiently.

Keywords: Coral Reef Substrates, Radiometric Correction, Fusion Image, Classification, Accuracy Assessment

SUSPENDED SEDIMENT CONCENTRATION MAPPING AT TEMENGGOR LAKE USING LANDSAT-8 TM DATA

Hamzah Mohd Ali (1), Abd Wahid Rasib (1), Nur Amalina Aminuddin (1), Othman Zainon (1), Rozilawati Dollah (2), Abdul Razak Mohd Yusoff (1), Khairulnizam M.Idris (1)

[1]TropicalMap Research Group, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia.
[2]School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia.
Email: abdwahid@utm.my

Abstract: Sediment is a natural occurring material that is broken down by the process of climate and soil erosion whereby transported by the action of wind, water or by the force of gravity acting on the particles. From the satellite data, the total concentration of suspended sediment in the inland water able to be mapped using remote sensing technique processing. Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and therefore not comparable to in-situ observations. In modern usage, the term generally refers to the use of aerial sensor technologies to detect and classify objects on earth by means of propagated signals. In this study, Landsat-8 TM satellite image is used in determining the concentration of suspended sediment at Temenggor Lake, Perak. Remote sensing techniques is used in processing and analysing the correlation of data sampling and satellite data, respectively. This study indicates that band 2 of Landsat-8 TM able to show the good correlation from polynomial equation at $R^2 = 0.54$ in determining the suspended sediment concentration at Temenggor Lake. This study concluded that Landsat-8 TM is able to map the concentration of suspended sediment in inland water at Temenggor Lake.

Keywords: Suspended sediment, Temenggor Lake and Landsat-8 TM

FLUORESCENCE ANALYSIS FOR CHLOROFILL-A DETECTION IN MAHAKAM DELTA, INDONESIA

Elland Y. Sobhytta (1), Susanna Nurdjaman (1)

[1] Oceanography Department, Faculty of Earth Science and Technology, Bandung Institute of Technology, No. 10, Jl. Ganesha, 40132 Bandung, Indonesia
Email: elland.yupa82@gmail.com; susanna@fitb.itb.ac.id

Abstract: Delta Mahakam is one of the water regions in Borneo that experienced considerable sedimentation especially the coastal area which is the area of Case II Water. As a result it causes inaccuracies in the detection of chlorophyll-a from satellite. This is due to sediment and chlorophyll-a having the same light spectrum, which is green-blue, therefore using satellite fluorescence as an alternative way of detecting chlorophyll-a is better. In this study, we use fluorescence data in the form of NFLH (Normalized Fluorescence Line Height) Level 3 AquaMODIS data with resolution of 4 km (monthly) throughout the year 2015. From this research, it appears that there is a temporal relationship between the spread of fluorescene with chlorophyll- a. This is due to the unique fluorescence properties that only chlorophyll-a has. Temporally, areas close to the coast (Case II Water) have a high fluorescence and chlorophyll a correlation, while the point that is far from the coast and has a depth of more than -2000 m has a small correlation. During the rainy season, in January to March there is an increase of concentration from chlorophyll-a sensor compared with chlorophyll-fluorescence concentration. This is due to the number of sediments entering the waters and the water column stirring. Fluorescence is good enough in detecting chlorophyll-a without being disturbed by sediment especially during the rainy season and in the Case II Water area. Fluorescence is influenced by several factors, such as rainfall and PAR. The correlation value of a fluorescence and rainfall is > 0.4 in the estuary area whereas the correlation with PAR has negative value for the area along the coast.

Keywords: NFLH, Case II Water, Aqua-MODIS, Fluorescence, Chlorophyll-a

AN EVALUATION OF LANDSAT 8 IMAGERY FOR MAPPING ON SHALLOW WATER USING STUMPF & HOLDERIED ALGORITHM (CASE STUDY: COASTAL WATER OF NARUSSALAM DISTRICT, EAST ACEH REGENCY)

Maulia Mahirani (1), Soni Darmawan (1)

[1] Geodesy Engineering Department, Faculty of Civil Engineering and Planning, Institut Teknologi Nasional, No 23, Jalan P. K. H Mustopha, Neglasari, Cibeunying Kaler, Bandung, Jawa Barat 40124
Email: maulmhrn@gmail.com; soni_darmawan@yahoo.com

Abstract: Bathymetry mapping is conducted to produce some depth water information. The data of depth was obtain by measurement of directly to field across Indonesia takes time and high costs. Therefore, there is an alternative for doing bathymetry mapping shallow water to save time and money that is by using remote sensing. Technology remote sensing meant is to use Landsat 8 imagery. But this needs to be re-tested according to the charactheristics of the waters and tried to how accurate it is adjusted to the local area. The purpose of this research is to give a depth of the shallow water in be based on the image processing by using Stumpf & Holderied algorithm and to knows thoroughness Landsat 8 imagery for mapping bathymetry shallow waters. The research study area is located in Coastal Water of Narussalam District, East Aceh Regency. The research methodology consisted of collecting Landsat 8 image data, radiometric calibration, pan sharpening, cropping area, masking, application of Stumpf & Holderied algorithm and validated the result from image processing with data in situ. This study shows that the Landsat-8 Satellite Imagery has the potential to extract bathymetry information with vatiations of depth 0, 2, 5, 8, 10, 15 and 20 m. The coefficient of determination produced is 0,918 which means that the correlation between field data and image data is included in the category of very strong correlation. And by using linear model in Stumpf & Holderied algorithm on Landsat-8 Imagery there is errors obtained at depth intervals 0-5 m is 2,45 m, depth intervals 5-10 m is 3,79 m, depth intervals 10-15 is 2,37 m, depth intervals 15-20 is 4,11 m, depth intervals 20-25 m is 7,81 m, depth intervals is 25-30 is 12,13 m and depth intervals 30-35 m is 16,98 m.

Keywords: Remote Sensing, Optic Imagery, Shallow Water, Satellite Landsat-8, Stumpf & Holderied Algorithm

MANGROVE DETECTION USING UAV-MODIEFIED NIR SENSOR

Nurul Khakim (1), Muh Aris Marfai (2), Ratih Fitria Putri (2), Muhammad Adnan Shafry Untoro (1), Raden Ramadhani Yudha Adiwijaya (1), Taufik Walinono (3)

[1] Department of Geographic Information Science, Faculty of Geography, Universitas Gadjah Mada, Indonesia
[2] Department of Environmental Geography, Faculty of Geography, Universitas Gadjah Mada, Indonesia
[3] Planning and Management of Coastal Area and Watershed, Faculty of Geography, Universitas Gadjah Mada, Indonesia
Email: nurulk@ugm.ac.id

Abstract: Mangrove ecosystem is a natural resource that can be beneficial for the coastal community. One of its benefits is it can be used as an eco-tourism spot such as Baros Mangrove Conservation Area in Kretek, Bantul. Hence, mangrove ecosystem must be conserved or expanded if possible. The first step to conserving mangrove ecosystem is to map its existing condition. Unmanned Aerial Vehicle (UAV) can be used to acquire a high-resolution imagery quickly. With modified near-infrared (NIR) sensor from a pocket camera can produce several vegetation indices such as Simple Ration (SR), Normalized Difference Vegetation Index (NDVI), and Enhanced Difference Vegetation Index (ENDVI). The result indicated that those vegetation indices can be used to detect mangrove and distinguish it from other object using supervised image classification. The digitally classified imagery then compared to manually digitized mangrove map to calculate the total error.

Keywords: Mangrove, NIR, UAV

THE IDENTIFICATION OF SHORELINE CHANGE AND COASTAL VULNERABILITY ON ARUGAMBAY COASTAL REGAIN USING NEW MAPPING TOOLS AND TECHNIQUES BASED ON CLOUD GIS

M.A.D. Samanmali (1), J.A.D.M. Sadani (1)

[1] Department of Geography, University of Colombo, Sri Lanka
Email:mataraarachchids@gmail.com; sadanijayasooriya@gmeil.com

Abstract: Shoreline changes have large importance for coastal communities and people living from the resources of the coastal environment (Rodríguez, I. M., et al 2009). The coastal change ware studied world wild with the increasing sea level. Shoreline can be defined as the line of intersection between a water body and land (Yang, X., & Li, J. Eds., 2013). It is process and responses are nonlinear and have high variability with the time and space. Sri Lanka is an island with a coastline of length approximately 1,600km. Shoreline can be change with human and natural factors. As example remove the mangrove covers, unplanned settlement, sand transportation changings, changes of current wave act… The selected area is located in Eastern part of coastal region in Sri Lanka. It was located between 6°53'12.72"N and 81°50'36.50"E North Coordinate and 6°45'4.50"N 81°48'47.50"E south coordinate. The main objective this study to identification of shoreline change and coastal vulnerability on Arugam bay coastal regain using new mapping tools and techniques based on cloud GIS. The shoreline was extracted from the Landsat image and it was collected from United State Geological Survey (USGS) online data base. The Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS) images of 1980 to 2016 were used for preparing shore lines. The soil moisture index was use for demarcate shoreline on ERDAS IMAGINE 2014 software. Data was analyzed using Digital Shoreline Analysis System (DSAS) with ArcGIS 10.1 platform. The coastal vulnerability was calculate using several thematic layers such as land use and land cover, geology, geomorphology, lithology, sea level, tide height and elevation etc… According to the analysis of shoreline change at the area was identified positive relationship between time and distance. The Arugam beach area was recorded 2.5 m/yr shore line changes during the past decade. Furthermore CVI was clearly indicates the vulnerable situation of the Arugam beach area. Majority of built up also distributed close to coastal zone as example Pottuvil and Arugam area. Both human and natural factors were effected to the coastal erosion. Finally those analysis hosted to the cloud GIS and it can be used for sharing information with environmental protector.

Keywords: DSAS, Cloud GIS, Shoreline Change

CHANGE DETECTION IN BENTHIC HABITAT COMMUNITIES USING LANDSAT DATA: A CASE STUDY IN WAKATOBI ISLANDS, SOUTHEAST SULAWESI

Muhammad Hafizt (1), Pramaditya Wicaksono (2), Dodi Yuwono (3), Novi Susetyo Adi (4), Bayu Prayudha (1), Suyarso (1)

[1] Research Center for Oceanography, Indonesian Institute of Sciences, Jalan Pasir Putih I, Ancol Timur 14430, Jakarta, Indonesia
[2] Universitas Gadjah Mada, Jalan Bulaksumur 55281, Yogyakarta, Indonesia
[3] Center for Thematic Mapping and Integration, Geospatial Information Agency, Cibinong, Indonesia
[4] Research Centre for Marine and Coastal Resources, Ministry of Marine Affairs and Fisheries, Indonesia
Email: muha169@lipi.go.id; prama.wicaksono@geo.ugm.ac.id; dmyuwono@gmail.com; novisusetyoadi@kkp.go.id; byu30des@gmail.com; suyarso_lipi@yahoo.com

Abstract: Wakatobi islands, located in Indonesia, has an extensive of reef formation of, 8.816,169 ha. Coral reef and seagrass ecosystem are the dominant benthic habitat in the area. Currently, the condition of both ecosystems in Wakatobi island is not categorized as good in term of its coral cover as it has less than 50 % coral cover. For sustainable planning and management of key coastal ecosystems, such as seagrass and coral reefs, a detail information about the dynamic of their conditions is needed. By utilizing time-series Landsat satellites which can record benthic habitat condition of Wakatobi Islands in 1990, 2000, 2010, and 2017, the cover change of both ecosystems was produced. The objectives of this study are to determine areas that experienced drastic changes in benthic habitat cover through multitemporal Landsat satellite imagery and then to analyze the dynamics of the changes. The method used in this study is Land Change Modelling in SPEAR Tools of ENVI software used to identify areas that experienced drastic changes. The next step was analyzing the cover change that occurred in the area by applying image processing to each image, including geometric correction, sunglint correction, water column correction, image masking, and image classification. The result of this study was the maps showing change of benthic habitat cover from 1990-2017 in every ten years periods. Using these maps, the status of coral reef and seagrass ecosystem conditions in Wakatobi Islands can then be assessed. The result of this study can be useful for the government and stakeholders in optimizing coastal planning and conservation activities for coral reefs and seagrass ecosystems in a sustainable way.

Keywords: Wakatobi Islands, Landsat, Benthic Habitat

SIMULATION OF BATHYMETRIC CHANGES IN RIVERS DUE TO SEDIMENTATION: A CASE STUDY OF SINDANGAN RIVER, SINDANGAN, ZAMBOANGA DEL NORTE

Isnailah S. Ontong (1), Glenn Leandri Brylle L. Lamparas (1), Raymond T. Ong (1), Augustini Ave O. Paduganan (1), Emir V. Epino (1), Mario S. Rodriguez (1)

[1] ADZU Geo-SAFER Mindanao: ZAMBASULTA, Ateneo de Zamboanga University, Philippines
Email: ontongisns@adzu.edu.ph

Abstract: Due to the country's geographical location, The Philippines is one of the natural-hazard prone area in the world as it experiences an average of 20 tropical cyclones every year which are capable of producing heavy rainfall resulting to flooding of rivers and on some major areas. This phenomenon has led to the morphological change on some rivers due to soil erosion and sediment deposition. In the case of Sindangan river, the accumulation of sediments on the downstream portion of the river has led to the decreased in channel's flood-carrying capacity, thus, flood inundates to the community. The study reach of about 6 km of Sindangan river, from Barangay Dicoyong to the outlet of the river, was modeled. Using HEC-HMS 4.2.1, it computes watershed sediment yield using the Modified Universal Soil Loss Equation (MUSLE) and calibrates the model using the In-situ measurement of sediments gathered by the Geo-SAFER: Ateneo de Zamboanga University. To study the bathymetric changes of the river, a mathematical modeling approach was selected using HEC-RAS 5.0.3 to simulate the existing changes and predict future trends using the LiDAR (Light and Detection Ranging) Data. Simplifications and assumptions were also made due to the limitations on the availability of data. Predictive simulation shows that continuous sediment accumulation on the downstream part will led to the decreased in draining capacity of the river and eventual flooding may occurs. It is therefore recommended to employ suitable remedial measures on the removal of accumulated sediments.

Keywords: Bathymetric change**,** HEC-HMS, HEC-RAS, LiDAR

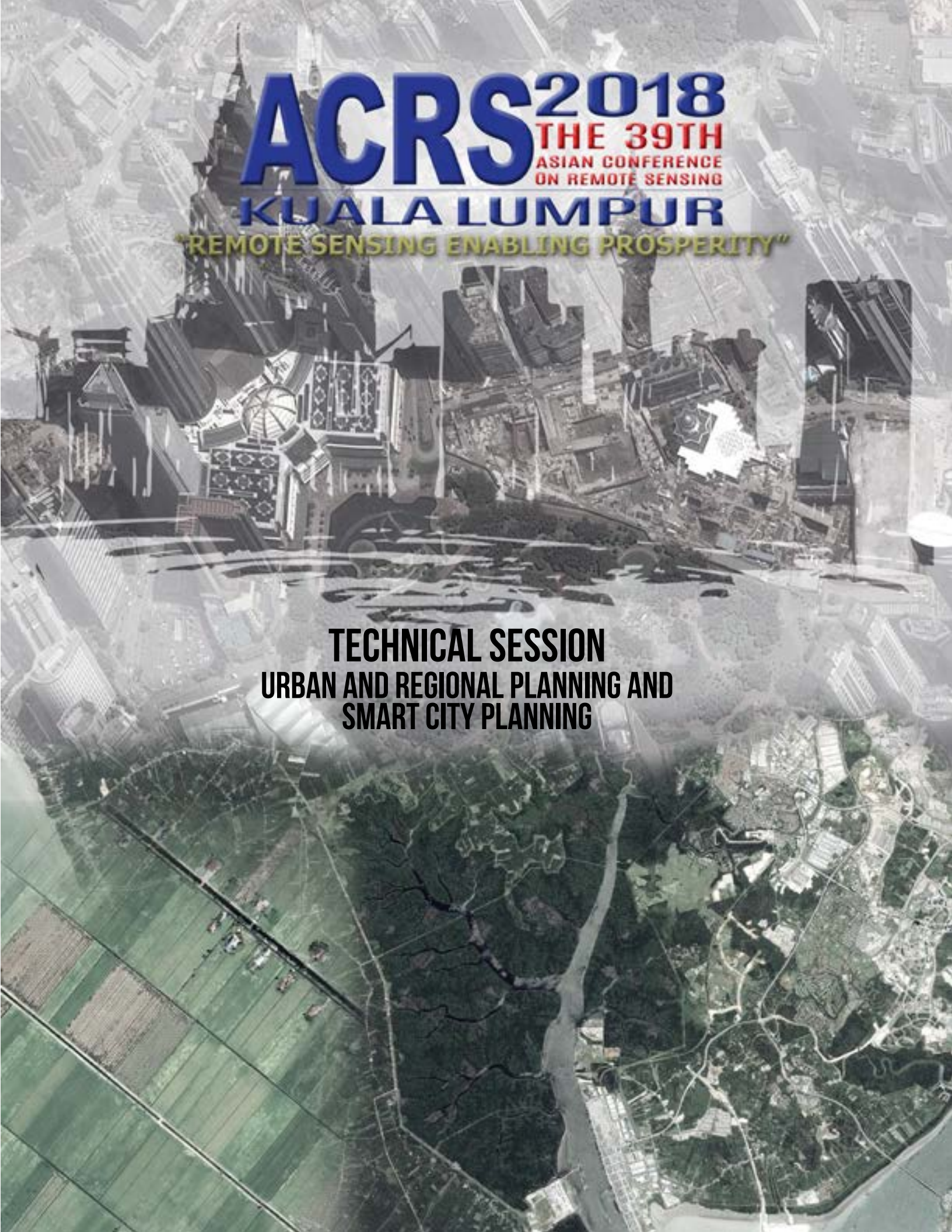
THE INVESTIGATION OF COASTAL VULNERABILITY TO SEA LEVEL CHANGE IN KALPITIYA PENINSULA

M.A.D. Samanmali (1), R.U.K. Piyadasa (1), D.D. Wickramasinghe (2)

[1] Department of Geography, University of Colombo, Sri Lanka
[2] Department of Zoology, University of Colombo, Sri Lanka
Email: mataraarachchids@gmail.com

Abstract: Coastal zones are sensitive landscapes to the impacts of the dynamics of the sea, atmosphere as well as human disturbances. Expanding cities, growth of population and unsustainable development have irreversible negative impacts on coastal areas. On top of this, climate change induced changes aggravate the problems. The historical tide gauge record shows that the average rate of global mean sea level rise over the 20th century was 1-7 + 0.2 mm yr-1 which might affect the coasts significantly. This study addresses the impacts of coastal changes on Kalpetiya peninsula in Sri Lanka using Geographical Information System. The study area is located in the North West coast with a total land area approximately of about 160 sq km and being a peninsula is vulnerable to the impacts of the sea from there sides. Knowledge about future sea level rise is essential in planning developmental activities in the coastal areas and make the landscape resilient. For instance, according to the sea level records of the Indian Ocean region highest mean sea level was recorded in Colombo, Sri Lanka (0.783m and 1.409m) in year 2015.This study uses many data sources: Daily, monthly mean sea level data were collected from the database of the Permanent Service for Mean Sea Level (PSMSL) open access database. Nine gauging station sea level data were also used. Autoregressive integrated moving average (ARIMA) models were used to predict the sea level rise and to identify most vulnerable areas. According to the results the mean sea level in the area will be increased by at least 0.8m in 2035. Under this situation, Mohotthuwarama, Kudawa and Mudalappalliya areas in the peninsula will be most vulnerable for the impacts of sea level rise. This information would be beneficial in decision making and secure socio economic settings of the area.

Keywords: Sea level rise, coastal changes, Kalpitiya



TECHNICAL SESSION

URBAN AND REGIONAL PLANNING AND SMART CITY PLANNING

URBAN SPRAWL STUDY USING SHANNON ENTROPY IN KAKINADA, ANDHRAPRADESH

Shrawani Sable (1), Kshitija Suryawanshi (1), Devendra Garg (1), Shaily R. Gandhi (1)

[1] Faculty of Technology, CEPT University, Ahemdabad
Email: shrawani.sable.mgeo17@cept.ac.in

Abstract: The most important problem in cities is its urban sprawl due to its growing environmental and societal impact. It is important to accurately analyze and understand the effective urban planning. This paper focuses on urban sprawl analysis in the Kakinada city, Andra Pradesh. In this study, urban sprawl was examined over a period of 20 years using Shannon's entropy based on remote sensing. The Shannon's entropy method was used to determine the degree of urban sprawl. The present finding will have high utility in understanding the present and projecting the future growth scenario. The study can be a valuable input to prepare the effective planning and management for controlled and systematic urban growth both at regional as well as local level. For appropriate categorization and handling data R model is been prepared.

Keywords: GIS, Urbanisation, Land use, Modelling, Urban sprawl, Shannon Entropy

RESOURCE MAPPING FOR THE SUSTAINABLE DEVELOPMENT OF THE BHUME RURAL MUNICIPALITY, NEPAL

Shree Krishna Adhikari (1)

[1] Tribhuvan University, Institute of Engineering, Pashchimanchal Campus Bhugdeu, Mahankal Chaur-01, Kavrepalanchok, Bagmati, Nepal
Email: 71bge543@wrc.edu.np; adhikari.krishnashree@gmail.com

Abstract: The western part of Nepal is backward in each and every aspects of development activities. Despite a great potential for development, it lags behind in the development activities. Even today the first thoughts that entangle the minds of millions of visitors who have enjoyed the splendor of this regions are its natural beauty. So it is the reason of the things to do research on this area which despite having a great potential is lagging behind by leaps and bounds. This paper geo visualizes multiple possibilities for the development of western regions investigating its resources that may be natural or facilities. This study uses spatial data collected using GPS as the primary data sources and the secondary data sources collected from Government offices and online sites. Remotely sensed data for river network (DEM), land use land cover (satellite imagery) are needed. After the collection of the data, the data are analyzed, data are prepared and finally using Geographic Information System, maps are prepared showing the available resources of the regions. The relevance of this study lies in the fact that it looks into the various resource and the sustainability of the development possibilities in this region. The under developed region can benefit from natural resource if used wisely and properly can revitalize and help in the overall development of the region. In the region where data availability is even today a challenge the way of generating new learning towards spatial data collection in open source environment like Open Street Map data.

Keywords: Open Street Maps, GPS, Sustainable development, Resource mapping, DEM

IMPACTS OF URBAN EXPANSION ON URBAN HEAT ISLAND – A GEOSPATIAL APPROACH

Shaily Gandhi (1), Bindi Dave (1), Anjana Vyas (1)

[1] K.L. Campus, Faculty of Technology, CEPT University, Ahmedabad-380007, Gujarat, India
Email: shaily.gandhi@cept.ac.in; bindi.dave@cept.ac.in; anjanavyas@cept.ac.in

Abstract: Growing urbanisation has led to increase in the built up area, reduction in open and green spaces with in the cities and the periphery. The urban saturation and the enlargement of the built space have determined environmental changes, increasing the already precarious condition of the natural systems in these spaces of high saturation. It results in to the formation of Urban Heat Island (UHI). Over the last few years, Ahmedabad has experienced rapid urbanization and associated Urban Heat Island (UHI) effects. This study aims at analysing spatially and temporally, the impact of urban form expansion on UHI in Ahmedabad using Landsat thermal images. The Mono Window Algorithm has been used to retrieve Land Surface Temperature (LST) from the thermal bands of LANDSAT-5, 8 TM satellite data. Various spatial analysis techniques were used to explore the relationships between area, compactness ratio, the gravity centers of urban land, and UHI. Under the similar urban land area condition, UHI and compactness ratio of urban land were in positive correlation. The moving direction of the UHI gravity center was basically in agreement with urban land sprawl. The encroachment of urban land on suburban land is the leading source of UHI effect. The results suggest that urban design based on urban form would be effective for regulating the thermal environment.

Keywords: Urbanization, Urban expansion, Urban Heat Islands, GIS, Remote Sensing

APPLICATION OF SATELLITE IMAGES LANDSAT 8 FOR INTERPRETATION OF PM10 DISTRIBUTION IN URBAN PART - HO CHI MINH CITY AS A CASE STUDY

Duyen Chau My Nguyen (1), Tham Truong Hoai Pham (1), Long Ta Bui (1)

[1] Laboratory for Environmental Modeling, Faculty of Environment and Natural Resources, Hochiminh City University of Technology, 268 Ly Thuong Kiet St., Dist. 10, Hochiminh city, Vietnam
Email: nguyenduyen91@hcmut.edu.vn; 91303765@hcmut.edu.vn; longbt62@hcmut.edu.vn

Abstract: This research is to focus on the application of Landsat 8 OLI remote sensing in 2017 to map PM10 dust emulation for the inner city, Ho Chi Minh City, using the method of calculating value of Aerosol Optical Thickness (AOT) and correlative regression between concentration of PM10 dust observed from ground stations and values reflected on each band. The results show that there is the best correlation on the linear regression function between the blue channel B2 and green channel B3 with the real measured data ($R^2 = 0.947$). Dust pollution in the air is increasing, PM10 dust concentration in Inner City, Ho Chi Minh City has a value of 100-200μg/m^3, the area has concentration of PM10 dust higher than 200μg/m^3 are discovered penetrating in residential areas, industrial zones and the most is concentrated in the traffic routes simulated on the image. The research results also compare the difference between observation value of ground surface observation and image analysis, which shows that satellite image remote sensing technology is reliable, can calculate and simulate air pollution and use it as an effective and useful tool for monitoring the air quality of big cities, especially in the inner urban areas.

Keywords: AOT, Remote Sensing, Landsat 8, Air Pollution, PM10

INVESTIGATION OF SURFACE TEMPERATURE AND LAND USE EFFECT ON FUTURE ENERGY SYSTEM IN GORONTALO CITY

Nursida Arif (1), Alfiatun Nur Khasanah (2), Risman Jaya (1)

[1]Faculty of Science and Technology, Universitas Muhammadiyah Gorontalo, Pentadio Timur, Gorontalo, 96181, Indonesia
[2]Remote Sensing and Geographical Information System, Vocational School, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia
Email: nursida.arif@um-gorontalo.ac.id; alfiatunnur.k@ugm.ac.id; risraider13@gmail.com

Abstract: Land use change is one of the factors affecting urban development including urban energy needs. This research uses land surface temperature to analyze the effect of land use and surface temperature on future energy system of Gorontalo city. Remote sensing technology and geographic information systems are helpful in mapping the spatial distribution of each parameter used. In this research the data used is Landsat 8 for mapping land cover/land use, green area and land surface temperature (LST). The results showed that in dry season the highest surface temperature in the building area and the lowest temperature in the vegetation area. Land use has an effect on the amount of thermal energy reflected by the earth's surface. Non vegetation will be brighter on the image because it reflects more solar energy. LST is dominant in the wet season of 30-40 0C i.e 50.51% of the area while in dry season is dominant at 40-50 0C covering 42%. The highest temperature in the city of Gorontalo in both dry and wet season is distributed in Pulubala, Limba U1, and Biawao. This research can provide insight into land surface temperature and become a recommendation in urban planning and energy policy.

Keywords: Energy, Land Surface Temperature, Land Use, Landsat

CLIMATE VARIABILITY ASSESSMENT FOR URBAN GROWTH MODELLING USING GEOSPATIAL TECHNIQUES TOWARDS REALIZATION OF THE UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS IN NIGER DELTA REGION, NIGERIA

Sulaiman Ibrahim Musa (1)(2)(3), Mazlan Hashim (1)(2)

[1]Geoscience & Digital Earth Centre (INSTEG), Research Institute for Sustainable Environment (RISE), University Technology Malaysia, 81310 Skudai, Johor Bahru, Malaysia
[2]Faculty of Geoinformation & Real Estate, University Technology Malaysia, 81310 Skudai, Johor Bahru, Malaysia
[3]Department of Surveying & Geoinformatics, Abubakar Tafawa Balewa University, PMB 0248, Bauchi, Nigeria
Email: sulaimanibrahimmusa@gmail.com; mazlanhashim@utm.my

Abstract: Urban growth and climate change are two interwoven phenomena that are becoming global environmental issues. This study aimed to analyze climate change pattern and predict its impacts on Niger Delta region of Nigeria with a view to evaluating the impact of the United Nations Sustainable Development Goals (UN SDGs) on future urban growth in the area. A MAGICC model, developed by the Inter-Governmental Panel on Climate Change (IPCC), was used to predict future precipitation under RCP 4.5 and RCP 8.5 emission scenarios, which was utilized to evaluate the impact of climate change on the study area from 2016 to 2100. Observed precipitation records from 1972 to 2015 were analyzed, and 2012 was selected as a water year based on depth and frequency of rainfall. River width-precipitation relationship was developed based on 2012 observed monthly precipitation and river width from Landsat imageries. A linear regression model derived from the observed precipitation and river width of 2012 was used to project the monthly river width variations over the projected climate change, considering the two emission scenarios. The areas that are prone to flooding were determined based on the projected precipitation anomalies. This will serve as a resilience to climate change and at the same time as an input for the prediction of future urban growth in the region towards realization of the United Nations Sustainable Development Goals 11 "Make cities and human settlements inclusive, safe, resilient and sustainable".

Keywords: Remote Sensing, Urban Growth, Climate Variability, Emission Scenarios, UN SDGs

IMPACTS OF URBANIZATION ON URBAN HEAT ISLAND (UHI) AND METEOROLOGICAL PARAMETERS IN HANOI (1998-2016) BASED ON GROUND-BASED AND SATELLITE OBSERVATIONS

Nguyen Thi Mai (1), Lin Tang-Huang (1)

[1] Center for Space and Remote Sensing Research, National Central University, Taiwan
No. 300, Zhongda Road, Zhongli District, Taoyuan City, 320
Email: mainguyen1495@gmail.com; thlin@csrsr.ncu.edu.tw

Abstract: Hanoi city, the capital of Vietnam, has experienced rapid urbanization since 1990 with the continuous increase of socio-economic indicators. In 2008, implementing the Resolution on administrative boundary adjustment has been helped Hanoi to develop expanding outside the city center. However, the environmental consequences of urban development can cause considerable concern. Therefore, the objective of this study aims at examining the impacts of urbanization in Hanoi focusing on urban heat island (UHI) effect and the changes of meteorological parameters (1998-2016) based on ground-based and satellite observations. The Landsat images at three time-points (1998, 2009 and 2016) were used to produce land use maps identifying the changes in land use patterns over time. To establish the spatial correlation with land surface temperature (LST) map, the normalized difference vegetation index (NDVI) and the normalized difference built-up index (NDBI) maps were employed. The results indicate that the less vegetation content in city center causes higher LST and NDBI values when compared with surrounding areas. The positive correlation between LST and NDBI and the negative correlation between LST and NDVI across all three time-points confirm the influence of urbanization on the formation of UHI. In addition, the intensified UHI has been driven by the increase in urbanization indicators based on the regression analysis. Furthermore, the analysis on meteorological data reveals that urbanization also has impacts on climatic indicators including relative humidity, total rainfall, temperature and wind speed in both urban and rural areas. The overall results might imply that urbanization and its impacts on the environment are challenges to the sustainable development of an increasingly urbanized Hanoi, which should be paid more attention.

Keywords: Hanoi, urbanization, urban heat island effect, change of meteorology

THE IMPACT OF DESERT URBANIZATION ON LAND SURFACE TEMPERATURE IN THE UNITED ARAB EMIRATES (UAE)

Latifa AlBlooshi (1), Abdelgadir Abuelgasim (2), Ahmed Nassar (3), Taoufik Ksiksi (1)

[1] Biology Department - UAE University - Al-Ain, UAE
[2] Geography Department - UAE University - Al-Ain, UAE
[3] Department of Earth and Environmental Sciences - University of Windsor, Canada
Email: 200670339@uaeu.ac.ae; a.abuelgasim@uaeu.ac.ae; aknassar16@gmail.com; tksiksi@uaeu.ac.ae

Abstract: The United Arab Emirates (UAE) has undergone major urban transformation in the past few decades after the creation of the country's union in 1971. One remarkable change was in the area of urban expansion in terms of major infrastructure, new residential areas, highways and airports. It is generally believed that major landscape change and disturbance, such as urban development, is a major contributor to global climate change. It has been demonstrated that urban areas can be 3.5 to 4.5 °C warmer than neighboring rural areas a phenomenon known as urban heat islands (UHI). It should be expected that the massive expansion in urban areas in the UAE would be a major contributor in the country towards climate change. This research investigates the impact of urbanization on land surface temperature (LST) within the desert of Al Ain, UAE using satellite data. Landsat image spanning the period 1988 to 2017 of the summer season for Al Ain City are used to analyze the changes in LST due to urbanization. It has been found, and contrary to published literature, that urbanization of desert surfaces leads to drop in the overall LST of the area. This drop is attributed to the associated expansion in green space within the newly developed urban areas as well as the expansion in agricultural plantations. The effect of UHI is not demonstrated well in the satellite data particularly on the conversion of desert surfaces to urban areas.

Keywords: LST, Thermal Remote Sensing, UHIs

A FRAMEWORK FOR UNDERGROUND UTILITY NETWORK MAPPING FOR SMART CITY PLANNING

Siow Wei Jaw (1)(2)(3), Rob van Son (3), Jingya Yan (3), Hock Soon Victor Khoo (4), Gerhard Schrotter (5), Wei Kiah Richard Loo (4), Shen Ni Sandy Teo (4)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
[2] Geoscience & Digital Earth Centre (INSTeG), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
[3] Future Cities Laboratory, Singapore-ETH Centre, I Create Way, Create Tower, #06-01, Singapore 138602
[4] Land Survey Division, Singapore Land Authority (SLA), 55 Newton Road #12-01 Revenue House Singapore 307987
[5] Geomatik + Vermessung, Stadt Zürich, Weberstrasse 5, 8004 Zürich
Email: swjaw@utm.my; vanson@arch.ethz.ch; jingya.yan@arch.ethz.ch; Victor_KHOO@sla.gov.sg; Gerhard.Schrotter@zuerich.ch; Richard_LOO@sla.gov.sg; Sandy_TEO@sla.gov.sg

Abstract: Underground utilities are one of the major infrastructures of modern cities. Complex utility networks lie beneath the streets of these cities but, often, these utilities are aging, and in unknown locations and condition. Additionally, utility owners have little idea of the precise location and properties of these utilities that are buried in congested configurations. As such, underground space contains hidden, unmapped pipework, cabling and box culverts. However, given the right standards and work flows, today's technologies allow us to acquire a reliable three-dimensional (3D) map of these buried infrastructures. This is beneficial to utility owners, and urban planners for the planning of underground spaces, and can result in a more efficient and resilient underground infrastructure. This study highlights a conceptual framework for underground utility mapping for the purpose of smart city planning. The purpose of this framework is to ensure acquisition of reliable 3D utility data and thereby reducing the inefficiencies, risks and costs during construction works. The framework defines best practices for 3D underground mapping using non-destructive geophysical instruments as well as a model that bridges the gap between data acquisition and data management. We hypothesize that application of this framework will be a key enabler for the planning of smart cities, improve underground land administration, and the possibility to conduct safer excavations and construction work.

Keywords: Conceptual Framework, Reliable, Underground Utility Mapping, Land Administration

A GIS MODEL ANALYSIS ON THE PREDICTION OF SOCIO ECONOMIC IMPACTS

M.Zainora Asmawi (1), Muhammad Faris Abdullah (1), Alias Abdullah (1),
Nur Azraei Shahbudin (2)

[1] Department of Urban and Regional Planning, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur
[2] IIUM Entrepreneurship and Consultancies Sdn Bhd, Level 3, RMC Building, Jalan Gombak, 53100 Kuala Lumpur
Email: zainora@iium.edu.my; mfaris@iium.edu.my; dralias@iium.edu.my; azraeishahbudin@gmail.com

Abstract: The recent global changes in GIS technology advancement have significantly influenced the spatial development of urban areas concerning its impacts on the surroundings. This paper addresses the formation of a GIS-based technology in predicting the potential socio-economic consequences due to the development. The approach employed was extensively based on a series of baseline data, models, spatial and statistical analysis to develop a prototype GIS system in predicting future socio-economic impacts, called Development Impact Assessment. Furthermore, this paper also uses a practical technique of 'what if' scenario which can assist in charting possible complicated linkages between criteria from multiple sources. The system consists of some selected vital components of the socio-economic, including car parking requirement, a projection of commercial floor space and estimated job creation. The results demonstrate the strengths and abilities of GIS to provide a spatial analysis showing the distribution of the socioeconomic impacts in urban planning system that could assist the local planning authority in creating a sustainable living environment. Thus, the GIS system also carries the value of incorporating the complexity of wicked problems existed in urban planning into a technology-based device. This GIS model analysis is efficient to determine the sustainability of urban areas, taking into the consideration the challenges that we face today.

Keywords: socio-economic consequences, prototype GIS, commercial floor space, what if

MONITORING THE LAND-USE/LAND-COVER CHANGES AND MODELLING THE URBAN EXPANSION IN SIDON CITY OF LEBANON

Lam Kuok Choy (1), Layal Abdul Rahim Halime (1), Mokhtar Jaafar (1)

Universiti Kebangsaan Malaysia
[1] Geography Programme, Centre for Development, Social and Environment (SEEDS)
Faculty of Social Sciences and Humanities, 43600 Bangi, Selangor, Malaysia.
Email: lam@ukm.edu.my

Abstract: The aim of this study is to analyze the impacts of urbanization and land use and land cover (LU/LC) changes on the agricultural areas in Sidon City, Lebanon throughout the years from 1985 to 2015, using satellite images and GIS techniques. The study site is a fast growing region, therefore, monitoring LU/LC changes is important for landscape planning and resource management. In this study, an analysis is carried out for urban land changes in Sidon district via satellite imagery, geographic information systems (GIS) and landscape metrics. The applied methods consist of two major components: remote sensing-based land classification and GIS-based land change analysis. The final step summarized by the modelling part which is important to predict future LU\LC scenarios. The significance of this study is to show the usefulness of integrating remote sensing with GIS and landscape metrics in land change analysis that allows for better characterization of spatial patterns and helps reveal the underlying processes of urban land changes. Thus, analyzing and modelling the Land-use\ Land-cover changes in Sidon city is certainly beneficial for land-use planners and decision makers. The land use classification produced seven land use classes for evaluating and quantifying the land cover changes for each class within the time frame series from 1985 and 2015. The final result of this research study shows the urban development across the city throughout the study period. Urban expansion and built up areas were clearly detected, besides the agricultural land changes where some crops dominates others in some areas and some has been completely transformed to built-up areas.

Keywords: Land use and land cover, GIS, Sidon city, remote sensing, urban expansion

THE OXYGEN CONCENTRATION ESTIMATION OF THE URBAN OPEN SPACE IN MAGELANG MUNICIPALITY AND ITS SURROUNDING AREA

Rossaydiana Apriadna (1), Prima Widayani (1)

[1] Faculty of Geography, Universitas Gadjah Mada, Bulaksumur, 55281 Yogyakarta, Indonesia
Email: rossaydiana@gmail.com; primawidayani@ugm.ac.id

Abstract: The increasing of population in Magelang Municipality and its surrounding area has triggered the conversion of non-built-up area to be a built-up area. The undergone development projects in town have indirectly implied to the decreasing of the urban open space. As main oxygen supplier for urban community. Oxygen concentration could be estimated by developing some approaches, such as remote sensing. This paper aimed to understand the ability of Sentinel-2A images in inventorying the urban open space vegetation and generating the oxygen concentration produced by urban open space vegetation in Magelang Municipality and its surrounding area. The Sentinel-2A image is used to extract the distribution of the urban open space and vegetation density. The urban open space identification is carried out visually by means of interpretation principals. The Normalized Difference Vegetation Index (NDVI) transformation is used to analyze the vegetation density to set the biomass sample. The Brown allometric equation is chosen to estimate the biomass while the chemical equation for photosynthesis is applied to estimate the oxygen production. The result of this research shows that Sentinel-2A image has an accuracy of 98.95% on the interpretation of recreational park, urban forest, protected forest, production forest, plantation, cemetery, and along the stream buffer zone. The oxygen concentration produced by the urban space in Magelang Municipality and its surrounding area is 3.221 million tons per day. The higher vegetation density contributes the most oxygen, as much as 3.182 million tons. On the other hand, the vegetation density resulted from transformation method has a low correlation to the actual biomass measured on field.

Keywords: oxygen estimation, urban open space

LAND ACQUISITION AT STRATA AND STRATUM SCHEME IN MALAYSIA

Liat Choon Tan (1), Siow Wei Jaw (1)(2), Siti Aishah Abd Latif (1), Azam Bazli Zulkiflee (1)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
[2] Geoscience & Digital Earth Centre (INSTeG), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
Email: tlchoon@utm.my; swjaw@utm.my; saishahlatif@gmail.com; muhdazambazli@gmail.com

Abstract: Acquisition of land is the process where the government acquires private land for essential public purpose or for any purposes that the State Authorities thinks that it is beneficial for Malaysia's economic development. For example, acquisition of land for building school, hospital, residential and public infrastructure, such as mass rapid transit (MRT), roads, etc. Land Acquisition Act 1960 (Act 486) is the legislation that enables the government to acquire private land. The landowner whose land is taken is compensated based on market value under this act. Occasionally, private land is acquired by Malaysia Government for a public project that serves as the catalyst for the economic development. Klang Valley in Malaysia has experienced large-scale land acquisitions spearheaded by the mass rapid transit project that started by the year 2011. The massive land acquisition takes place for the realization of the construction works for this MRT project, which expected to be one of the solutions to reduce the traffic congestion. This paper highlights the procedures and implementation of land acquisition on strata and stratum scheme as mentioned in the Land Acquisition (Amendment) Act 2016 and the related guidelines. It tends to understand the land acquisition working principle and role of the Government agencies. The theoretical and technical study is performed to examine land acquisition act for its fairness and equity aspects. Based on this, it will be the key enabler for more sustainable land resources management and yet avoid land-related conflicts.

Keywords: Land Acquisition, Strata, Stratum, Compensation

SUPERVISED CLASSIFICATION OF SPOT 6 AND 7 IMAGERIES FOR IDENTIFYING CULTIVATION AREA IN SPATIAL PLANNING REVISION OF WEST MANGGARAI REGENCY, EAST NUSA TENGGARA PROVINCE

Andi Abdul Manaf (1), Gerry Utama (2), Yamuna Jiwaningrat (2)

[1] Department of Development Geography, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang, Sekip Utara, Bulaksumur, Kabupaten Sleman, Daerah Istimewa Yogyakarta, 55281 Indonesia
[2] Department of Environmental Geography, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang, Sekip Utara, Bulaksumur, Kabupaten Sleman, Daerah Istimewa Yogyakarta, 55281 Indonesia
Email: abdul.manaaf.ma@gmail.com; gerry.utama@mail.ugm.ac.id; yamunajiwaningrat@gmail.com

Abstract: The process of building cultivation area in a spatial planning document is a very important part as guidance for regional development. Cultivation area is initially composed of existing land use which then incorporated with aspects of planning in it. Accurate land cover identification is the stage that determines the quality of the cultivation area, supervised classification method is one of the solutions to decently determine existing land use. The method used in identification of existing land use is supervised classification on SPOT 6 and SPOT 7 imageries of West Manggarai Regency, East Nusa Tenggara Province. Digital Interpretation imageries use training samples in the identified land cover for then used as a guide in classification in all areas of West Manggarai Regency. The result of classification is then generalized in order to obtain the division of the land cover area in accordance with required scale detail, as well as the correction of minor classification mistakes that occur in the process. The results showed that the quality of the supervised classification depends on the quality of the training samples used as a guide in digital interpretation. Although there are errors in digital interpretation with supervised classification, the errors are not in large quantities and manual correction can be done in a short time. Supervised classification on SPOT 6 and 7 imageries in the identification of land use to compile the cultivation area of regional spatial documents, produces classification quality that as good as the accuracy level of training samples used as guidance so that in the selection of sample training areas it is necessary to consider the allotment aspects of the cultivation area arranged.

Keywords: Supervised Classification, Cultivation Area, Land Cover, Spatial Plan

INDENTIFICATION OF TRIP PURPOSE AND MODE CHOICE USING MOBILE CALL DETAIL RECORDS

Kyaing (1), KoKo Lwin (2), Yoshihide Sekimoto (2)

[1] Department of Civil Engineering, Yangon Technological University, Ministry of Education, Insein 11011, Yangon, Myanmar
[2] Institute of Industrial Science, The University of Tokyo, Komaba 4-6-1, Meguro Ku, Japan
Email: kyaingkyaing63@gmail.com; kokolwin@iis.u-tokyo.ac.jp; sekimoto@ii.u-tokyo.ac.jp

Abstract: Rapid urbanization and modernization are increasing around the world including Myanmar. Mobile phone call detail records (CDRs) has new opportunities to measure the origin-destination trips, travel distance, travel duration and origin-destination matric, which is essential for urban planning and transport management. The purpose of this research is to identify transportation mode and trip purpose from one-week mobile CDRs provided by Myanmar Posts and Telecommunications (MPT). In this research, daily origin-destination trips have generated to detect various transportation modes such as public bus, private car, taxi and walk based on their travel distance, duration and speed. In order to identify trip purpose, we intersect individual person's origin-destination locations with fine-scale land use data such as commercial, residential, parks, offices and so forth. These data can support to use future transport forecasting and demand prediction using four step models. We hope that this study will help to improve Yangon City traffic planning and public facility management.

Keywords: Mobile CDRs, Origin-destination, Mode choice, Trip purpose, Land use

ROAD NETWORK SELECTION BASED ON SKELETON GENERATION USING QUADTREE BASED VERTEX PARTITIONING APPROACH FOR DIFFERENT SCALE OF MAPS

Mukul Priya (1), K.S.Rajan (2)

[1] International Institute of Information Technology, Hyderabad, India
[2] Lab For Spatial Informatics, International Institute Of Information Technology, Hyderabad, India
Email: mukul.priya@research.iiit.ac.in.; rajan@iiit.ac.in;

Abstract: Road network is a very important feature class for topographic maps and database. In order to develop maps at different scale, road network selection proves to be an integral part of the overall map generalisation process. Map generalization can be broadly classified into cartographic generalization where the focus is on visual appeal and model generalization where the primary focus is to extract reduced data by preserving most important features while the shapes and geometries of other features are not changed. Generation of a multi scale road representation model is the primary goal of this paper. In this work a Model generalization methodology has been proposed which comprises of quadtree based node indexing, density based node selection, betweenness calculation and network skeleton generation for different scales. Using the methodology, road networks at different scale is being generated which can be used as an input for multi scale map rendering. This approach is evaluated on a real world OSM road network data with varying degree of connectivity. The results demonstrate that the proposed methodology has been able to reduce the level of details in the road network by choosing relevant road segments and has also maintained the main characteristics and structure as well as the essential topological, geometrical and semantic properties of the provided road network.

Keywords: Road Network, Map Generalisation, Graphs, OpenStreetMap, Multi Scale Graph Database

INTEGRATION OF PHOTOGRAMMETRIC RECONSTRUCTION AND 3D MODELING FROM ARCHITECTURAL DRAWINGS FOR BIM MODELS

Deni Suwardhi (1), Shafarina Wahyu Trisyanti (1), Irwan Gumilar (2), Hana Widyatari (3), Nisrina Ulfah (3), Mohamad Gamal (2), Ied Fitrayana (2)

[1] Remote Sensing and Geographic Information Science Research Group, Institute of Technology Bandung, No. 10, Jalan Ganesa, 40123 Bandung, Indonesia
[2] Survey and Mapping Laboratory, No. 10, Jalan Ganesa, 40123 Bandung, Indonesia
[3] Geomatic Department, Institute of Technology Surabaya, Jalan Arief Rahman Hakim, Kampus Keputih, Sukolilo, 60111 Surabaya, Indonesia
Email: deni@gd.itb.ac.id; shafarina.wahyu@student.itb.ac.id; igumilar@gd.itb.ac.id

Abstract: 3D city model is a digital representation of the original environment that can be used for the process of planning, building, and maintaining a city. One of the thematic objects that became the focus of 3D city modeling is building. BIM is one of technologies in AEC that can simulate all information in development projects into a 3D model. For modeling the existing building, 3D building model usually made by using 2D architectural drawing as Computer Aided Design (CAD) data. But not all CAD data provide the complete data for modeling, so it requires additional data. In another side, spatial data recording technology using techniques of photogrammetry and laser scanner has reached an advanced stage. Therefore, automatic recording and modeling of project building data and conversion of 2D CAD data into the BIM model become a challenge. This study aims to build a 3D model of existing building in BIM by integrating 2D CAD data with Close Range Photogrammetry (CRP) technology. The building modeled in this study is Sekolah Bisnis Manajemen (SBM) Freeport at Institut Teknologi Bandung-Ganesa. The 2D CAD data is used to model the 3D building interior. For building exterior, CRP is used for data collection and processing with the control using Electronic Total Station (ETS). Then building can be modeled by data from those methods in a 3D modeling software. The result of combining those two methods is the 3D building model which already has global coordinates. That 3D building model saved as BIM model with format file IFC and can be uploaded to BIM server.

Keywords: 3D Model, BIM, CAD, Photogrammetry

ESTIMATION OF POPULATION DISTRIBUTION USING SATELLITE IMAGERY AND GIS DATA

Tran Thanh Dan (1), Manzul Kumar Hazarika (1), Hiroyuki Miyazaki (2), Syams Nashrrullah(2) , Ashok Dahal(1), Ryosuke Shibasaki(2)

[1] Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathum Thani 12120, Thailand.
[2] Center for Spatial Information Science, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa-shi, Chiba, 277-8568, Japan
Email: ttdan@ait.asia

Abstract: Spatial distribution of population map at a finer scale is useful for planning and policy development. A number of population estimation techniques have been developed to disaggregate census data and predict density of population at finer scale. Therefore, this research is one of those attempts to improving high resolution on human population distributions, by presenting a new modeling approach to map the population using census, building footprints, satellite imagery, and ancillary data. The data were processed through four main steps: (1) data collection and pre-processing including: population and building footprints extraction from census data and cadastral map and/or satellite data, respectively; socioeconomic and building information survey using DRM Survey mobile application which developed by Geoinformatics Center, Asian Institute of Technology (GIC- AIT, Thailand); and ancillary data collection, including: topographic, infrastructure, river network, road network, satellite data (GeoEye), and night-time light imagery; (2) covariates preparation for fitting and predicting randomForest models; (3) model adjustment and estimation population at building level; and (4) geospatial population distribution mapping at 30 m spatial resolution. Validation of results was made by comparing the estimation with the population census data at ward level, which showed a good correlation. We found that RF model performs better than several other commonly used models. An assessment of covariates is important for accurately estimating population. The values of variable importance may fluctuate as the number of covariates is reduced. However, relative ranking is quite stable among top covariates, for example: distance to function area (hospital, school, post office, …), road networks, or nighttime light are most important predictors for reducing amount of variability left in log population of training data. An advantage with the approach is that we can aggregated population can be re-distributed to a fine scale, providing quantitative information of planning and policy development.

Keywords: Population Mapping, Machine Learning, Building Extraction, Mobile Application

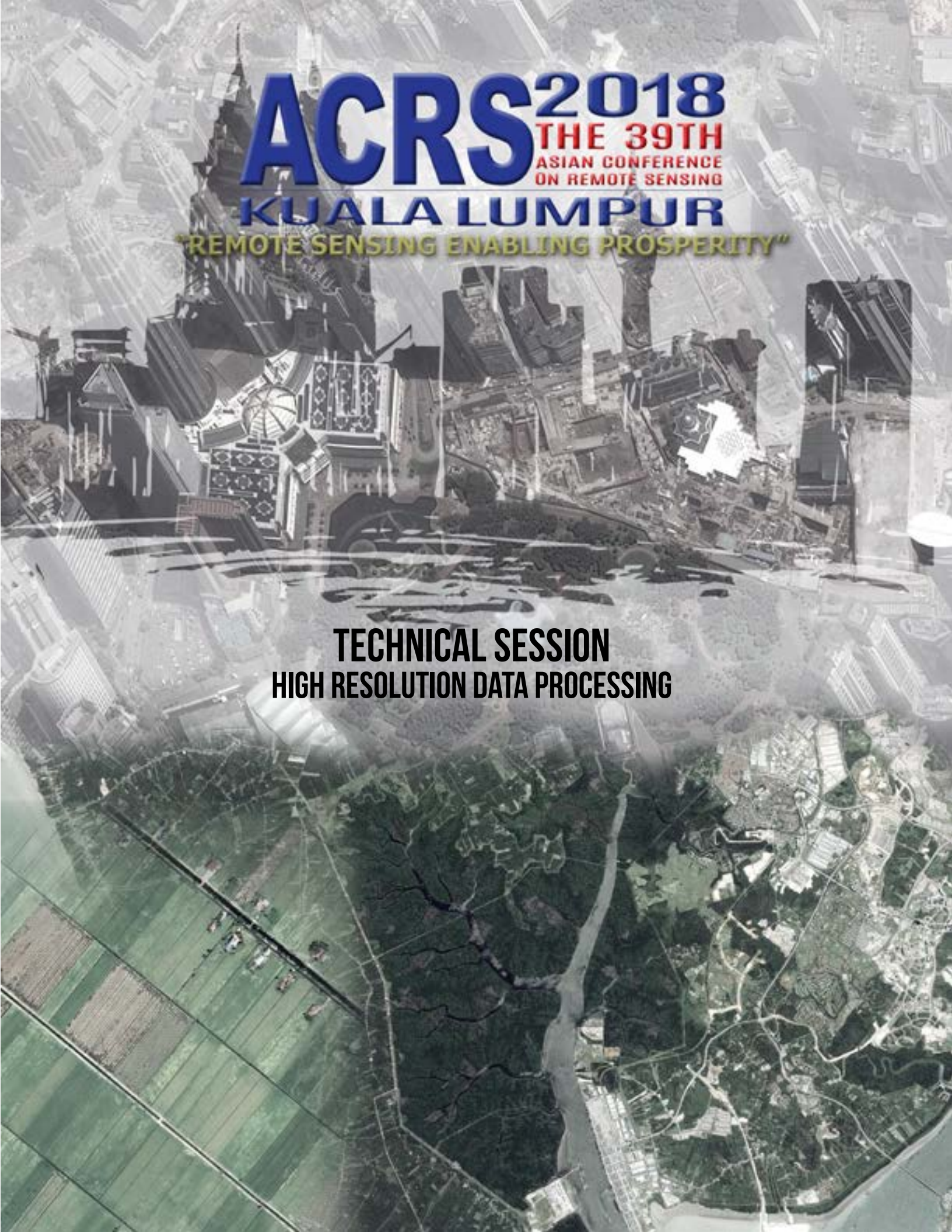
RECONSTRUCTION OF 3D URBAN ENVIRONMENT FOR THE IMMERSIVE PLANNING OF ELEVATED RAILWAY SYSTEMS

Yi-Chung Tung (1), Hsi-Hsien Wu (1), Hong-Kuei Cheng (1), Liang-Chien Chen (2)

[1] CECI Engineering Consultants, Inc., Taiwan, No. 323 Yangguang St., Neihu District, Taipei, 11491, Taiwan
[2] The Center for Space and Remote Sensing Research, National Central University, 300 Zhongda Road, Zhongli District, Taoyuan 32001, Taiwan
Email: tonytung@ceci.com.tw; zephyr@ceci.com.tw; tc561@ceci.com.tw; lcchen@csrsr.ncu.edu.tw

Abstract: One of the most important issues in the renewal of civil infrastructure is to examine the harmonization between the construction body and the existing environment. By comparing all of the optional scenarios through virtual visualization, the decision can be optimized. In addition, the owner and the general public tend to accept the renewal plan, provided that they can foresee the future reality. To practice this immersive planning thought, this paper reports an on-going renewal project of elevated railway systems from plane ones in ChiaYi, Taiwan. The existing 3D environment was reconstructed using photogrammetry. Then, the construction plan of the elevated railway systems, including a railroad station, was integrated with the environment information for decision support. The major work of this study comprises three major parts: (1) 3D building modelling, (2) landscape generation, and (3) integration of construction body, buildings, and landscape. By applying photogrammetry, the first level of details (LOD1) building models covering entire ChiaYi City were reconstructed in the first place. Some landmark buildings as requested by ChiaYi City Government were modelled with textured LOD2. In the landscape generation, the whole city was reconstructed by combining oblique aerial photogrammetry and unmanned aviation vehicle (UAV) images. The combination of the first two parts in a visualization platform illustrates the visualized city environment. The third step is to integrate the construction data for the elevated railway systems into the visualization platform. The integrated system provides planners a solid base to examine the harmonization between the engineering body and the city environment. The compatibility between the planned railway systems and the current transportation systems can also be scrutinized. It is also expected that the developed system will provide planners an effective way to communicate with the owner as well as to accommodate public opinions to create a win-win situation.

Keywords: Building Model, Infrastructure Planning, Landscape, Photogrammetry, Visualization



TECHNICAL SESSION

HIGH RESOLUTION DATA PROCESSING

RELATIVE ORIENTATION OF STEREO IMAGES FOR EPIPOLAR IMAGE RESAMPLING WITHOUT ANY GROUND CONTROL POINT

Jaehong Oh (1), Changno Lee (2)

[1] M Dept. of Civil Engineering, Korea Maritime and Ocean University, Busan, South Korea
[2] Dept. of Civil Engineering, Seoul National University of Science and Technology, Seoul, South Korea
Email: jhoh@kmou.ac.kr; changno@seoultech.ac.kr

Abstract: Stereo satellite images should be precisely resampled for the epipolar images that achieve zero y-parallax and make x-parallax linearly proportional to the ground height. The image providers support RPCs (Rational Polynomial Coefficients) that are not precise enough such that the relative orientation of stereo images is required without any GCP's (Ground Control Points). We extracted match points from stereo images to reconstruct their ground coordinates using the provided RPCs. The ground points are back projected into the image spaces to relatively refine the RPCs. We also applied the outlier detection for the match points for better RPCs refinement. The experimental results on Kompsat-3 data showed nearly zero parallax was observable.

Keywords: RPC, Epipolar, Relative orientation, RPC refinement

SATELLITE IMAGE DE-BLURRING PROCESSING

Yu-Lin Tsai (1), Chao-Tsung Huang (2), Shian-Jing Liu (1)

[1] National Space Organization, 10F, 9, Prosperity 1st Road, Science-Based Industrial Park, Hsinchu, Taiwan 30078, R.O.C.
[2] National Tsing Hua University, Department of Electrical Engineering, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C.
Email: morphling@nspo.narl.org.tw; cynthia@nspo.narl.org.tw; chaotsung@ee.nthu.edu.tw

Abstract: In recent years, de-blurring is commonly used for satellite image processing for increasing product image quality. The de-blurring processing can be classified into two parts: (1) point spread function (PSF) estimation and (2) deconvolution processing. The PSF of a satellite imaging system is determined by two effects: (1) satellite optical system and (2) atmospheric interference; therefore, it depends on locally and temporally atmospheric conditions. As a result, image-based computational modeling via sharp image edges is a classical way to generate a suitable PSF for each image. The deconvolution processing algorithms, such as inverse filter, Wiener filter, Richardson–Lucy deconvolution, and Total variation (TV), are different approaches which can recover blurred images with different image qualities. In satellite image de-blurring processing, we choose the TV-based algorithm, which was first proposed by Rudin, Osher, and Fatemi in 1992, for reconstructing clean satellite images. Its theoretical assumption is expressed by

$$B = k \otimes I^0 + n,$$

where B, k, I^0 , and n represent the blurred image, kernel function, original image, and additive noise respectively. The image I^0 is recovered from the model with given B and k:

$$\min_{I} \frac{\mu_1}{2} \|\nabla I\|_2^2 + \mu 2 \| k \otimes I^0 - B \|_1.$$

The computational efficiency of the traditional TV algorithm is a major issue. Therefore, for reducing the computational complexity, the Fast Fourier Transform (FFT) can be applied in each iteration of the TV method, which is called Fast TV (FTV) method. Moreover, for reducing the iteration number, the augmented Lagrange method is applied on the FTV method. The non-blind deconvolution technique with the estimated kernel, combined with a de-noise method, has proved to be an effective way to restore ground features from original images.

Keywords: Satellite image, Deblurring Processing, Total Variation method, Fast Fourier Transform, Augmented Lagrange Method

INVESTIGATION OF GEOMETRIC CORRECTION ACCURACY OF IKONOS-2 SATELLITE IMAGES USING RPC VERSUS GCPS

Essam Hamza (1), Hassan Elhifnawy (2)

[1] Electric and Computer Engineering Department, Aircraft Armament (A/CA), Military Technical College, Cairo, Egypt
[2] Civil Engineering Department, Military Technical College, Cairo, Egypt
Email: hamzaesam@gmail.com; hassanelhifnawy@gmail.com

Abstract: Geometric distortions are common problems when dealing with images captured from remote sensing satellite. Therefore, geometric correction is a necessary process for preparing images captured from satellite for many applications. Physical sensor model relates image pixels to ground positions by modeling geometry of imaging. Physical sensor comprises input of calibrated sensor parameters such as detector locations, focal length, input of satellite position and pointing at any given time. All these inputs data conveyed via image metadata. Since, physical sensor model is not available in common for satellite image users. So, a Rational Polynomial Coefficient (RPC) model is provided as an alternative representation of sensor model. The RPC model relates ground positions to image pixels by using ratio of third order polynomial equations. In case of using RPC file in correction process the accuracy of the resultant image depends on the accuracy of RPC model which is not known as common. The available data is IKONOS-2 image with its RPC file and seven GCPs with high accuracy obtained from ground survey for the study area. The research objective is to study geometric correction process for IKONOS-2 images using the available data in order to investigate the method that produce highest spatial accuracy. The input image is corrected three times; the first method correction using RPC file only; the second method correction using RPC file with polynomial model as a complementary model; the third method correction using first degree of polynomial in case of GCPs. Bilinear interpolation resampling technique is used to determine the pixel value of the newly resultant corrected images for the three cases. GCPs are preferred when available to be used with RPC file because the third case gives the best spatial accuracy.
resampling.

Keywords: Geometric correction, Rational Polynomial coefficient, Polynomial transformation, Image

ON THE TIME SERIES CONSTRUCTION OF OFFSHORE CHLOROPHYLL CONTENT BASED ON VIRTUAL SATELLITE CONSTELLATION

Huang Miaofen (1), Xing Xufeng (1), Fu Yao (2), Sun Zhongyong (1), Wang Zhonglin (1)

[1] Faculty of Mathematics and Computer Science, Guangdong Ocean University, 524088 Guangdong Zhanjiang China
[2] South China Sea Institute of Oceanography, Chinese Acadamy of Sciences, 510301 Guangdong Guangzhou, China
Email: hmf808@163.com; 4918585@qq.com; 339477465@qq.com; 1027126966@qq.com; wzlin19@qq.com

Abstract: In order to resolve the conflict between the temporal and spatial resolution of remote sensing, we plan to construct a virtual satellite constellation by combining multiple satellites with high spatial resolution sensors to improve the temporal resolution. By using satellite-land synchronized data obtained in 4 different offshore regions near china between 2015 and 2017, we evaluated the remote sensing chlorophyll inverse algorithms of different sensors, and further determined a remote sensing inverse model, which is suitable for data of multiple medium-high resolution satellites. By using GOMS/GOCI chlorophyll concentration product as reference, we first projected the chlorophyll concentration values inverted from satellites HJ-1A, HJ-1B, GF-1, GF-2, GF-4, Landsat 5, Landsat 7 and Landsat 8 to a 50-m grid by applying flux conservation resampling method. We further applied re-standardization method to obtain re-standardization equations, which make the chlorophyll concentration values inverted from different sensors comparable. Finally, we chose the seas around Chudao Island near Weihai as the studied area, and established a monthly time series of chlorophyll concentration of the past 20 years (between 1998 and 2017) according to the re-standardization equations, and analyzed the characteristics of the time series.

Keywords: virtual satellite constellation, chlorophyll remote sensing inverse model, GOMS/GOCI, re-standardization, seas near Weihai

DEVELOPMENT OF NORMALIZED INDICES FOR EXTRACTION BUILT-UP AREA BASED ON SPECTRAL CHARACTERISTIC OF WORLDVIEW-2 IMAGERY

Iswari Nur Hidayati (1), R. Suharyadi (2), Projo Danoedoro (2)

[1] Student of Doctorate Program, Faculty of Geography, Gadjah Mada University
[2] Geographic Information Science Department, Faculty of Geography, Gadjah Mada University
Email: iswari@ugm.ac.id

Abstract: Urban built-up is the impact of agricultural land and green open space conversion into settlements. Comprehensive data and effective mapping methods are needed in mapping dynamic land especially in urban areas. Mapping, planning, and monitoring of urban built-up area requires information about the land conversion. Mixing urban-built-up with the bare land, vegetation, and water reflection is a problem in land conversion using medium resolution imagery. Remote sensing images are useful for monitoring the spatial distribution and growth of urban built-up areas because they can provide timely and synoptic views of urban land cover. Remote sensing data, especially worldview-2 imagery, has advantages in both spatial and spectral resolutions. High spatial characteristics and combined with various spectral make the worldview-2 imagery is the best choice as the main data in the study for urban phenomena. The pure-band combination indices and PCA become the simple input for creating normalized index (NI). NI is a simple formula for index transformations. This study aims to explore the performance of the whole spectral information offered by the Worldview-2 sensor for built-up automatic extraction and to find the best accuracy of the normalized difference index produced by spectral reflection of worldview-2 images. The first step is to combine eight pure-indices images with normalized index. Then, make NI from eight PCA bands combined with pure-indices band of worldview-2. Visual analysis and interpretation is carried out by researchers to continue determining threshold values that distinguish built-up and non-built-up area. The number of combinations produced were 56 combinations of pure indices and 56 combinations of PCA. The results showed that the combination of pure-indices had better accuracy than PCA involving 8 bands at that time.

Keywords: built-up mapping, Normalized Index, PCA, urban area

ROOF SEGMENTATION USING TRUE-ORTHOIMAGE AND DSM WITH OBIA PARADIGM

Theo Prastomo Soedarmodjo (1), Jiann-Yeou Rau (1)

[1] Department of Geomatics, National Cheng Kung University, No.1, University Road, Tainan City 701, Taiwan (R.O.C.)
Email: theo.soedarmodjo@gmail.com; jyrau@mail.ncku.edu.tw

Abstract: Currently analyzing high-spatial resolution image data to classify the object is one of the most important research topic. Conventional stereo-plotting method that use manual object delineation will take a long time in the process. Therefore, a more effective approach is needed to overcome it. Object Based Image Analysis (OBIA) is the solution offered to facilitate the identification of objects by considering to the shape, size, area, and information contained in the objects. In this study, we use true-orthoimage and DSM (Digital Surface Model), generated by (Unmanned Aerial Vehicle) UAV images, with 0.05-meter spatial resolution as the base data to get the segmentation results from the roof of the building. In which, DSM is used to obtain height information for each object. Moreover, DSM data is used to get the slope of the roof to separate different roof planes of the same building. And then, the segmentation process is done on the roof of the building based on the aspect of the roof of the building. Segmentation of the object is done by multi-resolution segmentation technique by considering the parameters of scale, shape and compactness to get maximum accurate result in each building. This approach is applied to identify the roof of the building at the sea shore villages of Tainan, Taiwan with an area of 200 x 200 square-meters. Finally, the result of segmentation is compared with the manually delineation result for accuracy assessment.

Keywords: OBIA, True-orthoimage, DSM, Segmentation,

CLASSIFIED RESULT IMPROVEMENT OF HIGH RESOLUTION SATELLITE IMAGE BY USING MAXIMUM AND MINIMUM FILTER

Tsukasa Hosomura (1)

[1] Division of Information System Design, Tokyo Denki University, Ishizaka, Hatoyama, Hiki, Saitama, 350-0394, Japan
Email: hosoura@mail.dendai.ac.jp

Abstract: Land cover classification is still very important in remote sensing field. Many kinds of approaches are conducted for the classification. These approaches are succeeded for medium resolution satellite image. There are many noises in land cove classified result of high resolution satellite image. Land cover classes are usually selected as urban, forestry, water body, soil and glass. Forestry can be improved by using NDVI. Water body and soil cannot be improved so easy. Classified result shows that water body includes shadow of building. There are many colors for soil because of humidity and vegetation contents. We found out that these problems can be solved by using maximum filter and minimum filter. Water body and shadow of building are detected very easy by using pixel value. These pixels have very small value. Shadow of buildings were deleted by using these filters because the area is very small. After applying these filters, we can divide into water body and shadow of building. Soil has many colors for multi spectral image. Soil has simple characteristic for panchromatic image. Difference of maximum filter and minimum filter is small. This characteristic was obtained for water body and roof of building also. Water body can be detected by the previous mentioned method. The area of roof is smaller than that of soil. Soil was detected by using these characteristics. In this paper, the procedure of these filter to improve the classified result is explained precisely.

Keywords: Filtering, High resolution, Classification, NDVI, Difference

MULTI-SCALE RESIDUAL CONVOLUTIONAL NEURAL NETWORK FOR SHADOW DETECTION IN HIGH RESOLUTION REMOTE SENSING IMAGES

Shuang Luo (1), Huifang Li (1), Yumin Chen (1), Zhiwei Li (1), Yancong Wei (2), Huanfeng Shen (1)

[1] School of Resource and Environmental Sciences, Wuhan University, No.129 Luoyu Road, 430079 Wuhan, Hubei, P. R. China
[2] McFLY Technology, Chaoyang District, 100000 Beijing, P. R. China
Email: sluo@whu.edu.cn; huifangli@whu.edu.cn; ymchen@whu.edu.cn; lizw@whu.edu.cn; weiyancong@mcfly.com.cn; shenhf@whu.edu.cn

Abstract: The presence of shadows degrades the image quality and reduces the interpretation accuracy. With the improvement of the spatial resolution of the remote sensing images, the shadow effect has become more and more obvious. Therefore shadow detection is an essential step for remote sensing image analysis. Convolutional neural networks have recently demonstrated outstanding performance for image processing, but few works have been done for shadow detection in remote sensing images with this technology. In this paper, we propose a novel multi-scale residual convolutional neural network for shadow detection in high resolution remote sensing images. The core of the proposed network is composed of a multiscale encoder network and a corresponding decoder network with residual structure. The encoder network is used to extract the image features and downsample the input feature maps gradually, while the decoder network learns to upsample its input feature maps and generates the shadow detection result which has the same size as the input image. The residual structure is used in two aspects, i.e., internal same scale connection and encoder-decoder connection. The pre-activation residual structure is adopted in the proposed network which has been verified to be much easier to train and generalize better result than the original ResNet. The training data is from UCF database and data augmentation is used to increase the amount of the training data with random downscale, flipping and rotation. The overall accuracy of the proposed method on the test images is above 90%. The shadow detection results from the proposed method are compared with the traditional shadow detection algorithms in visual analysis and quantitative assessment. It shows that the proposed deep learning approach can achieve more accurate result than the traditional methods.

Keywords: Deep learning, residual convolution neural network, shadow detection, remote sensing images

ACCURACY ASSESSMENT OF SPOT-6 IMAGERIES BASED ON VARIOUS DISTRIBUTION OF GCP

Nuradzri bin Ahmad (1) Mohamad Yatimi bin Mohd Rasid (1)

Malaysian Remote Sensing Agency, Department of Geospatial Data Analysis,
50480 Kuala Lumpur Malaysia
Email: nuradzri@remotesensing.gov.my; yatimi@remotesensing.gov.my

Abstract: The Spot 6 satellite has the capability to acquire images with a resolution of 1.5 meters (pan-sharpen). High-resolution images such as Spot 6 requires a high accuracy geometric correction (orthorectification) which is on par with the resolution. In this study, Spot 6 images in Klang Valley has been geocorrected (orthorectified) using PCI Geomatica and then compared with Ground Control Point (GCP) measurements. GCP points within Klang Valley area were collected using GPS with MyRTKNet. All the GCPs points were tested using 7-type distribution method to determine the Root Mean Square Error (RMSE), mean error and maximum error. For the purpose of this study, I have focused on 7 types of distribution which were 1, 2, 3,4,5,6 and 7. Seven different kinds of distributions of GCPs and checkpoints were designed. The GCPs and checkpoints (CPs) were selected manually. The orthomodel were geocode manually refer the 7 type distribution design using PCI Geomatica 2013 software. Check Point (CP) were done to assess residual error for each individual point. With CP, the difference between ground location (E and N) can be determined using formula. The result of this paper, evaluate the quantitative and qualitative accuracy of the image. From quantitative analysis, the result shows that the type-7-ortho generated imagery have the better result in the horizontal position compare to another types ortho generated imagery. But the qualitative the result shows that there were not too much different between the topographic datasets overlaid these two ortho-imageries. Qualitative analysis shows that SPOT-6 suitable for mapping purposes at 1:10000 ~ 1:25000 scale.

Keywords: Accuracy Assessment, GCP Distribution, Quantitative & Qualitative, RMSE, Remote Sensing

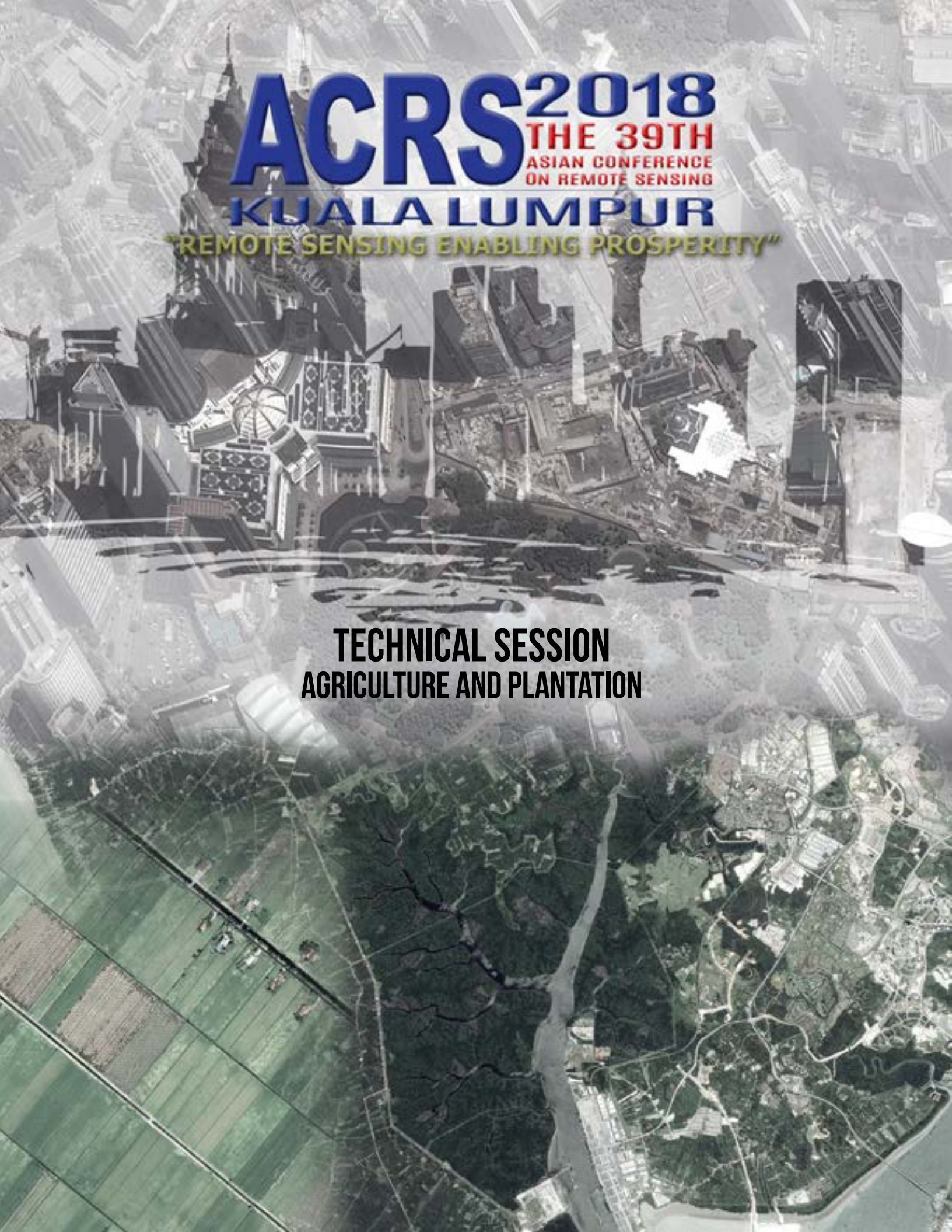
URBAN VEGETATION MAPPING THROUGH PIXEL BASED IMAGE ANALYSIS OF MULTISPECTRAL PLEIADES IMAGERY

Haslina Hashim (1), Zulkiflee Abd Latif (1), Nor Aizam Adnan (1)

[1] Centre of Studies Surveying, Science & Geomatics, Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
Email: haslinah8118@gmail.com.my; zabdlatif@gmail.com.my; adnannoraizam@gmail.com

Abstract: Urban vegetation and land use information is critical for sustainable environmental management in urban areas. Furthermore, urban vegetation plays an important role for urban planning through a balance between the natural environment and the built environment. Thus, mapping of urban vegetation is important towards sustainable urban development. Remote sensing has increasingly been used to derive such information for mapping and monitoring the changes of urban vegetation. The use of remote sensing data for urban mapping has increased along with the availability of very high resolution (VHR) satellite data such as Quickbird, Worldview and Pleiades. The aim of this study is to identify and classify using remote sensing methods in the context of a vegetation mapping in urban environment. This paper describes the use of high resolution Pleiades imageries to extract and classify vegetation in an urban area with the use of pixel-based image analysis. Classification types in the study area were divided into vegetation and non-vegetation classes. Pixel based method was applied and support vector machine algorithm was used for classification of urban vegetation. Comparison of accuracies was made from the error matrices, overall accuracy and kappa coefficient. The overall accuracy for threshold classification approach was 98.980% and a kappa value of 0.9795. Result shows the ability of multi angular images to extract urban vegetation accurately despite the complex surface of urban area. This information is useful to support other research application related with urban green spaces monitoring and conservation purpose.

Keywords: Remote Sensing, Urban Vegetation, Very High Resolution (VHR), Pixel-Based Classification, Support Vector Machine



TECHNICAL SESSION
AGRICULTURE AND PLANTATION

EXTRACTION OF WINTER WHEAT PLANTING AREA WITH THE WBSI IMAGES OF THE KEY GROWTH PHASE IN BINZHOU-DONGYING CITY, CHINA

Qingsheng Liu (1), Gaohuan Liu (1)

[1] State Key Laboratory of Resources and Environmental Information System, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences
11A, Datun Road, Chaoyang District, 100101 Beijing, China
Email: liuqs@lreis.ac.cn; liugh@lreis.ac.cn

Abstract: The Wide Band Spectral Imager (WBSI) onboard the Tiangong-II space lab was launched at the Jiuquan Satellite Launch Center of China on September 15, 2016 which has 14 visible and near-infrared (VNIR) spectral bands covering the range from 403-990 nm at a spatial resolution of 100 m. The WBSI images the Earth's surface in 300-killometer-wide swath which supports a wide range of applications such areas as agriculture, forestry, geology, geography, ocean, water resource, natural hazard, and coastal researches. Objectives: In this paper, we firstly attempted to use the key growth phase images from the WBSI to extract the winter wheat planting area at Binzhou-Dongying City of Shandong Province in 2017. Methods: The spectral reflectance of the WBSI imagery was retrieved using the quick atmospheric correction method within ENVI software v5.1. A Decision Tree (DT) was built to extract winter wheat planting area from the images using NDVI2017 (NDVI value in 2017), NDVI2016, B12017, B22017, and B142016. Results: An area 295,419 ha of winter wheat at Binzhou and 64,715 ha at Dongying was estimated using the DT based on the images acquired on October 14, 2016 and March 18, 2017. Compared the authorized winter wheat planting areas in 2017 from Binzhou and Dongying, the area at Binzhou was overestimated by 26,944 ha, about 10%, and the area at Dongying was underestimated by 40,025 ha, about 38%. Comparison of spatial distribution of winter wheat planting area was performed between the data sampled from the same period Landsat OLI images and the WBSI-extracted winter wheat distribution results. The overall accuracy of spatial distribution of WBSI-extracted winter wheat is 82.5%, the winter wheat omission error is 20.0%, and the winter wheat commission error is 15%. Conclusions: This study indicated that Band 1 and Band 2 and Band 14 of the WBSI were useful to identify the winter wheat. However, the mixing pixels and marginal effect of pixels from lower spatial resolution of the WBSI imagery (100 m) increased the NDVI values of the small rural residents in the green-up phase of winter wheat, which would increase the extraction error of winter wheat planting area.

Keywords: the wide band spectral imager, winter wheat planting area, decision tree, NDVI

DETERMINATION OF TROPICAL FORESTS PARAMETERS IN GROSS PRIMARY PRODUCTION CAPACITY ESTIMATION ALGORITHM IN BRAZIL

Aika Wakai (1), Kanako Muramatsu (1)

[1] Nara Women's University, Faculty of Science, Environmental Science, Kita-Uoya-Nishimachi, Nara, 630-8506, Japan
Email: wakai-aika6492@es.nara-wu.ac.jp; muramatu@es.nara-wu.ac.jp

Abstract: Global warming is caused by the increase in CO_2. In terrestrial region, plants absorb it through photosynthesis. Gross primary production (GPP) is the total amount of CO_2 absorbed by plants. It is important to estimate GPP to understand carbon cycle in detail. Satellite data are useful for estimating GPP globally. Gross primary production capacity ($GPP_{capacity}$) estimation algorithm using satellite data was developed by Thanyapraneedkul *et al*. (2012). In the algorithm, photosynthetic processes are divided into two parts. One is photosynthetic capacity and the other is photosynthesis reduction because of weather conditions. $GPP_{capacity}$ is defined as GPP when plants have less stress of dryness. Light-response curve is used to determine the parameters in the algorithm. In previous studies, they were determined for each vegetation type in Asia, North American and European continent. Tropical forests in Brazil occupy 14% of the forests on the earth. It is important to determine the parameters in $GPP_{capacity}$ estimation algorithm of tropical forests especially in Brazil. In this study, we focused on the tropical forests in Brazil and determined the parameters in $GPP_{capacity}$ estimation algorithm. We used ground observed flux data and satellite data of Moderate-resolution Imaging Spectroradiometer (MODIS). First, $GPP_{capacity}$ was selected from ground observed GPP. Second, the parameters such as initial slope and $GPP_{capacity}$ in the light saturation ($P_{max\_capacity}$) were determined. Light-response curve was fitted to the data of photosynthetically active radiation (PAR) vs. $GPP_{capacity}$ to determine them using flux data. $P_{max\_capacity}$ has a relationship with chlorophyll content. To estimate $P_{max\_capacity}$ also from the satellite data, the relationship between $P_{max\_capacity}$ and chlorophyll index calculated from MODIS data was examined. From this study, the initial slope in light-response curve was determined. And $P_{max\_capacity}$ was estimated from the chlorophyll index as a linear formula in tropical forests in Brazil. $GPP_{capacity}$ could be regarded as GPP in Brazil because the ratio of GPP to $GPP_{capacity}$ was 0.91. $GPP_{capacity}$ estimated using satellite data was different from $GPP_{capacity}$ selected from flux data because of the cloud-affected satellite data. In next study, we should consider them in detail.

Keywords: Gross primary production, Photosynthesis, Tropical forest, MODIS

A STRAIGHTFORWARD FRAMEWORK TO FIND CROP AGE FROM MULTIPLE SATELLITE IMAGES: A CASE STUDY OF PARA RUBBER

Sornkitja Boonprong (1), Peerapong Torteeka (2), Pantip Jongkroy (1),
Mongkol Raksapatcharawong (3), Chanika Sukawattanavijit (4)

[1] Department of Geography, Faculty of Social Sciences, Kasetsart University, 50 Ngamwongwan Rd. Lardyao, Jatujak, 10900 Bangkok, Thailand
[2] National Astronomical Observatories, Chinese Academy of Sciences, 20A Datun Road, Chaoyang District, 100012 Beijing, China
[3] Department of Electrical Engineering, Kasetsart University, 50 Phaholyothin Rd. Ladyao, Jatujak, 10900 Bangkok, Thailand
[4] Geo-Informatics and Space Technology Development Agency (GISTDA), Chaeng Wattana Rd. Lak Si, 10210 Bangkok, Thailand
Email: sornkitja.b@hotmail.com; torteeka@outlook.com; fengmkr@gmail.com; fengwcy@ku.ac.th; chanika.sukawattanavijit@hotmail.com

Abstract: Crop age is a key parameter for production management and for determining the carbon distribution in ecosystems. However, using satellite images to determine crop age is often complex and requires a thorough understanding of the crops in the study area. This study provides a simple and practical framework for assessing crop age, particularly for *Hevea brasiliensis* or Para rubber, a major cash crop in Southeast Asia that is a key parameter for latex and rubberwood production. In this framework, for each satellite image in a series, it is determined which pixels can be classified as bare land using their SAVI and NDVI values. These pixels are labeled with the acquisition dates of their respective images, and composited together to create a bare land reference layer. By subtracting the reference layer from any rubber plantation map, an accurate rubber plantation crop age map is obtained. This framework is suitable for creating the reference map using historical Landsat imagery since old rubber plantations are typically cut 25 – 30 years after being planted. Although the framework requires several satellite images, absolute atmospheric correction is not required since no qualitative value is assumed or calculated across the images. The major advantage over all traditional age classification methods is that once a reference map is obtained, it can be used or updated with satellite images from any sensor. Aside from the conventional challenges in satellite imagery such as cloud cover and hazy conditions, the precision of the crop age estimated using this framework depends strongly on the temporal resolution of the image series due to some bare lands remaining bare for several years.

Keywords: big data, plantation age, remote sensing, rubber

CALCULATING GREEN HOUSE GAS EMISSIONS (CH_4, N_2O, CO_2) RELEASED FROM AGRICULTURE – A CASE STUDY IN DONG THAP PROVINCE

Thao Tong (1), Hang Doan (1), Linh Nguyen (1), Long Ta Bui (1)

[1] Bach Khoa University, Ho Chi Minh City National University
Email: longbt62@hcmut.edu.vn

Abstract: Agriculture sector accounted about 33% of total greenhouse gas emissions, ranked second after energy. In Vietnam, agriculture plays a vital role in the economic development contributing 18.14% to the GDP of Vietnam in 2016 with average growth accelerator approximately 4.06% per year from 1986 to 2015. The case study is Dong Thap province which was ranked the third in producing rice (3,397 million tons /year, 2016) and the second in aquatic products in Vietnam. This article presents results of the GHG emissions assessment from agricultural activities in the cultivation (rice, maize, sweet potato) and biomass burning, aquaculture and livestock (manure management, enteric fermentation) by utilizing IPCC method (IPCC, 2006). The results show that CO_2 emissions from crops accounted for the highest rate at 57.22%, followed by the combustion of agricultural straw burning, 41.1%. While that of livestock and aquaculture figure reach 1.28% and 0.39%, respectively.

Keywords: green house gas emissions, agricultural production, IPCC 2006 model for emission calculation (Intergovernmental Pannel on Climate Change)

CONCOCTING VARIATION IN NEE AND ITS RELATION WITH LANDUSE AND VEGETATION TYPE OF BANNI GRASSLANDS OF KUTCH USING GEOSPATIAL APPROACH

Usha Joshi (1), Ashwini Mudaliar (1), G.Sandhya Kiran (1)

[1] Eco-physiology RS-GIS Lab., Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India
Email: ushajosh12@gmail.com; ashwini144@gmail.com; sandhyakiran60@yahoo.com

Abstract: Banni grasslands of Kutch region of Gujarat is one of the finest grasslands of Asia and covers an area of 2658.44 km^2. It is having rich wildlife and high floral biodiversity owing to diverse habitats existing in the area. However, improper grazing management associated with large livestock, extensive use of fire, invasion of Prosopis, etc. is leading towards the degradation of these grasslands resulting into reduced capacity of carbon uptake. This makes it important to study carbon dynamics of these ecosystems using well known potential of geospatial approach. Landsat 8 ETM+ image of Nov. 2017 was utilized to identify the landuse types of the study area and for derivation of Normalized Deferential Vegetation Index (NDVI) and Fractional Vegetation Cover (FVC) of the region. Net Ecosystem Exchange (NEE) was acquired from the SMAP NEE data for the entire year of 2017 to analyse the seasonal variation of NEE. Results revealed that the Banni grasslands acted as the source of Carbon for almost entire year while as sink during the growth period (i.e. during July to December). NEE when compared with Land use type revealed that grasslands are the most active sink of carbon while Prosopis and Acacia acted as weak sinks. Negative correlation of NEE with NDVI and NEE revealed that the dense grasslands with good FVC can act as good sink of the carbon. In the nut shell, the results proves that NEE is affected significantly by the type of vegetation and landuse of the ecosystem. An effective management plan with special emphasis on prevention of degradation of the Banni grasslands is the need of the hour.

Keywords: CO_2 flux, Grasslands, Source and Sink, NDVI, FVC

ASSESSMENT OF DAILY CROP EVAPOTRANSPIRATION USING ANALYTICAL CROP COEFFICIENT AND VEGETATION INDEX OF LANDSAT TM OVER SONG CAU BASIN OF VIETNAM

Luong Chinh Ke (1), Nguyen Van Hung (2)

Vietnam Association of Surveying - Mapping – Remote Sensing, Hanoi, Vietnam
Departement of National Remote Sensing, Hanoi, Vietnam

Abstract: Sustainable management of water resources plays an important role in agricultural production under the pressure of climate change. This study focused on estimating the daily actual evapotranspiration (ETa) of the SONG CAU basin surface in northern Vietnam based on the Kc-analytical using external meteorological data and vegetation index NDVI extracted from Landsat TM images. The study was conducted for the Landsat TM images on November 23, 2001 and was tested on November 4, 2000 under two variants: (1) ETa is estimated from Kc-analytical and (2) ETa is estimated using the Simple Surface Evapotranspiration Balance Index (S-SEBI) method. In particular, for both above variants reference evapotranspiration are calculated using FAO-56 model. In experimental results, obtained ETa of variant 1 for November 23, 2001 on 6 meteorological observations, ETa(2001-Kc) has RMSE = 0.22 mm/d (7.45%, respectively); mean bias error, MBE = -0.152 mm/d; and mean absolute error, MAE = 5.60%. Variant 2 defines ETa for the same time, ETa(2001-S) has the following compatibility errors: RMSE = 0.444 mm/d (15.05%); MBE = 0.150 mm/d; MAE = 11.13%. Using the Kc-analytical model of November 23, 2001 (Variant 1) to calculate ETa for the time of November 4, 2000, ETa(2000-Kc), the errors of ETa(2000-Kc) are: RMSE = 0.582 mm/d (14.92%); MBE = -0.089 mm/d; MAE = 14.05%. Similarly, the errors of ETa for the same time calculated under variant 2, ETa(2000-S) have the corresponding values: RMSE = 0.872 mm/d (22.37%); MBE = -0.570 mm/d; MAE = 16.64%. Research results in the SONG CAU watershed, Vietnam, show that the ETa estimated by Kcanalytical with NDVI is more accurate than that of the S-SEBI method.

SPATIAL DISTRIBUTION OF NET PRIMARY PRODUCTIVITY AND POTENTIAL EMISION CARBON IN SUMATERA ISLAND USING WITH MODERATE RESOLUTION IMAGING SPECTRORADIOMETER DATA

Ayu Nur Safi'i (1), Nugroho Purwono (1)

[1] Geospatial Information Agency, Jalan Raya Jakarta-Bogor KM.46, 16911, Cibinong, Bogor, Indonesia
Email: ayunursafii.10@gmail.com; inugpurwono@gmail.com

Abstract: Reducing emissions from the forestry sector both deforestation and forest degradation (REDD) is an important issue considering that forests in Indonesia are able to store a number of biomass, both in the form of surface biomass and subsurface biomass. Logging is one of the processes that cause the carbon dioxide (CO^2) gas release into the air. One type of forest ecosystem that becomes a pool of carbon in underground volumes is peatland forests. When forests on peatlands are burnt or drought, carbon emissions are not only limited from the vegetation above the soil, but also from the organic substance in the soil. Biomass is useful for assessing an ecosystem. One of the most realistic approaches to estimating large areas of biomass is by using a remote sensing data with the concept of Gross Primary Production (GPP). This concept can be calculated to obtain the NPP value estimation. Estimation Net Primary Productivity (NPP) based on Moderate Resolution Imaging Spectroradiometer (MODIS) monthly data which collected in 15 years from 2002 until 2016 with CASA (Carnegie Ames Stanford Approach) Model. Estimation of average per year for NPP in Sumatera Island from 2002 until 2016 is 569,731 (gt C m^{-2} yr^{-1}); 641,984 (gt C m^{-2} yr^{-1}); 577,054 (gt C m^{-2} yr^{-1}); 573,483 (gt C m^{-2} yr^{-1}); 550,234 (gt C m^{-2} yr^{-1}); 539,584 (gt C m^{-2} yr^{-1}); 540,069 (gt C m^{-2} yr^{-1}); 538,318 (gt C m^{-2} yr^{-1}); 525,560 (gt C m^{-2} yr^{-1}); 544,314 (gt C m^{-2} yr^{-1}); 538,228 (gt C m^{-2} yr^{-1}); 537,777 (gt C m^{-2} yr^{-1}); 551,219 (gt C m^{-2} yr^{-1}); 557,644 (gt C m^{-2} yr^{-1}); 533,173 (gt C m^{-2} yr^{-1}). Meanwhile, the flux of NPP in peat area in range 150-400 (gt C m^{-2} yr^{-1}). Based on climate variability, NPP value are closely related with Indian Ocean Dipole (IOD). In the period of monsoonal changes occurred, in April the value of NPP is in the highest range while in September and October the value of NPP is in the lowest range.

Keywords: NPP, CASA, MODIS

COMPARISON OF SPECTRAL MIXTURE ANALYSIS AND VEGETATION INDICES FOR FOREST CLASSIFICATION USING THEOS DATA

Sunsanee Maneechot (1), Rasamee Suwanwerakamtorn (2)

[1] Department of Computer Science Faculty of Science, Khon Kaen University Khon Kaen, Thailand
Geo-informatics Centre for Development of Northeast Thailand,
[2] Faculty of Science, Khon Kaen University, Khon Kaen, Thailand 40002
Email: sunsanee.maneechot@gmail.com; rasamee@kku.ac.th

Abstract: In general, a surface of land cover types is composed of a variety of natural mixtures. Mixed pixels have been recognized as a problem affecting the use of remotely sensed data in land cover classification. Spectral Mixture Analysis (SMA) approach is one of the most commonly used methods for handling the mixed pixel problem. It can be used to provide a full spectrum measurement of vegetation response, which makes it more robust than vegetation indices. This study aims to compare SMA and three vegetation indices – Normalized Different Vegetation Index (NDVI), Enhanced Vegetation Index (EVI) and Soil Adjusted Vegetation Index (SAVI) – in forest classification based on Maximum Likelihood Classifier (MLC). The area of study is Phukhieo Wildlife Sanctuary, Chaiyaphum province located in Northeast of Thailand, covering an area of approximately1560 km2. THEOS multispectral images with 15m resolution acquired 2013 was used for analysis process. The process of SMA included minimum noise fraction (MNF), pixel purity index (PPI), and n-dimensional visualization. The endmember extraction consists of four end member: Green Vegetation (GV), nonphotosynthetic vegetation (NPV), Shade and Soil. The result shows that the accuracy and kappa coefficient of 88.06% and 0.86 respectively were from SMA. The multispectral THEOS data with 15-m resolution proved to be effective in analyzing through SMA technique for classifying various forest types in high accuracy.

Keywords: Spectral Mixture Analysis, Vegetation Indices, Maximum Likelihood, THEOS data

PRIORITISED DEFORESTATION ALERTS USING A MULTI-SENSOR REMOTE SENSING APPROACH FOR THE MONITORING OF TROPICAL FORESTS IN SABAH REGION, MALAYSIA

Michel L. Wolters (1), Nanne Tolsma (1), Vincent Schut (1), Rens Masselink (1), Niels Wielaard (1)

[1] Satelligence, Hooghiemstraplein 121, 3514 AZ Utrecht, The Netherlands
Email: wolters@satelligence.com; tolsma@satelligence.com; schut@satelligence.com; rens.masselink@satelligence.com; wielaard@satelligence.com

Abstract: The main driver of land use change and forest cover loss in Sabah over the past few decades has been the demand for palm oil and the increasing profitability of its cultivation. Although total forest cover in Sabah remains high, and rates of deforestation low by regional standards, significant conservation issues remain. The regional government of Sabah launched a jurisdictional approach in 2015, with the aim to prevent further loss of natural capital and achieve deforestation-free supply chains by 2025. We propose a methodology that can assist with achieving this goal: a near real-time deforestation monitoring system based on a combination of freely available Sentinel-1 radar, and Sentinel-2 and Landsat-5,7,8 optical imagery. The prioritised deforestation alerts for early warning coming from this system can be used to plan timely interventions on the ground. Current studies show that the automated system can detect deforestation with high accuracy over large areas, and the inclusion of Sentinel-1 radar provides insights weeks earlier than when relying on traditional Landsat observations only. The implementation of this new system can play an instrumental role in helping to demonstrate Sabah's palm oil can be 100% traceable, transparent and sustainable by 2025.

Keywords: forest cover change, near real-time, actionable alerts

DETECTION OF FOREST FIRES IN TROPICAL FORESTS USING SENTINEL-3 SLSTR DATA

Noel Ulloa (1), Shou-Hao Chiang (1)

[1] Center for Space and Remote Sensing Research (CSRSR), No 300, Zhonga Rd., Zhongli District, Taoyuan City, Taiwan
Email: ulloa.noelivan@gmail.com

Abstract: Forest fires are considered a major hazard and environmental issue worldwide. The substantial ecological damage of wildfires is caused by the considerable amounts of greenhouse gases emitted during the biomass burning process, as well as by the changes in the soil properties, thus accelerating the erosion rate. The objective of this study is to detect wildfire events in tropical areas using satellite data acquired by Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR), the latest Earth Observation Satellite from the European Space Agency. The SLSTR sensor includes bands dedicated to detect active fire, and thanks to its fast revisit period and high spectral resolution it is suitable for rapid detection of forest fires, in addition to monitoring the recovery of burned forests. For this study, a single forest fire event that took place in the Indio Maiz Biological Reserve, Nicaragua, during April 3-13th of 2018, was selected as the study case. A total of six S3-SLSTR images were downloaded and pre-processed. The images were visualized with different combinations of bands, including those specific for active fire detection. Additionally, optical images from MODIS and Sentinel-2 were also acquired and compared to the S3-SLSTR, in terms of fire detection capabilities. The results indicate that S3-SLSTR imagery is capable of detecting active fire events in remote areas. Despite its coarse resolution of 500 m, S3 is a valuable addition to emergency response and disaster management team's toolkit, who will definitely benefit from the fire monitoring optimized images. Moreover, a twin Sentinel-3 satellite was launched on April 25, 2018, meaning that the twin S3 satellites could be employed the monitor wildfires on daily basis, even in remote areas of the tropical region.

Keywords: Forest fires, Earth Observation Satellite, Sentinel-3, SLSTR

ORNAMENTAL FISH FARM DISTRIBUTION IN LAYANG-LAYANG KLUANG DISTRICT USING GEOGRAPHIC INFORMATION SYSTEM (GIS) AND REMOTE SENSING

Eleanor Daniella Lokman (1), Ong See Ling (1), Siti Hasshura Hashim (1), Mohd Hafiz Hamdan (1), Hairul Anuar Mohd. Nafiah (1), Mckreddy Yaban Julius (2), Suhaida Aini (2)

[1] Department of Fisheries, Ministry of Agriculture and Agro-Based Industry Malaysia, Wisma Tani, Level 1-6, Blok Menara 4G2, Precinct 4, 62628 Putrajaya.
[2] Malaysian Remote Sensing Agency, Ministry of Science, Technology and Innovation, No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: eleanor@dof.gov.my; see_ling@dof.gov.my; hasshura@dof.gov.my; hafizhmdn@dof.gov.my; hairul@dof.gov.my; eddie@remotesensing.gov.my; suhaida@remotesensing.gov.my

Abstract: Ornamental fish is the export-oriented sub-sector relishes as one of the fastest-growing in Malaysia's agriculture sector. Along with the high demand locally, the industry successfully penetrated the international market. However, the Malaysia's ornamental fish industry started to face an embargo on exports made by the European Union (EU) in year 2015. The study was conducted to solve the issue of import restrictions by the EU on Malaysia against ornamental fish by establishing the compartment system as required, using GIS and *remote sensing*. A total sample population comprised of 19 ornamental fish farmers in Layang-layang, Kluang. The data sources used in this study were based on non-spatial data (survey) and supplemented by spatial data (GIS) and Spot-6 images to capture farm location effect on the farm operational activities especially in fisheries biosecurity terms. Basically, the descriptive analysis was used to describe the respondent's socio-economic profile. The relationship between farming participation and the independent variables identified were cross-tabulated. Chi-square analysis was used to test the null hypothesis. The GIS, supported by Spot-6 images was used to determine the spatial characteristics to farming activities in distinctive regions. The result precisely shows that majority of the farmers were male and married. The middle age group of 41-50 years old (34.8%) who are the majority to join farming. Results shows the highest number of the people who had participated in secondary education level were SPM holders with 41.6%, majority of 7 (36.8%) respondents had a scale more than 10ha of farm size and average total of 2 millions of production a year. Most of the farmers breed goldfish (29%) and tiger barb (8%). Age, education level, total of production and income have a significant relationship with farming participation. Spatially, the results indicated that most of the farmers lives near the town which in Kluang, as is less than fifteen (15) kilometres away from their house and farm. Having spatial database of the compartmentalized farm will facilitate farm monitoring and it does benefits the Department of Fisheries, particularly Fisheries Biosecurity Division, in the management of aquatic animal health for the country's export trade value.

Keywords: Ornamental Fish, Spatial Analysis, GIS, Fisheries Biosecurity

THE UTILITY OF SPOT IMAGERY AND RANDOM FOREST IN DETERMINING MULTITEMPORAL DISTRIBUTION OF PARTHENIUM (*P. HysterophoruL)* IN KWAZULU-NATAL, SOUTH AFRICA

John Odindi (1), Lwando Royimani (1), Onisimo Mutanga (1)

[1]Discipline of Geography, School of Agricultural, Earth & Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209, Pietermaritzburg, South Africa
Email: Odindi@ukzn.ac.za; lwandoroyimani91@gmail.com; MutangaO@ukzn.ac.za

Abstract: Detecting the spatial and temporal distribution of Alien Invasive Plants (AIPs) such as Parthenium (*P. HysterophoruL)* is crucial for facilitating management and mitigation of spread. The availability of historical remotely sensed data with fine spatial resolution from the SPOT mission offers greater prospects to cost-effective management of AIPs spread. Using the Land Change Modeler (LCM), this study sought to determine the spatial and temporal distribution of Parthenium using multi-temporal SPOT series data. Although not consistent, findings show that Parthenium has been decreasing over the 10-year period of the study. The general decline in Parthenium distribution is attributed to the low annual rainfall in the recent past. However, the sharp incline in Parthenium spread in the year 2016 is attributed to the high rainfall, leading to increased invasion on vacant or bare areas. Generally, low rainfall has not only affected Parthenium distribution but also other vegetation classes such as grassland, thereby increasing the area of bare soils. Moreover, increased Parthenium spread has been recorded from areas with frequent altered soils, as opposed to areas of infrequent manipulated soils. This study has demonstrated the value of readily available multispectral SPOT series data in concert with robust and advanced non-parametric Random Forest classifier in detecting and mapping the spatial and temporal spread of AIPs.

Keywords: SPOT, Random Forest, Perthenium, KwaZulu-Natal

EVALUATING SPATIAL PATTERNS AMONG FOREST TYPES IN PENINSULAR MALAYSIA USING FRAGSTATS

Y. Siti Yasmin (1), M. Muhamad Afizzul (1)

[1] Geoinformation Programme, Forestry and Environment Division, Forest Research Institute of Malaysia (FRIM), 52109 Kepong, Selangor Darul Ehsan, Malaysia
Email: sitiyasmin@frim.gov.my; afizzul@frim.gov.my

Abstract: Forest plays an important role as habitat for flora and fauna. However, due to land use conversion activity conducted by human, the forest area are continually decreasing and facing fragmentation. This study is aimed to evaluate the spatial patterns and determine the status of fragmentation among three major forest types in Peninsular Malaysia namely inland forest, mangrove forest and peat swamps forest. The input data required are forest cover was generated from Landsat imagery acquired throughout year 2016. The input data then was evaluated using an open source spatial statistical package software called Fragstats. A number of landscape metrics consists of first and second order statistic was generated using Fragstats. First order statistic or simple statistics includes such as number or density of patches, total edge, mean patch size, percentage of landscape, total landscape area and largest patch index. Meanwhile, the second order statistics or variability measurement includes range, standard deviation and coefficient of variation. From the result obtained, we found that inland forest have the biggest number of patches (439 patches), followed by mangrove forest (116 patches) and peat swamp forest (20 patches). However, even peat swamp forest have the smallest patch number, all second order statistic metrics showed that this forest type have the smallest variation. Another landscape metrics were discussed further in this paper.

Keywords: Spatial Patterns, Forest, Fragstat, Fragmentation

EVALUATE THE EFFECT OF SATELLITE IMAGE SPATIAL RESOLUTION ON THE PREDICTIVE PERFORMANCE OF SPECIES DISTRIBUTION MODEL

Bao-Hua Shao (1), Nan-Chang Lo (2), Kai-Yi Huang (3)

[1] Graduate Student, Dept. of Forestry, National Chung-Hsing University, No. 250, Kuo-Kuang Road, Taichung 402, Taiwan, R.O.C.
[2] Specialist, Experimental Forest Management Office, National Chung-Hsing University, Kuo-Kuang Road, Taichung 402, Taiwan, R.O.C.
[3] Professor, Dept. of Forestry, National Chung-Hsing University, Kuo-Kuang Road, Taichung 402, Taiwan, R.O.C.
Email: baobao357@gmail.com; njl@dragon.nchu.edu.tw; kyhuang@dragon.nchu.edu.tw

Abstract: 3S along with multivariate statistics, especially machine learning algorithms, can integrate geo-spatial data and fieldwork measurements, and establish a species distribution model (SDM) to predict the potential habitats of tree species for ecological conservation. Vegetation indices (VI) derived from satellite images could analyze the health and vitality of plant, and there are many types of VI. After testing different VIs through pilot studies, no improvement was found on the SDM performance. Hence, the study attempted to evaluate the effect of satellite image spatial resolution on SDM predictive ability. Two satellite images with different spatial resolution, WorldView-2 (WV-2) and SPOT-5, were used to simulate the potential habitat of Randaishan cinnamon (RC, *Cinnamomum subavenium* Miq.) in the Huisun Experimental Forest Station (HEFS) in central Taiwan. Ecological parameters, including elevation, slope, aspect, terrain position, and normalized difference vegetation index (NDVI) were accounted for in tree habitat evaluation and site search. The study developed maximum entropy (MAXENT), decision tree (DT), and discriminant analysis (DA) models that related known tree sites to habitat characteristics and extrapolated the tree's unexplored sites in HEFS. The accuracy of DT is almost equal to that of MAXENT, and accuracies of the two models are much better than that of DA; the three models are highly efficient in modelling the tree's potential habitat. Because DT and MAXENT models greatly reduce the amount of fieldwork, they are better suited for predicting the tree's potential habitat. More importantly, the results indicate that the vegetation indices derived from WV-2 images can improve model's accuracy, while those derived from SPOT-5 images cannot do that. This is because WV-2 imagery has much finer spatial resolution (1.85 m) than SPOT-5 imagery (10 m) has, and the former can differentiate a single RC tree crown with 5m×5m size from others surrounding it. Accordingly, it could be inferred that WV-3 and WV-4 imagery with finer spatial resolution (1.24 m) would improve the accuracy of SDM more than WV-2 imagery. However, it should consider the contrast between target and background in the imagery and invest more money to purchase WV-3 and WV-4 images.

Keywords: 3S (Remote Sensing, GIS, and GPS), Vegetation Index (VI), Decision Tree (DT), Maximum Entropy (MAXENT), Species Distribution Model (SDM)

THE ENVIRONMENTAL FACTORS THAT INFLUENCING PAPAYA DIEBACK DISEASE OUTBREAK: A PRELIMINARY STUDY

Marliana Azman (1), Nurul Hawani Idris (1), Mohamad Hafis Izran Ishak (2)

1 Department of Geoinformation, Faculty of Built Environment and Survey, 81310 Universiti Teknologi Malaysia, Johor Bahru, Malaysia
2 Department of Control and Mechatronics, School of Electrical Engineering, Faculty of Engineering, 81310 Universiti Teknologi Malaysia, Johor Bahru, Malaysia
Email: marrazmn@gmail.com; hawani@utm.my; hafis@utm.my

Abstract: Papaya disease outbreak has threatened papaya crops in Malaysia as it has resulted economic losses and decreasing in crop yield. The production cost has risen due to increasing farming expenses in purchasing pesticides and fertilizers. Bacteria Dieback disease is one of major disease that attacking papaya crops and decreasing the production. The aim of this study is to to identify the dominant environmental factors that might influence the occurrence of papaya disease. Papaya disease records in Batu Pahat district were acquired from Plant Biosecurity Division of Johor. The distribution of papaya disease incidence was analysed. From the result, generally, the hotspots of papaya disease incidences were likely to occur in two mukims that located at the centre of Batu Pahat district. Ordinary least squares (OLS) was used to analyse the relationship between papaya disease and environmental factors in the study area. The global regression model indicated from OLS shows that the distance to water bodies, distance to road and elevation are positively associated with the incidence of papaya disease. However, the distance to river has been identified as the dominant environmental factor that influencing to the Papaya Dieback disease. Whereas, the climatic variables that have been tested are negatively associated with the disease incidence. This paper provides an insight of the dominant environmental factors and its relationship with papaya dieback disease incidence in Malaysia.

Keywords: Geographic Information Science, Bacteria Dieback Disease, Environmental Factor, Spatial Analysis, Papaya

MAPPING RICE ECOSYSTEMS IN ILOCOS REGION, PHILIPPINES USING SENTINEL-1A SAR TIME SERIES DATA AND RANDOM FOREST

LorenaS.Villano (1), Alice G. Laborte (2), Ariel C. Blanco (1)

[1] Department of Geodetic Engineering, College of Engineering, University of the Philippines Diliman, Quezon City 1101, Philippines
[2] Agri-Food Policy Platform, International Rice Research Institute DAPO Box 7777 Metro Manila 1301, Philippines
Email: lsvillano@up.edu.ph; a.g.laborte@irri.org; acblanco@up.edu.ph

Abstract: Boosting rice production in the Philippines is necessary to feed the growing population. To optimize production, information about the extent and location of irrigated and rainfed rice areas is important for effective targeting of appropriate ecosystem-specific technologies and interventions. This study is a first attempt to develop a methodology to classify irrigated and rainfed ecosystems using multi-temporal Sentinel-1A Synthetic Aperture Radar (SAR) images, and other derived layers from ancillary sources. Random Forest (RF), an ensemble machine learning classifier, was used for rice ecosystem classification. Sentinel-1A VH-polarized Interferometric Wide (IW) swath mode images acquired during 2016 wet season cropping (between May and December) were used to derive a rice mask and 21 predictor variables for the RF classification. Additional predictor variables derived from ancillary sources include elevation, flow accumulation, proximity to water, and cumulative rainfall. Field data, government statistics, and irrigation network map were used in the validation of the results. The rice mask had an overall accuracy of 93% with kappa index of 0.86, and the ecosystem classification yielded an overall accuracy of 68.3% with kappa index of 0.37. We found that the mean backscatter difference between the ecosystems was most evident at the start of the season (SoS), i.e., agronomic flooding, wherein irrigated rice had lower mean backscatter (-19.5 dB) than rainfed rice (-17.6 dB). The key factors in the RF classification were the backscatter at the SoS, the span from the SoS to the peak of SAR (PoS), and the sum of absolute gradients within the temporal series. However, significant discrepancies from government statistics were observed, with underestimation of irrigated areas (R^2= 0.79 and RMSE = 998 ha) and overestimation of rainfed areas (R^2 = 0.54 and RMSE = 971 ha). Comparison with existing maps showed correct classification of irrigated rice areas near the stream and irrigation network. This suggests good agreement in areas with surface water irrigation. The results suggest that further improvement in the methodology is necessary to achieve better accuracy. Nevertheless, findings from this initial study contribute to future research on the development of a robust method for rice ecosystem classification.

Keywords: irrigated rice, rainfed rice, Random Forest, SAR, Sentinel-1A

IRRIGATED AREA MAPPING TO ASSES AWD POTENTIAL OVER BANGLADESH WITH MODIS TIME SERIES FROM 2001-2017

Md Rahedul Islam (1), Wataru Takeuchi (1)

[1] Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo, 153-8505, Japan
Email: rahe@iis.u-tokyo.ac.jp; wataru@iis.u-tokyo.ac.jp

Abstract: Bangladesh is one of the countries that use 80% of groundwater withdrawal for agricultural irrigation. Due to the green revolution and irrigation technology development, the irrigated water demand increases day by day. Among the irrigation crops, rice is the highest water-consuming crops and 70% of the total cultivatable area of the country used for rice production. Excessive pumping of groundwater and climate change impacts the groundwater table gradually declined. Moreover, the traditional flooded irrigation rice production producing GHG's especially methane, which accelerated the climate changes. Alternate wetting and drying (AWD) irrigation system is a less water use and methane emission reduction techniques for a better solution to the dilemma. To better water resource management and planning in agriculture need to introduce AWD irrigation. The main objectives of this study to prepare an irrigated area map for AWD irrigation appraisal. The important things for irrigated area mapping for AWD assessment are - to monitoring the crop growth, Crop water loss and the crop water requirement. The important things for detecting the AWD irrigation is to detect the irrigated rice crop area because in rain-fed rice cultivation AWD irrigation is not applicable. In this study, the MODIS satellite images derived NDVI and ET time series data, LSWC data from AMSR/E and AMSR2, Rainfall data from GSMaP have been used for spatiotemporal analysis of irrigated area mapping. In this study, the crop evapotranspiration is higher than the effective precipitation in a region considered as irrigated area. By using long time MODIS NDVI and AMSR LSWC indices analysis, the crops growing session, change of intensity and seasonal NDVI peak, ET and Rainfall are considered for assessment of Irrigated area. The result compared with the sub-national statistics and published data of the irrigated area of Bangladesh shows a positive co-relation and higher accuracy. The significance of this long-term irrigated area mapping is to analysis the AWD irrigation suitability and evaluating in terms of socioeconomic and environmental benefit. Bangladesh has been selected as a study area, due to the high-water demand, 4th largest rice producing country and climate change vulnerability.

Keywords: Alternate Wetting and Drying (AWD), Normalized Difference Vegetation Index (NDVI), Irrigated, LSWC, Bangladesh

SATELLITE DATA ANALYTICS IN AGRICULTURE AREAS

Rahul Neware (1), Amreen Khan (1)

[1] G. H. Raisoni College of Engineering Nagpur CRPF Gate No. 13, Hingna Road Nagpur, 440016 Maharashtra, India
Email: rneware00@gmail.com; Amreen.khan@raisoni.net

Abstract: In India, agriculture is the main source of economy, and work related to agriculture is the main source of livelihood for people of rural areas in India. Nearly 70% of India's population depends on agriculture for livelihood. If we think about it, the global population worldwide today stands at about 7 billion, and it is expected to grow to 9.6 billion by 2050. So, to provide food for such a huge population, we need new and modern methods of agriculture. Unfortunately, owing to the non-availability of temporal data about land used in previous years, agricultural productivity in India has been decreasing day by day. Collecting and maintaining temporal data about agriculture area is a crucial task to increase productivity. In India, State Agriculture Statistics Authorities (SASAs) collects and provides information about crop and land statistics, crop forecasts, horticulture statistics, land use statistics, irrigation statistics, land house holding statistics, agriculture input statistics, agriculture price statistics etc. SASAs follows traditional field surveying method which has various disadvantages, such as this method is time consuming, costly and depends on agents or officers for interpretation. In this research, we are employing the trend analysis method in agriculture area. Firstly, the field area is selected for study and from Sentinel2 satellite images are downloaded on a monthly or yearly basis. Then to find out agriculture areas from satellite images, three satellite image classification techniques are used which comprise NDVI Classification, Supervised Classification and Object-based Classification. Then on classified results grid-wise scenario is created to study agriculture areas in the pixel grid of 2X2, 5X5 and 10X10. Each grid contains green pixels and from that is created a knowledge base that shows values of weather and whether that grid contains crop areas or not, and if it does contain crop areas, then the highest NDVI value of that area is determined. Knowledge base is then used for finding trends in selected agriculture study area from temporal satellite images.

Keywords: Remote Sensing, Classification, Segmentation, Agriculture, Land Cover and Use

SPECTRAL REFLECTANCE ANALYSIS OF BANANA IN FRUIT RIPENING PROCESS

Sonia Fatima Devy Koesyani (1)(2), Fenny M Dwivany (1)(3), Ketut Wikantika (1)(2)

[1] Center for Remote Sensing, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[2] Remote Sensing and Geographic Information Science Research Group, Faculty of Earth Science and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[3] Research Group of Genetics and Molecular Biotechnology, School of Life Sciences and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
Email: sonia.fatima@students.itb.ac.id; fenny@sith.itb.ac.id; ketut@gd.itb.ac.id

Abstract: Indonesia is a country that has a high level of biodiversity in the world. With Indonesia's extraordinary potential, there needs to be more intensive empowerment to carry out research, one of which is in the field of biogeography where in the field many learn about the spread of living things. One of the biodiversity in Indonesia is the diversity of bananas. Bananas are tropical fruits from Southeast Asia, which are widely consumed by people around the world, because their nutritional content is complete. Indonesia is estimated to have around 1000 banana cultivars spread throughout the regions in Indonesia. Currently, only 300 banana cultivars have been identified. Based on data from the Department of Agriculture, banana production is spread from west to east Indonesia and Indonesia is one of the largest banana producers in the world. Maximizing banana production can be done by applying remote sensing with spectral reflectance. There is a potential use of near infrared (NIR) applications as a non-destructive method to estimate Total Soluble Solid (Brix) from bananas. Banana sample used is Cavendish banana from Sunpride Company which is around 9 weeks old with a long time of observation for 7 consecutive days. The banana was taken spectral data using a multispectral and hyper spectral spectrometer and the Total Soluble Solid data was taken which then analyzed the results obtained. From the results obtained there is a spectral change from the initial measurement to the end of the measurement. Similarly, the brix value obtained from the beginning to the end. From this research, the application of spectral reflection can be used to estimate the sugar content of bananas.

Keywords: biodiversity, multispectral, hyper spectral, total soluble solid, banana

DEVELOPMENT OF A NEW ALLOMETRIC EQUATION CORRELATED WITH RS VARIABLES FOR THE ASSESSMENT OF CARBON STOCK IN DATE PALM PLANTATIONS

Salem Issa (1), Basam Dahy (1), Taoufik Ksiksi (1), Nazmi Saleous (1)

[1] UAE University, College of Science, P.O. Box 15551, Al Ain, United Arab Emirates
Email: salem.essa@uaeu.ac.ae; basam.d@uaeu.ac.ae

Abstract: The United Arab Emirates (UAE) has the largest number of date palms for any single country in the world with an estimated number of about 42 million palms. Date palm, *Phoenix dactylifera,* is considered as the most important fruit crop in arid regions. In addition to its ability to tolerate harsh weather, high temperature, drought and high levels of salinity, date palm is a good source for carbon sequestration in such ecosystems. The main objective was to develop a new allometric equation for aboveground biomass assessment of date palm in arid lands of the UAE and to determine the best remote sensing (RS) predictors to develop a RS and GIS biomass model. Testing plots from Al Ain area (UAE) were used to estimate the above ground biomass (AGB) and carbon stocks (t/ha) of date palm and soil using standard sampling techniques and allometric equations of date palm. In each plot, the crown area (CA) and trunk height (Ht) of the date palms were measured to estimate the biomass and carbon at plot level. Soil carbon was assessed using regression equations built especially for date palm in the studied arid lands. These findings were correlated with remote sensing (RS) predictors to determine the best predictors and develop RS based biomass assessment model. Landsat 8 images were used for the development of the AGB assessment model. The relationships between the AGB and RS variables (e.g., single band and various vegetation indices) were investigated using multiple linear regression analysis. Preliminary results were promising, and final model is being refined and will be published soon.

Keywords: Arid lands, Biomass, Carbon sequestration, Date Palm, Remote Sensing

USE OF ARTIFICIAL NEURAL NETWORKS FOR ESTIMATING WINTER WHEAT LEAF AREA INDEX WITH SENTINEL-2/MSI IMAGERY

Yuanheng Sun (1), Qiming Qin (1), Huazhong Ren (1), Zhaoxu Zhang (1), Zehao Long (1)

[1] Institute of Remote Sensing and GIS, School of Earth and Space Science, Peking University, No. 5, Yiheyuan Road, 100871 Beijing, China
Email: yhsun@pku.edu.cn; qmqin@pku.edu.cn; renhuazhong@pku.edu.cn; 1601110526@pku.edu.cn; longguoxxwl@163.com

Abstract: As a new generation of satellite launched by ESA, Sentinel-2 could achieve a high frequency ground observation in a 5-day revisit period with A/B two satellites being in orbit. The satellite-equipped MSI (Multi-Spectral Instrument) sensor provides multi-spectral imagery with spatial resolutions of up to 10 m, which marks a new source of data for dynamic monitoring of crop growth. In this paper, an artificial neural network (ANN) algorithm for winter wheat leaf area index (LAI) inversion is proposed. First, the winter wheat canopy spectra were generated based on the PROSAIL model in multiple sets of single solar zenith angles (SZA). Then, the corresponding broad-band reflectance is obtained by integrating with the MSI spectral response as the ANN training data. For 10-m resolution LAI retrieval, the surface reflectance of blue (B2), green (B3), red (B4) and near-infrared (B8) bands are used as the inputs of the ANN training. In the LAI inversion process, two nearest SZA values in network collection will be searched out for each pixel first, and the LAI will be estimated by these two networks, separately. The final LAI estimation result will be the linear interpolation of the retrieval outcomes based on their SZA value. The performance of our proposed model is evaluated and validated by using the simulated data generated by the PROSAIL model and the ground measured data afterwards. The evaluation based on simulated data demonstrated that the ANN model proposed by this paper performs better than the traditional ANN inversion method, with RMSE decreasing from 0.37 to 0.20. Validation against ground LAI observation on Sentinel-2 imageries achieves an acceptable accuracy, with R2=0.90 and RMSE=0.73, which will benefit the agriculture applications. Future study for LAI estimation will focus on the use of extra red edge bands of Sentinel-2 imagery in order to achieve a higher accuracy.

Keywords: leaf area index, Sentinel-2, winter wheat, neural network, solar zenith angle

REMOTELY SENSED RELATIVE HUMIDITY FOR PREDICTING *METISA PLANA*'S POPULATION

Siti Aisyah Ruslan (1), Farrah Melissa Muharam (1), Dzolkhifli Omar (2), Zed Diyana Zulkafli (3), Muhammad Pilus Zambri (4)

[1] Department of Agriculture Technology, Faculty of Agriculture,Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan,Malaysia
[2] Department of Plant Protection, Faculty of Agriculture,Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan,Malaysia
[3] Department of Civil Engineering, Faculty of Engineering,Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan,Malaysia
[4] Department of Agronomy and Innovation, TH Plantations Berhad, Level 31 –35, Menara TH Platinum, No. 9, Jalan Persiaran KLCC, 50088 Kuala Lumpur, Malaysia
Email: aisyahruslan01@gmail.com; farrahm@upm.edu.my; dzolkhifli@gmail.com; zeddiyana@upm.edu.my; pilus@thplantations.com

Abstract: *Metisa plana* (Walker) is leaves defoliating insect that is able to cause a staggering loss of USD 2.32 billion within two years to Malaysian oil palm industry. Therefore, an early warning system to predict the outbreak of *Metisa plana* that is cost, time, and energy effective is crucial. In order to do this, the role of environmental factors such as relative humidity (RH) on the pests' population's fluctuations should be well understood. However, the current practices are still leaning towards on ineffective and time-consuming *in-situ* data collection. On the contrary, the utilization of geospatial technologies can be used to obtain data in rapid, harmless, and cost-effective manners **Objective:** Hence, this study utilized the geospatial technologies to i) to construct the relationship between the geospatially derived relative humidity and *Metisa plana* outbreak, and ii) to predict the outbreak of *Metisa plana* in oil palm plantation. **Methods:** *Metisa plana* census data of larvae instar 1, 2, 3, and 4 were collected approximately biweekly over the period of 2014 and 2015. Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images providing values of RH were extracted and apportioned to 6 time lags; 1 week (T1), 2 weeks (T2), 3 week (T3), 4 weeks (T4), 5 week (T5) and 6 weeks (T6). Pearson's correlation, multiple linear regression (MLR) and multiple polynomial regression analysis (MPR) were carried out to analyse the linear relationship between *Metisa plana* and RH. Artificial neural network (ANN) was then used to develop the best prediction model of *Metisa plana*'s outbreak. **Results:** Results show that there are correlations between the presence of *Metisa plana* with RH, however, the time lag effect was not prominent. MPR was able to produce model with higher R2 in comparison to MLR with the highest R2 for both analysis were 0.4818 and 0.1550 respectively at T4 to T6. Model with the highest accuracy was achieved by ANN that utilized the RH at T1 to T3 at 95.29%. **Conclusion:** Based on the result of this study, the elucidation of *Metisa plana*'s landscape ecology was possible with the utilization of geospatial technology and RH as the predictor parameter.

Keywords: *Metisa plana*, Relative humidity, Outbreak prediction, Artificial neural network, Geospatial technology

EVALUATION OF ABOVEGROUND BIOMASS DYNAMICS IN FOREST REHABILITATION AREA USING LANDSAT TIME-SERIES DATA

Wilson V. C. Wong (1), Syazwani Nisa Anuar (1), Mui-How Phua (1), Keiko Ioki (1)

[1] University Malaysia Sabah, Faculty of Science and Natural Resources, Forestry Complex, Jalan UMS, 88400 Kota Kinbabalu, Sabah, Malaysia
Email: w.wilson@ums.edu.my; pmh@ums.edu.my; keiko_ioki@ums.edu.my

Abstract: Spatio-temporal estimation of aboveground biomass (AGB) is useful to evaluate the aboveground biomass dynamics in forest area. In this paper, we evaluated the use of Landsat time-series data in AGB estimation at Innoprise-IKEA Tropical Forest Rehabilitation Project (INIKEA) located in Sabah, Malaysia. We analysed spectral indices and eight grey level co-occurrence matrix (GLCM) based texture measures (i.e., mean, variance, homogeneity, contrast, dissimilarity, entropy, second moment, and correlation), associated with four different window sizes (3x3, 5x5, 7x7 and 9x9), and five bands in estimating AGB for year 1999 and 2017. Our result showed that the estimated mean AGB had increased in year 2017 over 1999. The utilization of Landsat time-series data in AGB estimation is potentially useful in facilitating the assessment of aboveground biomass in forest rehabilitation area.

Keywords: Forest rehabilitation, aboveground biomass, temporal assessment, LANDSAT

MAPPING PADDY FIELD IN RAINY AND CLOUDY PRONE AREA BY USING MULTI-SENSOR AND MULTI-RESOLUTION DATA

Yongnian Zeng (1)(2), Wenjie Liu (1)(2), He Wang (1)(2)

[1] School of Geosciences and Info-physics, Central South University, Changsha 410083, China;
[2] Center for Geomatics and Regional Sustainable Development Research, Central South University, Changsha 410083, China
Email: ynzeng@csu.edu.cn; liuwenjiers@126.com; 2441629623@qq.com

Abstract: Paddy rice plays an important role in food security, water use, and climate change. Therefore, high precision paddy field mapping is of great significance for agricultural configuration, environmental management and decision-making in global and regions. Remote sensing techniques have been affirmed promising in paddy field mapping. However, it is difficult to obtain remotely sensed data with high temporal and spatial resolution due to satellite recycle and rainy and cloudy weather, which affects the accuracy of paddy fields mapping. This paper proposed a method of paddy field mapping method in cloud prone area by using multi-sensor and multi-resolution data. Firstly, China's environmental satellite (HJ-1B) normalized difference vegetation index (NDVI) and Moderate Resolution Imaging Spectroradiometer (MODIS) normalized difference vegetation index (NDVI) were fused by using Spatial and Temporal Adaptive Reflectance Fusion Model (STARFM). The time series fused HJ-1B NDVI was smoothed by using Savitzky-Golay filter and calculated the phenological parameters. Finally, paddy field was mapped by using time series fused HJ-1B NDVI and phenological parameters with random tree classifier. The results indicate that the paddy field mapping achieved higher accuracies. The total classification accuracy is 91.71% and kappa coefficient is 0.9024, which is higher than that of mono temporal HJ-1B image. The proposed approach of mapping paddy field can be applied to areas with rainy and cloudy weather, especially in the tropical and subtropical regions.

Keywords: Paddy field mapping, HJ-1B, MODIS, Spatial and Temporal Data Fusion, Phenological Parameters

MAPPING OIL PALM EXPANSION FROM 2000 TO 2017 IN INDONESIA AND MALAYSIA

Pegah Hashemvand Khiabani (1), Wataru Takeuchi (1)

[1] Institute of Industrial Science, The University of Tokyo, Meguro 4-6-1, Tokyo 153-8505, Japan
Email: phkh1366@iis.u-tokyo.ac.jp; WATARU@iis.u-tokyo.ac.jp

Abstract: Oil palm plantations are rapidly expanding in Malaysia and Indonesia, which leads to deforestation and other associated damages to biodiversity and ecosystem services. Therefore, in response to international criticism on oil palm practices, various certification schemes have been set up in recent years to monitor sustainable production of the oil palm but despite similar starting points and comparable rates of increasing productivity and profit in this sector, both countries have developed almost different policies and legislation regarding oil palm sustainable production. Respectively, it is important to understand and monitor how these counties are acting toward their commitments. Google Earth Engine (GEE) is a low-cost, accessible, and user-friendly tool for detecting the establishment and extension of industrial oil palm plantations which hosts publicly available satellite images and allows for land cover classification using inbuilt algorithms. This paper aims to use this tool to analyses trends of oil palm expansion at the national level in Indonesia and Malaysia as the result of different policies. In order to perform land cover classification different spectral bands (RGB, NIR, SWIR, TIR, all bands) were used from Landsat 8 image to distinguish the following land cover classes: oil palm plantation, forest, water, cropland, urban area, and clouds. Classification and Regression Trees (CART) and Random Forests (RFT) algorithms have been used to classify land cover maps. In order to assess the accuracy of classification, this paper used overall accuracy and Kappa coefficient where the highest value was observed by using all bands for land cover classification. Comparing the trend of the oil palm explanation from 2000 to 2017 in both countries, it seems that Malaysia has assigned more policies into promoting oil palm intensification, however, Indonesia has less focus on intensification and oil palm explanation is conducting.

Keywords: Remote sensing, Land cover map, pixel based analysis

RAINFALL VARIABILITY AND REMOTE SENSING ANALYSIS FOR MONITORING AND MODELLING VEGETATION ANPP IN SEMIARID ENVIRONMENT

Lam Kuok Choy (1)

[1] Universiti Kebangsaan Malaysia
Geography Programme, Centre for Development, Social and Environment (SEEDS) Faculty of Social Sciences and Humanities, 43600 Bangi, Selangor, Malaysia.
Email: lam@ukm.edu.my

Abstract: This study seeks to develop predictive vegetation species distribution modeling using bioclimatic and remote sensing predictors. Two spatial predictor sets were developed using rainfall and remotely sensed variables to map the distribution of semiarid vegetation species in the Jornada basin. A set of generalized simple linear regression model data was created to model the annual ANPP-rainfall relationship and applied to the spatially interpolated rainfall of various years to model the temporal and spatial distribution of the main vegetation species. Remote sensing approach was used to estimate the biomass production by using Normalised Different Vegetation Index (NDVI) as surrogates of annual net primary productivity (ANPP). The NDVI approach was successful in mapping the vegetation species within the Jornada basin and was used as validation for the Rainfall-ANPP predicted ANPP distribution. A simple regression analysis of the predicted ANPP production results from the Rainfall-ANPP model showed no significant relationship compared to the NDVI-ANPP predicted results for all three vegetation species over the study period. In most years, the Rainfall-ANPP model under-predicts the biomass production for all species, whereas the NDVI-ANPP estimates were relatively close for blackgrama and creosote, but overestimate the production in mesquite. Compared to the field plot data, the performance of the NDVIANPP model was better than the Rainfall-ANPP model. When compared to the annual rainfall, the ANPP was found to have weak correlation for the entire study period. The weak relationship could be attributed to the time lag effects of the plant response to rainfall. These results seem to suggest that the accuracy of the Rainfall-ANPP and NDVI-ANPP model were species- and location-dependant. Given the considerable variation in estimates of ANPP among the two ANPP estimation models and vegetation species, it is difficult to assess the absolute accuracy of the ANPP production estimates at this time. Result of this study has also highlighted one important aspect of the response of ANPP to inter-annual rainfall fluctuations where time lags affect ANPP production considerably.

Keywords: ANPP, NDVI, Remote Sensing, Jornada Basin, Biomass

VEGETATION CANOPY CHANGES AND USE OF SOILGRIDS DATA FOR ASSESSING THE EFFECTS OF EXTREME RAINS ON ANNUAL SOIL LOSSES

Dhruba P. Shrestha (1)

[1] University of Twente, Faculty of Geo-information Science and Earth Observation (ITC/UT)
Department of Earth System Analysis, P.O. Box 217, 7500 AE Enschede, the Netherlands
Email: d.b.p.shrestha@utwente.nl

Abstract: Extreme rains trigger natural hazard processes such as soil erosion, land sliding and flash floods. Climate change studies show that the frequency of extreme rains is in an increasing trend, which will have an effect on hazard processes. For assessing the magnitude of soil losses various models are available. While annual empirical models (e.g. USLE, RUSLE, MMF) are easy to use, they do not take into account the effect of extreme rains. The event based models (e.g. LISEM, WEPP) can simulate erosion processes in detail, but rainfall event data is simply not available everywhere. To solve this problem, (Shrestha and Jetten, 2018) have developed a daily erosion model and shows that the effect of extreme rains can be incorporated easily in annual estimates. For running the model, daily rainfall and vegetation canopy changes are required in addition to topography and soil data. Recently, time series NDVI and SoilGrids data are available freely, solving data scarcity problem. The objectives of the study are in assessing the effect of daily canopy cover changes on rain interception, and in the use of SoilGrids data for erosion estimation. The study area is located in Sehoul, Morocco. Time series NDVI data at 1 Km resolution was downloaded from Vito, Belgium (http://free.vgt.vito.be), and resampled to 20 m spatial resolution and at daily time step. Similarly, SoilGrids data at 250 m resolution was downloaded from ISRIC, The Netherlands (https://soilgrids.org). Pedotransfer functions were used to generate soil parameters and the daily erosion model was applied to assess soil losses. The results show that vegetation canopy cover plays an important role in the magnitude of soil losses. Canopy cover intercepts rain and protect the soil from raindrop impact. When canopy cover is lower, erosion rates are higher. During extreme rains, erosion can be very severe. The study shows that SoilGrids is a useful data source but it should be supported by field data. The results also shows that daily erosion modelling gives better picture of annual soil losses since the effect of extreme rains are also incorporated.

Keywords: vegetation canopy change, SoilGrids, extreme rain, daily erosion model

COMPARISON BETWEEN LINEAR AND QUADRATIC MODEL APPROACH FOR GANODERMA CLASSIFICATION

Nur Azuan Husin (1), Aiman Nabilah Noor Azmi (1), Siti Khairunniza Bejo (1)(2)(3)

[1] Department of Biological and Agricultural Engineering, Faculty of Engineering,
[2] Smart Farming Technology Research Centre,
[3] Laboratory of Plantation Science and Technology, Institute of Plantation Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
Email: nurazuanhusin@gmail.com; aimannabilahazmi@gmail.com; skbejo@upm.edu.my

Abstract: *Ganoderma* is the most destructive disease affecting oil palm plantation in Southeast Asia. *Ganoderma* infection caused reducing of oil palm productivity and potentially impacting the market value of palm oil in Malaysia. There was no effective treatment to control this disease, meanwhile the conventional method to detect the disease is time consuming and labour intensive. Terrestrial laser scanner (TLS) was used to obtain 3D features of oil palm trees and its physical properties were analysed for *Ganoderma* detection. There were five physical properties utilized in the study: frond number, frond angle, pixel number, canopy section at 200 cm (canopy200) and canopy section at 850 cm (canopy850). Classification models were developed using the physical properties of oil palm trees for *Ganoderma* classification at four different severity levels. The aim of this study was to compare between the linear model and quadratic model. Data of this study were divided into three datasets: training, testing and validation. Training dataset were used as input for the classification model and testing dataset were used to attain the range of value for each severity level for classifying the trees. The classification models were validated using different dataset to determine the ability of the model to classify oil palm trees according to its healthiness level. The results showed that linear model with a combination of frond number, frond angle and canopy200 was a better model. The model can classify the healthiness level of oil palm trees with classification accuracy of 100 % for T1 and T2 whereas 50% for T3.

Keywords: *Ganoderma*, Classification model, Oil palm properties

ACCURACY ASSESSMENT OF SENTINEL 2 IMAGE-DERIVED LEAF AREA INDEX (LAI) OF PLANT CANOPIES AND OTHER LAND USE/COVER TYPES IN MANGROVE AREAS

Armando A. Apan (1)(2), Jose Alan A. Castillo (1)(2)(3), Tek Narayan Maraseni (2), Severino G. Salmo III (4)

[1] School of Civil Engineering and Surveying, University of Southern Queensland (USQ), QLD 4350, Australia
[2] Institute for Agriculture and the Environment, USQ, QLD 4350, Australia
[3] Mangrove and Beach Forests Research Section, Ecosystems Research and Development Bureau, Los Baños 4031, Philippines
[4] Department of Environmental Science, Ateneo de Manila University, Quezon City 1101, Philippines
Email: apana@usq.edu.au; allan536@yahoo.com; Tek.Maraseni@usq.edu.au; ssalmo@ateneo.edu

Abstract: Leaf area index (LAI) quantifies the amount of foliage area per unit ground surface area. A dimensionless quantity (i.e. LAI = leaf area / ground area, m^2/m^2), it is an important variable to predict photosynthetic primary production and for monitoring vegetation dynamics. The aim of this study was to assess the accuracy of Sentinel 2 image-derived LAI of plant canopies and other land use/cover types in tropical mangrove areas in the Philippines. This is part of a bigger study on mapping of above-ground biomass and soil carbon of mangrove forests. Using hand-held *CI-110 Plant Canopy Imager,* field-level LAI measurements were made between June-July 2015, in mangrove areas from 90 sample sites located in Honda Bay, Palawan, Philippines. A regression analysis was conducted between the a) Sentinel 2 (Level-1C, acquired in April 2016) image-derived LAI values, and b) field-collected LAI measurements. The regression analysis was accomplished using the traditional linear regression and new machine learning algorithms from the WEKA software. The accuracy of prediction was analysed using root mean square error (RMSE) and agreement (r) of predicted and observed values from leave-one-out cross-validation method. The results show that the field collected LAI data ranges from 0 - 2.71 (mean = 0.86), while the Sentinel 2 image-derived LAI values range from 0.19 - 4.32 (mean = 1.64). The regression models had 0.9419 correlation/agreement of observed and predicted value for linear regression; and had 0.9435 for using the support vector machine algorithm. The corresponding RMSE obtained were 0.3350 (linear regression) and 0.3424 (support vector machine), demonstrating a high prediction accuracy although the two datasets' LAI values were nine months apart. This study validates the good accuracy of the Sentinel 2 image-derived LAI values, indicating their usefulness for selected applications.

Keywords: Sentinel 2, Leaf Area Index (LAI), mangroves, Philippines

ON THE RELATION OF SURFACE TEMPERATURE AND LAND USE TYPE FROM AERIAL THERMAL IMAGE

Chen-Yuan Su (1), Peter Tian-Yuan Shih (1)

[1] Department of Civil Engineering, National Chiao Tung University,
1001 Ta-Hsueh Road, Hsinchu, Taiwan
Email: ajghmcvu@gmail.com; tyshih@mail.nctu.edu.tw

Abstract: This study investigates the relation between surface temperature and land use type. The study site is located in Banchiao, a built-up area in New Taipei City, Taiwan. The area is about 3.5 square kilometer. Thermal images were taken with an ITRES TABI-1800 on September 14, 2014. Image spatial resolution is 0.5m. Land use type information is obtained from the NLSC Land Use Map (2017). The relation is then analyzed. Besides, several spectral indices, NDVI, NDBI, NDWI, are derived from a Sentinel-2 satellite image scene. The 1*1m DSM can show the surface elevation was scanned by Leica ALS60 Airborne Laser Scanner. Regression analysis and correlation coefficient are mainly method to distinguish the correlation between surface temperature and land cover. Expected that the elevation of building and temperature are low correlation, but the shadow from high building cause the low temperature area. The temperature in industrial area is higher, the potential causes include material or energy discharge. Through research, the meticulous correlation between surface temperature and land cover will be found.

Keywords: Land cover, Airborne TIR imagery, DSM

MODELLING SHIFTING CULTIVATION AND CHANGES TO LAND USE IN BARAK VALLEY

Jyoti Misra (1), KS Rajan(1)

[1] International Institute of Information Technology Gachibowli, Hyderabad, India
Email: jyotimisra.misra@research.iiit.ac.in; rajan@iiit.ac.in

Abstract: Barak valley is an area in northeast part of India where traditionally practice of shifting cultivation is more prevalent than sedentary agriculture. In addition, population growth coupled with the geographic isolation of the area has further aggravated the decline of forest cover in the area. The three districts of Assam that cover the Barak valley show varied land covers and also has very different population densities. This paper attempts to model the land use changes in the Barak valley over a period of 1988 to 2005, using an agent-based model. Each district is modelled as an agent of change here to capture the interactions between the various land uses and to decide on the resource allocation over the district to be allotted to shifting cultivation. The model accounts for both economic as well as geographic factors, like access to infrastructure while making the land use decision on a year-on-year basis. The model considers the need for shifting cultivation area for both a staple crop - rice and a non-staple crop based on the demand against the supply estimated from irrigated and rain-fed crop regions. While the model has been tuned based on the data till 1997, the simulated model outcome of 2005 is evaluated against an existing remote sensing derived land use map of the region and it is found to achieve an accuracy of about 85%. While the aggregated results across the region show good concurrence, the randomness inherent in the choice of the shifting cultivation land limits the ability to predict the precise locations. The paper will discuss the challenges including scale issues in model application for a region as diverse as Barak.

Keywords: Agent Based Modelling, Barak Valley, Land Use, Shifting Cultivation

AN APPROACH TO DETERMINE THE OPTIMUM SPATIAL DISTRIBUTION OF HYDROMETEOROLOGICAL STATIONS FOR HYDROLOGICAL MODELING: 4ONSE DEPLOYMENT

Emeshi Warusavitharana (1), Rangajeewa Ratnayake (1), Seneviratne Mahanama (1)

[1] Department of Town & Country Planning, Faculty of Architecture, University of Moratuwa, Bandaranayake Mawatha, 10400 Moratuwa, Sri Lanka
Email: emejayani@gmail.com; rangajeewar@gmail.com; mahanama_pks@yahoo.com

Abstract: Any hydrological model starts with collecting relevant hydrometeorological data to run the model. Despite the importance of hydrological models for water resource management and disaster risk reduction, the adequacy of the hydrometeorological stations and their location play a significant role in generating reliable model outputs. Although World Meteorological Organization (WMO) recommends minimum station densities for different physiographic areas with some detailed standards on siting and calibrating the instruments used in the stations, it doesn't provide any guideline to select optimum locations to deploy the stations. The adequacy of the stations vary with the weather condition of the area and the measured parameters. Since some of the most widely used parameters in hydrological modelling, such as precipitation and wind speed can vary greatly with small distances, in reality, the required density is higher than the recommended density by the WMO. Genrally, the locations are selected considering the accessibility and the network coverage. This creates subjectivity in location selection and ultimately results in disregarding the remote locations where the hydrometeorological condition mostly influences. Therefore, it is indispensable that the locations of the stations be chosen wisely to get the maximum results from the hydrological models. This study was conducted in Deduru Oya river basin, which is the fourth largest river basin of Sri Lanka. Currently, the University of Moratuwa in collaboration with University of Applied Sciences and Arts of Southern Switzerland have launched a research project called 4ONSE (4 times Open and Non-Conventional technology for Sensing the Environment) to deploy low cost, open technologies (open hardware, open software, open data and open standards) based hydrometeorological stations in the basin. The process of determining the optimum locations for the stations started with discretizing the watershed into subbasins. Satellite retrieved weather data was applied in Shannon's Entropy method to measure the spatial distribution of uncertainty levels of most sensitive hydrometeorological parameters. In addition, requirements of the hydrological modeling software and several other factors were considered in determining the number and the locations for the stations. The method presented in this research is an experimental approach of deploying the 4ONSE stations in real world.

Keywords: 4ONSE, Hydrological Modeling, Hydrometeorological Stations, Deployment

DETECTION OF START OF SEASON DATES OF RICE CROP USING SAR AND OPTICAL IMAGERY, CENTRAL LUZON, PHILIPPINES

Jeny Raviz (1), Alice Laborte (1), Luca Gatti (2) and Mary Rose Mabalay (3)

[1] International Rice Research Institute, Los Baños, Laguna, Philippines
[2] Sarmap SA, Purasca, Switzerland
[3] Philippine Rice Research Institute, Muñoz, Nueva Ecija, Philippines
Email: j.raviz@irri.org; a.g.laborte@irri.org; lgatti@sarmap.ch; mrmabalay@philrice.gov.ph

Abstract: Rice plays a crucial role to food security in the Philippines. Information on rice such as where and when it is planted is essential in planning and decision making on food security. Knowing the start of season (SoS) date is very important for proper management such as timing of irrigation, fertilizer application, and rice production estimation. Multi-temporal synthetic aperture radar (SAR) has been effectively used to detect rice area and seasonality. In this study, we used Sentinel 1A/B and Landsat 8 imagery to derive the rice planted areas and SoS dates. We processed data for two cropping seasons in 2016-2017: dry season (DS, Sep 2016 to Feb 2017) and wet season (WS, Mar to Aug 2017) in Central Luzon, Philippines. We used the MAPscape-RICE® software to generate the rice and SoS maps, and compared results with ground observations. We performed 3 main steps: (1) basic processing, (2) classification based on rule-based detection, and (3) accuracy assessment of the maps of rice area and start of season. In the rule-detection SoS date, we utilized VV and VH polarizations from SAR and vegetation index (NDVI) derived from Landsat 8. The SoS date is detected based on the weights used to compute the reliability coefficient (RC). The following are the inputs: (1) backscatter value from VV and VH polarizations, (2) backscatter increase after the SoS, (3) correspondence of SoS date from VV and VH, (4) consistency of backscatter with NDVI value, and (5) value of local incidence angle (LIA) in overlapping areas in case multiple tracks are used. All inputs are considered on the basis of its own weight factor, the RC is obtained by summing up the contribution of each input multiplied by its own weight factor. For the accuracy of the rice area classification, we used 120 validation points per season and for the start of season, we used 70 (DS) and 80 (WS) ground observations. The rice area classification results have an overall accuracy of 93.3% and kappa of 0.85 for DS and 91.7% with kappa of 0.83 for WS. The estimated start of season dates derived from SAR correlated strongly with actual dates (R^2=0.83 for DS and R^2=0.82 for WS). The average deviation is 2 days for DS and 3 days for WS. With such high accuracy this approach of detecting the area and start of season of rice has implications on identification of appropriate interventions and their timing, assessment of areas at risk and damages brought by typhoons, and vulnerability to pests and diseases.

Keywords: crop establishment, rice mapping, Sentinel 1, start of season, Philippines

ESTIMATION OF GLOBAL AND DIFFUSE PHOTOSYNTHETIC PHOTON FLUX DENSITY BY GROUND-BASED WHOLE-SKY IMAGERIES

Megumi Yamashita (1), Mitsunori Yoshimura (2)

[1] Tokyo University of Agriculture and Technology, Faculty of Agriculture, 3-5-8 Saiwai-cho, Fuchu, Tokyo, Japan
[2] PASCO Corporation, 2-8-10 Higashiyama, Meguro-ku, Tokyo, Japan
Email: meguyama@cc.tuat.ac.jp; mairtu1698@pasco.co.jp

Abstract: Photosynthetic photon flux density (PPFD: μmol m-2 s-1) is indispensable for plant physiology processes in photosynthesis. However, PPFD is seldom measured, so that PPFD has been estimated by using solar radiation (SR: W m-2) measured in worldwide. In method using SR, there are two steps: first to estimate photosynthetically active radiation (PAR: W m-2) by the fraction of PAR to SR (*PF*) and second: to convert PAR to PPFD using the ratio of quanta to energy (*Q/E*: μmol J-1). *PF* and *Q/E* usually have been used as the constant values, however, recent studies point out that *PF* and *Q/E* would not be constants under various sky conditions. In this study, we use the numeric data of sky-conditions factors such cloud cover, sun appearance/hiding and relative sky brightness derived from whole-sky image processing and examine how sky-conditions factors influence on *PF* and *Q/E* of global and diffuse PAR. Also, we try to estimate the global and diffuse PPFD with instantaneous value by using sky- conditions factors derived from multi-temporal whole-sky imageries. Through this study, we could clarify the detailed influence of sky conditions factors on *PF*, *Q/E* in global and diffuse PAR, and *DR* in hourly timescale. Furthermore, we could confirm the possibility to develop the estimation model of global and diffuse PPFDs by whole-sky images. These knowledges would be contributed to improve photosynthetic models at community scale with short-time scale for local vegetation ecosystem.

Keywords: PPFD, Solar Radiation, PAR Fraction, Quantum-To-Energy Ratio, Sky Condition

STATE OF THE ART REMOTE SENSING TECHNOLOGY FOR OIL PALM MANAGEMENT IN INDONESIA

Soni Darmawan (1), Milad Naser (1), Dewi Kania Sari (1), Ita Carolita (2)

[1] Geodesy Engineering Department, Institut Teknologi Nasional, PHH. Mustafa No. 23, Bandung 40124, West Java Indonesia
[2] National Institute of Aeronautics and Space (LAPAN), Jalan Kalisari No. 8, Pekayon, Pasar Rebo, Jakarta 13710 Indonesia
Email: Soni_darmawan@itenas.ac.id

Abstract: The oil palm industry is one of the most important sources of revenue for Indonesia but there are still many challenges that must be faced by the palm oil plantation management, one of which is to maintain production sustainability. The problem of palm oil plantations related to land resources requires effective and efficient technology inputs. Remote Sensing technology is one of the inputs that can be used as one of the decision support system (DSS) to decide the problem spatially quickly, accurately and dynamically. However, remote sensing technology has not been applied in Indonesian palm oil plantations. It is because of tropical climate conditions that tend to be covered with clouds that can inhibit the performance of remote sensing technology. Purpose this study is to review utilization of remote sensing technology in palm oil plantation in Indonesia. Based on the our review we found some journal paper in remote sensing application for oil palm from 1999 until now (2017). Remote sensing technology will produce a data in the form of description of palm oil conditions in the field which the data must be processed and re-analyzed using a customized method of management needs. The results revealed that remote sensing technology was able to provide output in the form of land mapping, tree volume estimation, palm fruit classification, palm oil growth, estimated age of plant, biomass estimates, palm oil productivity estimates, health detection and accurate mapping of palm oil diseases using the right method and opportunity the remote sensing application for oil palm management on the future in Indonesia.

Keywords: Oil Palm Management, Geospatial Technology, Production Sustainability

CHARACTERISATION OF TROPICAL RAINFOREST TREE STRUCTURE PARAMETER BASED ON REMOTE SENSING IMAGERY

Intan Noradybah Md Rodi (1), Shaparas Daliman (1), Radhiah Zakaria (1), Ibrahim Busu (1)

[1]Faculty of Earth Science, Universiti Malaysia Kelantan Jeli Campus,
17600 Jeli Kelantan, Malaysia
Email: intan96noradybah@gmail.com; shaparas@umk.edu.my; radhiah.z@umk.edu.my

Abstract: Malaysia is a megadiverse country which two thirds of its area are covered with forest which is mainly dipterocarp forest. However, the forest area of Malaysia are not updated especially in Kelantan state. This study propose to apply image processing techniques in characterising forest tree structure parameter using fusion techniques of high spatial resolution Drone imagery which will indirectly updating the forest tree in Kelantan. The study area is located in Gunung Basor with a high potential of different forest tree species. The main objectives are to develop a forest tree recognition techniques and build a classification strategy for forest tree area segmentation. With fusion of high resolution remote sensing imagery data, the forest structure parameter can be further estimated by implementing point cloud segmentation (PCS) algorithm and a hierarchical support vector machine (SVM) classification method to extract information beneficial for tree crown detection purposes using MATLAB software. Automated forest detection supports a method in obtaining information on tree abundance and spatial distribution. Both criteria are important in assessing the status of regenerating forests and estimating the size of the forest area, hence will support the natural forest management.

Keywords: Forest Tree Structure, Pleaidas, SVM, MATLAB

CLASSIFICATION OF CITRUS (RUTACEAE) USING MACHINE VISION

Najwa Bari'ah Mohd Tabri (1), Shaparas Daliman (1), Radhiah Zakaria (1), Ibrahim Busu (1)

[1]Faculty of Earth Science, Universiti Malaysia Kelantan Jeli Campus,
17600 Jeli Kelantan, Malaysia
Email: najwa019728@gmail.com; shaparas@umk.edu.my; radhiah.z@umk.edu.my

Abstract: There has not been much research done on classification of Citrus (Rutaceae) based on its vegetative and generative characters which enables to improve the general knowledge and technology by identify the species using computing capability. Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. The aim of this study are to identify the selected species of Citrus (Rutaceae) by using image processing and to differentiate the selected species based on vegetative and generative characters. This study proposed the methods to identify the classification of four selected Citrus (Rutaceae) based on vegetative and generative characters by using an image processing based approach. This study is important in identifying the selected species and discovering about new application and technology for future generation.

Keywords: Image Processing, Citrus Genus, Spectral Signature

SPECTRAL CHARACTERISATION OF TRIGGERING BIOPHYSICAL PROPERTIES OF GENERAL FLOWERING USING SATELLITE REMOTE SENSING DATA

Noordyana Hassan (1, 2), Mazlan Hashim (1, 2), Shinya Numata (3)

[1] Department of Geoinformation, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia
[2] Geoscience & Digital Earth Centre (INSteG), Faculty of Geoinformation & Real Estate, Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia
3Department of Tourism Science, Graduate School of Urban Environmental Sciences Tokyo Metropolitan University, Minami-Osawa 1-1, Hachiouji, Tokyo 192-0397, Japan
Email: noordyana@utm.my; mazlanhashim@utm.my; nmt@tmu.ac.jp

Abstract: General flowering (GF) plays a central role in the regeneration of dipterocarp forests in Southeast Asia. Thus, phenological stages and climatic cues that trigger GF identification in monitoring GF is essential. This is because flowering phenological stages would provide useful information to estimate GF. Meanwhile, biological studies have proved that GF synchronisation in Peninsular Malaysia was triggered by climatic cues such as prolonged drought (PD) and low temperature (LT). However, identification of tropical rainforest phenological stages is challenging by using satellite data due to high trees diversity. Besides that, the research on formulating and developing algorithm on estimation of GF composition using satellite based climatic cues has not yet been attempted. Thus, we suggest that identification of tropical rainforest phenological stages would accurately estimate GF composition using satellite data than using satellite based climatic cues. Therefore, this research was designed to identify the spectral variation for each phenological stages to estimate GF and to formulate and develop GF estimation by using satellite based climatic cues (rainfall and temperature). In-situ spectral data for each phenological stage (bud, flower and fruit) of dipterocarp will be measured in the laboratory and will be analysed by using spectral mixture analyses to estimate GF composition. Meanwhile, the satellite based climatic cues (rainfall and temperature) will be analysed and an algorithm to estimate GF composition will be developed. As a result, GF composition and the distribution of dipterocarp based on phenological stages and climatic cues will be developed. Result of this research will suggest the crucial factor that cause GF especially for dipterocarp species as a dominant trees in Malaysia tropical rainforest. Thus, the result would be useful for the researchers to conduct further research on GF of tropical rainforest for sustainable forest ecology.

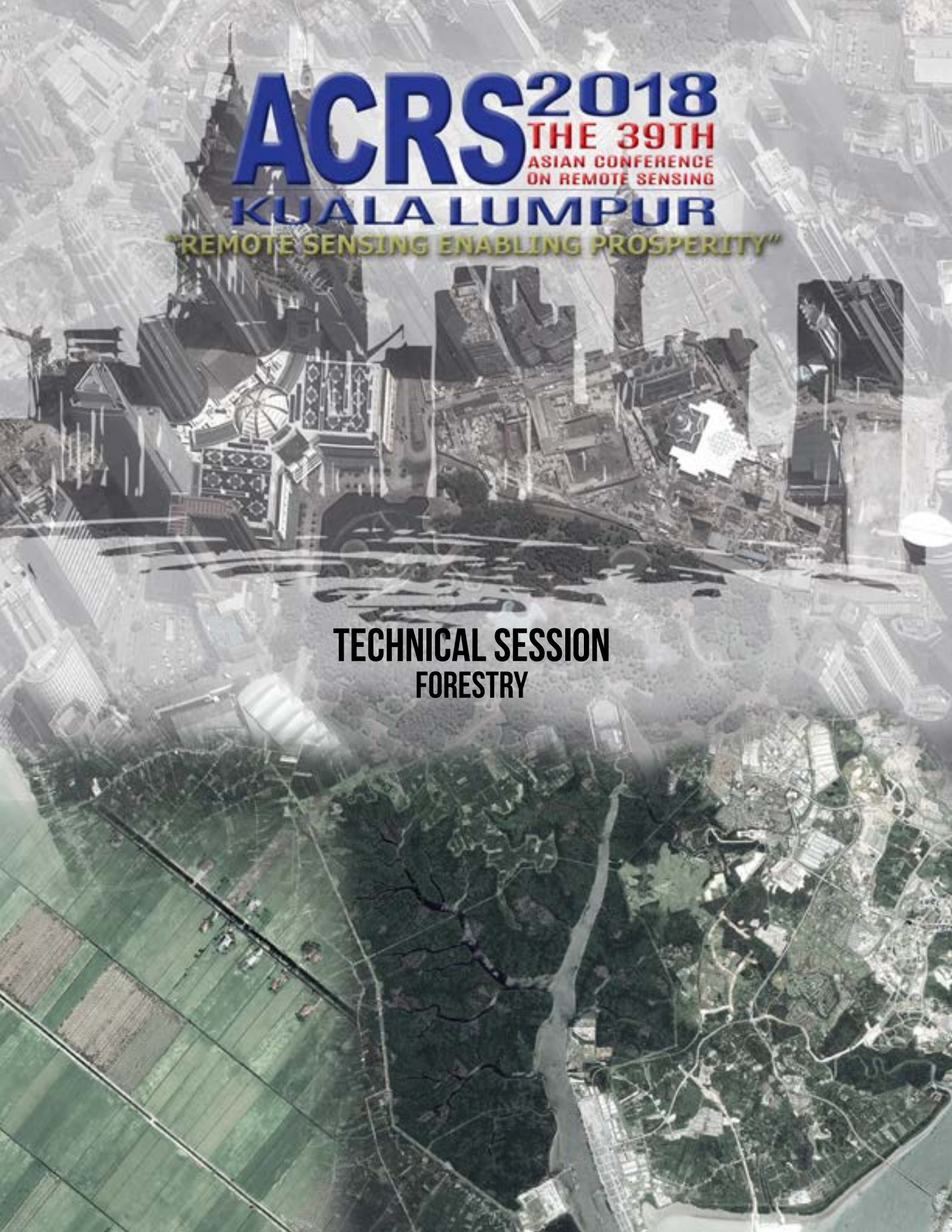
Keywords: General Flowering, Tropical Rainforest, Remote Sensing.

GEOSPATIAL INFORMATION SYSTEM FOR PADDY (MAKGEO PADI) AND IT'S IMPACT ON MALAYSIA RICE INDUSTRY

Iman Zakhrias bin Saberi (1), Iman Lyana bte Abdulah (1), Mohd. Amirudin bin Ramli (1), Sutha A/P Veloo (1), Muhamad Hilmi bin Abdul Rabiki (1)

[1] Department of Agriculture, Malaysia, Level 7-17, Wisma Tani, No. 30 Persiaran Perdana, Persint 4, Pusat Pentadbiran Kerajaan Persekutuan, 62624 Putrajaya Malaysia
Email : iman@doa.gov.my, amir@doa.gov.my, sutha@doa.gov.my

Abstract: The objective of the project is to develop an online geospatial information system that is efficient to manage the order lot of paddy field for Granary and Non Granary area in Malaysia using remote sensing and Geographic Information System (GIS). Using the system that had been developed, determining area of planted and non planted field is faster and more precise. This is achievable by utilizing information and image acquired from remote sensing satellite such as SPOT, Landsat and Radarsat. Information that is acquired from these satellites are integrated and digitized with spatial modeling to produce maps of paddy field in Malaysia. The developed system able to speed up the process of recognizing of planted paddy area than the conventional method of on field visual confirmation.



TECHNICAL SESSION
FORESTRY

IDENTIFYING FOREST LOSS AREA USING GOOGLE EARTH ENGINE CODING SYSTEM AT KEONJHAR, ODISHA, INDIA

Ratiranjan Jena (1), Biswajeet Pradhan (1)

[1] School of System, Management and Leadership, Faculty of Engineering and Information Technology, University of Technology Sydney, 15 Broadway, Ultimo NSW 2007
Email: biswajeet24@gmail.com; Biswajeet.Pradhan@uts.edu.au

Abstract: Keonjhar district of Odisha is famous for iron and manganese rich minerals according to the directorate of mines, Govt of Odisha. The district is the home to 45.4% of tribal people. However, Depletion of forest, increase of wastelands and loss of grazing fields are the major problems for the district. Therefore, the main reason for these changes are mining activity in Keonjhar that is inclusively affecting the tribal livelihood system as well as health. Direct impact of the forest loss is lowering assess of nutrition to the tribal people. Therefore, researchers have not attended any effective research to identifying the areas of forest loss in Keonjhar. Therefore, we have made a reliable attempt by using the google earth engine coding for the identification of forest loss and gain areas in Keonjhar. We have used the Hansen global forest change data of 2014 and 2017 for the analysis. To the end, we identified the regions of forest loss as well as gain. Our results show that there is no forest gain from 2014 to 2017 where the loss is very high. In general, these forest changes were due to mining activity and unusual logging activity.

Keywords: Forest change; Google earth engine; Mining activity; Keonjhar

MULTI TEMPORAL ANALYSIS OF LANDSAT SATELLITE IMAGERY FOR NATIONAL FOREST CARBON STOCK MONITORING OF INDONESIA

Anna Tosiani (1), Ruandha Agung Sugardiman (1), Ahmad Basyirudin Usman (1), Riva Rovani (2)

[1]Directorate of Forest Resource Inventory and Monitoring, Ministry of Environment and Forestry, Gedung Manggala Wanabakti Block I Floor 7th, Jalan Gatot Subroto, Senayan-Jakarta 10270 Indonesia
[2]Indonesian Embassy, 5-2-9 Higashigotanda, Shinagawa-ku, Tokyo, 141-0022 Japan
Email : annatosiani95@gmail.com; ra.sugardiman@gmail.com; basyir@hotmail.com; rovani.riva@gmail.com

Abstract: Indonesia is the tropical countries having third largest forest coverage in the world after Brazil and Democratic Republic of Congo. However, based on FAO data (2015), it set a record as the highest annual net forest cover loss. Based on Second National Communication (2010) and First Biennial Update Report (2016), the land use/land cover changes are calculated as the largest GHG emissions contributing sector, including peat fire. Those conditions motivated Indonesia to make a pledge to reduce carbon emissions 29% (independently) or 41% (internationally supported) by 2030 through Nationally Determined Contribution (NDC). Carbon stocks mapping and monitoring in forested region is basic part of policy arrangement to meet Indonesian commitment and to mitigate the climate change impacts. The study aims to map the national carbon stock and to calculate above ground carbon stocks, emissions/removals, and absorptions. The analysis is conducted using Stock Difference Approach based on national land cover data (both inside and outside of forest state) that was obtained from Landsat image interpretation over 23 land cover classes. Analyzing above ground biomass had done from forest national inventory data that uses biomass allometric model. The calculations of carbon stocks as well as the absorption and greenhouse gas (GHG) emissions have done through Geographic Information System (GIS) that based on spatial analysis of activity data and carbon stock data for each land cover type. The study results the national and sub national (seven archipelagoes) carbon stocks and emissions/removals (as illustrated on table, graphic and map). They depict the decreasing of carbon stocks caused by forest cover change, both inside and outside of forest state. Merging Landsat imagery with above ground biomass and data analyzing of forest national inventory not only produce estimation of carbon stocks but also absorption and greenhouse gas emissions from the land sector on national scale with good accuracy. Improving the quality and quantity of forest inventory data and methods needs to be undertaken to reduce the uncertainty.

Keywords: Carbon Stock, Emission Factor, Land Cover, Forest State, Spatial Analysis

IDENTIFICATION OF DIPTEROCARPACEAE FLOWERING PHENOLOGY USING REMOTE SENSING DATA

Hanif Abdullah (1), Noordyana Hassan (1)

[1] Department of Geoinformatics, Faculty of Geoinformation and Real Estate Universiti Teknologi Malaysia, 81310, Skudai, Johor Bahru Malaysia
Email: hanifabdullah193@gmail.com; noordyana@utm.my

Abstract: The extinction of Dipterocarp family in Malaysia are very critical which may lead to unbalanced ecosystem. The flowering phenological phases of the dipterocarp family is the key to sustain the Dipterocarp. Prolonged drought and low temperature were the parameters that trigger Dipterocarp family flowering phenology as stated in previous study. Thus, we hypothesized that normalized different vegetation index (NDVI) may also affected by the climatic condition that been derived from the raw data. In this study, MODIS and TRMM data were utilized to estimate the prolonged drought and low temperature condition. NDVI data were extracted from data product of MODIS. To enhance the result, downscaling method was employed to 50 ha plot of Pasoh Forest Reserve. Result shows that climatic condition derived from satellite data can be used to trigger the flowering phenology. NDVI obtained has significant relationship with the flowering phenology at 50 ha plot of Pasoh Forest Reserve. This result suggests that during flowering phenology, NDVI values is low. While, NDVI values will be higher when there are no flowering occurrences as the Dipterocarp crown may have different in colour. As a conclusion, the remote sensing parameter are can be used to study the flowering phenology of dipterocarpaceae and the data product is better compared to the raw data.

Keywords: Flowering phenology, dipterocarpaceae, Pasoh reserve Forest, NDVI, Remote sensing data

IMPACTS OF AQUACULTURE FARMS ON THE MANGROVES FORESTS OF SUNDARBANS, INDIA (2010-2018): TEMPORAL CHANGES OF NDVI

Sandeep Thakur (1), Ismail Mondal (1), Phani B Ghosh (2), Papita Das (3), Tarun K De (1)

[1] Department of Marine Science, University of Calcutta, 35 BC road, Kol-19
[2] Institute of Engineering & Management, Salt Lake, Sector-V, Kolkata-91
[3] Department of Chemical Engineering, Jadavpur University, Kok-32
Email: sandeept.pu@gmail.com; thakursandeep.cu@gmail.com

Abstract: Sundarbans Reserve forest of India has been undergoing major transformations in the recent past owing to population pressure and related changes. This has brought about major changes in the spatial landscape of the region especially in the western parts. This study attempts to assess the impacts of the landcover changes on the mangrove habitats. Time series imageries of Landsat were used to analyze the Normalized Differential Vegetation Index (NDVI) patterns over the western parts Indian Sundarbans forest in order to assess the heath of the mangroves in the region. The images were subjected to Land use Land cover (LULC) classification using sub pixel classification techniques in ERDAS Imagine software and the changes were mapped. The spatial proliferation of aquaculture farms during the study period was also mapped. A multivariate regression analysis was carried out between the obtained NDVI values and the LULC classes. Similarly, the observed meteorological data sets (time series rainfall and minimum and maximum temperature) were also statistically correlated for regression. The study demonstrated the application of NDVI in assessing the environmental status of mangroves as the relationship between the changes in the environmental variables and the remote sensing based indices felicitate an efficient evaluation of environmental variables, which can be used in the coastal zone monitoring and development processes.

Keywords: Landsat, NDVI, Meteorological data, environment

PROPOSING A MACHINE LEARNING BASED BIOPHYSICAL QUANTIFICATION APPROACH FOR ESTIMATING MULTIPLE VALUED ECOSYSTEM SERVICES IN THE SUNDARBAN BIOSPHERE RESERVE REGION, INDIA

Srikanta Sannigrahi (1), Saikat Kumar Paul (1), Somnath Sen (1)

[1] Department of Architecture and Regional Planning, Indian Institute of Technology,Kharagpur, India
Email: srikanta.arp.iitkgp@gmail.com

Abstract: Driven by the growth of the population and the economy, human demands on earth's land surface have increased dramatically in the past 50 – 100 years. The Sundarbans is the world's largest mangrove forest ecosystem with 3% of global mangrove share situated in the coastal region of the Bay of Bengal, India, and Bangladesh, considered one of the natural wonders of the world for its high ecological and biodiversity value. The area studied was divided into six major categories; cropland, mangrove forest, sparse vegetation, built-up urban area, water bodies and sandy coast, and the land coverage was calculated for the years 1973,1988, 2002, 2013, and 2018, respectively. Several machine learning algorithms, i.e. Support Vector Machine (SVF), Random Forest (RF), Artificial Neural Network (ANN), Gradient Boosted Tree (GBT), Linear Discriminant Analysis (LDA), Maximum Likelihood (MLC), K Means Nearest Neighbour (KNN) etc. were employed in this study to explicitly classify the regions into several landscape units. The spatially explicit value of the primary regulatory and supporting ecosystem services (climate regulation, raw material production, water regulation) was quantified through the indirect market valuation approach. A number of light use efficiency based ecosystem model, i.e. Carnegie- Ames-Stanford-Approach (CASA), Vegetation Photosynthesis Model (VPM), Eddy-Covariance Light Use Efficiency (EC-LUE), Global Production Efficiency Model (GloPEM), Moderate Resolution Imaging Spectroradiometer (MODIS) MOD17, Thornthwaite Memorial (TM) model, and Leith MIAMI model was utilized to estimate spatiotemporal NPP from 1973 to 2018. The Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model was employed to determine various regulatory, supporting, and provisioning ecosystem services for Sundarban biosphere region (SBR). While evaluating the trade-off between human appropriation and ecosystem service changes, it has been estimated that the ecosystem service value of multiple key ecosystem services of Sundarban regions decreased substantially. Therefore, the rigorous and centralized policy for sustainable and regionally balanced land-use planning has been essential in the recent era for economic viability, and ecosystem preservation, to prevent undesirable outcomes. The valuation method used for the significant regulatory ecosystem services (climate regulation, gas regulation, provision of organic matter production) is found ambiguous in several aspects.

Keywords: Ecosystem Service Value, Land Use Transition, Light Use Efficiency, Ecosystem Model, CASA

DEVELOPMENT OF FOREST ENCROACHMENT MODEL FROM SATELLITE IMAGERY DATA IN NAN PROVINCE

Kairop Pongphiboonkiat (1), Kativich Kantha (1), Pitsukarn Aeimyoung (1)

[1] Geo-Informatics and Space Technology Development Agency (Public Organization), Geo-informatic Applications and Service Office,120 The Government Complex Commemorating His Majesty The King's 80 th Birthday Anniversary, 5th December, B.E.2550(2007) Ratthaprasasanabhakti Building 6th and 7th Floor, Chaeng Wattana Road, Lak Si, 10210 Bangkok, Thailand.
Email: kairop@gistda.or.th; kativich@gistda.or.th; pitsukarn@gistda.or.th

Abstract: Encroachment of forest areas in Nan province has continuously increased. Although there are agencies responsible for monitoring and protecting natural resources including forest areas, the number of Forest officer is rather limited and not adequate to monitor and protect all forest areas. Therefore, forest encroachment model was created using satellite data Nan Province. The objectives are to design and develop a model to analyze forest encroachment sites accurately. The model used Landsat8 data of two periods (Before and After). Clouds and shadows were removed from the images to analyze the difference of the Normalized Difference Vegetation Index (NDVI) between the two periods. Then the data was reclassified using Unsupervised Classification's hereby the data groups with has high difference values in forest areas and other conservation areas that larger than 1 Rai (0.0016. Square kilometers) were selected. Then the data was converted into points. In the final step of the model, the point data was filtered in accordance with associated geospatial information, for example, Agricultural Land Reform Office data, State Property data, Nikom Sang Ton Eng, etc. Visual analysis of satellite data in two periods of time was also made. The field survey was proceeded to inspect the actual areas. The results of the analysis using the forest encroachment model, from 20 points, it was from that 10 sites of forest encroachment were detected while the remove up 10 sites were not detected as a forest encroachment. For the 10 sites with no forest encroachment, there are 4 sites of shifting cultivation areas, 4 sites of the areas that can be used by government permission, and 2 sites of litigation area by the Royal Forest Department. The percentage of accuracy of the model is 71.43%. Improvement of the model may be made by satellite data dating back several years and up-to date geospatial data for filtering the data points to reduce errors and improve accuracy of the results.

Keywords: Forest Encroachment, satellite imagery data, Geo-Informatics, Normalized Difference Vegetation Index

EVALUATING MANGROVE FOREST DEFORESTATION CAUSES IN SOUTHEAST ASIA BY ANALYZING RECENT ENVIRONMENT AND SOCIO-ECONOMIC DATA PRODUCTS

Adam Irwansyah Fauzi (1), Anjar Dimara Sakti (1), Lissa Fajri Yayusman (1), Agung Budi Harto (1), Irawan Sumarto (1), Ketut Wikantika (1)

[1] Center for Remote Sensing, Institut Teknologi Bandung, Bandung, Indonesia
Email: adam_irwansyah99@yahoo.com; anjardimarasakti@gmail.com; lissafajri@gmail.com; agung@gd.itb.ac.id; irawan@gd.itb.ac.id; ketut@gd.itb.ac.id

Abstract: Recent research conducted in Southeast Asia reveals that mangrove forest degraded 2.12% from 2002 to 2012. The availability of various data products that commonly used to analyze global and regional phenomenon encourages to be utilized for this topic. Therefore, this paper aims to present a critical review of certain environment and socio-economic data products correlation associated to mangrove deforestation based on Global Distribution of Mangrove (USGS) and Mangrove Forest Watch (CGMFC-21) data to achieve general description focusing in Southeast Asia countries. Environment and socio-economic data products applied in this study are population (GPWv4), rainfed field and irrigated field (HYDE 3.2), average nighttime lights (DMSP-OLS 4), cropland area (GFSAD), and cropland, built up, water area (IPUMS Terra). Analysis organized by calculating and comparing the total mangrove deforestation extent of each Southeast Asia country derived from overlaying Global Database of Mangrove and Mangrove Forest Watch data to each data products. Furthermore, anomaly and extreme deforestation area are selected to be correlated and discussed. Results indicate that several data products are relatively consistent while others are inconsistent based on mangrove deforestation extent calculation. As a result of the study, it was concluded that the distinction of method and resolution adopted to develop each data products is the primary issue that need to be concerned. There are also many possible data products sources for future study, and alternative measurement technique for the assessment have been described, thereby providing scope for future research and development following this review.

Keywords: Mangrove Deforestation, Southeast Asia, Socioeconomic

THE IDENTIFICATION OF FOREST PATCHES BASED ON NATIONALLY DEFINED FOREST BIOPHYSICAL PARAMETERS ESTIMATED FROM LIDAR AND LANDSAT 8 DATA

Wim Ikbal Nursal (1), Lilik Budi Prasetyo (1), Yudi Setiawan (1)

[1] Environmental Analysis and Spatial Modeling Laboratory, Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry, Bogor Agricultural University, Jl. Ulin Lingkar Akademik, Kampus IPB Darmaga, Bogor 16680, Jawa Barat, Indonesia
Email: bangwim@gmail.com; lbprastdp@apps.ipb.ac.id; setiawan.yudi@apps.ipb.ac.id

Abstract: Indonesia has defined the forest by using its biophysical parameters such as canopy cover and height of trees in the size of half of hectare. In reality forest identification or classification in national scale has been done mainly through manual interpretation and classification of optical satellite imageries. To support our proposal to improve national forest monitoring system by digital classification approach, we studied the integration of LiDAR and Landsat 8 image. We chose agroforestry area in Cidanau watershed, West Java as a research site and a case study by considering its accessibility and resemblance to natural forest. From LiDAR data that acquired in 2017, we extracted First Return Canopy Index (FRCI) as the estimators of forest canopy cover. These indices are used together with spectral vegetation indices derived from Landsat image to develop models which used for indicating the forest. The prediction of the models was then validated with a free and closest acquired Very High Resolution Image to the acquired date of our remotely sensed data. It was then compared with the land classification that made by the national authority for forest mapping particularly on the forest class. The results shows that the Corrected Normalized Difference Vegetation Index (CNDVI) is the best estimator of FRCI. From the validation result on model prediction to the forest existence and comparison with national forest map, it was shown that the model which uses CNDVI is very useful for indicating forested land. We are confident that the digital classification approach by taking the advantage of the integration of LiDAR and Landsat 8 imageries is promising method to provide forest map in national scale.

Keywords: forest, canopy cover, Landsat 8, LiDAR, vegetation index

SPATIAL MODELING OF FUTURE FOREST COVER CHANGES IN THE ISLAND OF PAPUA

S Zakiy Muwafiq (1)(2), Rizky Firmansyah (2), Arief Wijaya (2)

[1] Department of Geography, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Pondok Cina, Beji, Depok 16424, Indonesia
[2] World Resources Institute Indonesia, Wisma PMI 7th Floor, 63 Wijaya I, Kebayoran Baru, South Jakarta 12170, Indonesia
E-mail: sodi.zakiy@ui.ac.id; rizky.firmansyah@wri.org; arief.wijaya@wri.org

Abstract: This study aims to understand the key drivers of deforestation and predict future forest cover changes in Indonesia's Papua and West Papua Provinces (i.e. Western New Guinea). Land Change Modeler (LCM), a spatial modeling software tool, was utilized to analyze historical forest cover changes, create forest loss risk maps, and model future forest cover changes in the year 2030. Land use land cover data from Ministry of Environment and Forestry were used as the primary input for the model in the year of 2000, 2006, 2012. Validation of the model was based on the Receiver Operating Characteristic (ROC) values and confusion matrix from forest loss risk and predicted land cover, respectively. Based on analyses of historical forest cover changes, we selected several drivers of deforestation and related variables to be incorporated in the model for predicting forest cover changes. These include biophysical conditions (elevation, slope, average precipitation), accessibility (distance to rivers, roads, and settlement) and land management (logging concessions and protected areas). Between 2000 and 2012, Papua lost 517.135 Ha of forest cover, mainly due to transition to cropland. Elevation and accessibility are the primary drivers of these changes. By 2030, as much as 1.069.897 Ha of forests are predicted to be converted to other land uses, primarily to cropland (53.6%). The ROC value is 0.82, indicating that past changes from forest to other land use/land cover area are clustered in the high-risk areas of forest loss. Also, the mean value of confusion matrix (0.98) suggests a high accuracy for the predicted land cover/land use maps. This prediction model can assist agencies involved in sustainable development issues in the provinces of Papua and West Papua. In particular, the model can help with decision-making regarding forest conservation targets and greenhouse gas emission targets from the land use sector.

Keywords: drivers of deforestation, land use land cover changes (LUCC), land change modeler (LCM)

SYNERGY BETWEEN SATELLITE AND UNMANNED AERIAL VEHICLE (UAV) IMAGES FOR DEFORESTATION AND FOREST DEGRADATION ASSESSMENT

Khoirun Nadia Zainol (1), Mohd Fairuz Fuazi (1), Harita Jamil (1),
Mohd Hamadi Shahid (1), Razis Osman (2)

[1]Malaysian Remote Sensing Agency, Ministry of Energy, Science, Technology, Environment and Climate Change, Kuala Lumpur, Malaysia. No.13 Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
[2]Forestry Department of Peninsular Malaysia, Ministry of Water, Land and Natural Resource. Jalan Sultan Salahuddin, 50660 Kuala Lumpur, Malaysia
Email: khoirunnadia@remotesensing.gov.my; fairuzfuazi@remotesensing.gov.my; harita@remotesensing.gov.my; hamadi@remotesensing.gov.my; razis@forestry.gov.my

Abstract: Lately, the issue of forest destruction caused by various factors has received serious attention from various parties. This is because forest plays an important role in ensuring overall ecosystem stability. Therefore, forest managers should continuously seek forest information quickly, accurately and cost-effectively. Difficulty faced in detecting forest cover changes using conventional method due to inaccessible sites and complexity of Malaysia tropical forest landscape. Conventional field verification of forest cover changes are costly and time consuming. Some of the forest changes are very small and undetectable even though using high resolution satellite imagery. Hence, the usage of UAV equipped with high resolution sensor for data acquisition at the area of interest (AOI) is needed. The focus of this study is to monitor and assess deforestation and forest degradation In Sungai Menyala Forest Reserve, Negeri Sembilan through mapping and analysis of forest cover changes using geospatial approaches. Early information on forest cover change is extracted from Forest Monitoring Using Remote Sensing System (FMRS) equipped with SPOT 6/7 satellite imageries, forestry and secondary data. Supervised classification of multi-temporal images was carried out. Meanwhile, data acquired from UAV at the AOI is mosaic and analyzed. Next, resultant classes changes is compared and verified for ground truthing and verification. Therefore, the satellite images map at the selected area can be provide to the authorities for more effective and efficient forest management.

Keywords: Satellite Imagery, UAV, Deforestation, Forest Degradation, FMRS

HABITAT SUITABILITY FOR RED-BILLED QUELEA (Quelea *quelea*) IN HADEJIA-NGURU WETLANDS AREA OF NORTH EAST NIGERIA

Mohammed Inusa Nguru (1), Chong Leong P. (2), Muhammad H.I. (2), Alias M. S. (2)

[1] Department of science Laboratory Technology Mai Idriss Alooma Polytechnic P.M.B .1020 Geidam, Yobe state Nigeria
[2] Department of Forest Management University Putra Malaysia Serdang Selangor Darul Ehsan Seri Kembangan 43400 Malaysia
Email: ngurumuhammad@yahoo.co.uk; clppuan@yahoo.com; mhasmadi@upm.edu.my; ms_alias@upm.edu.my

Abstract: This research was carried out from July 2017 to Nov 2017. Red-billed Quelea is an avian species distributed in different parts of the Sub-Saharan Africa including the Hadejia-Nguru wetlands area of North eastern Nigeria. The species is identified as a species of least concern by the IUCN Red list. However, despite the stable nature of its population, there is no research conducted regarding the species and its environmental requirements in the Hadejia-Nguru wetlands. Therefore the main objective of this study was to carry out habitat suitability analysis to find out suitable sites for its habitation within the Hadejia-Nguru wetlands and its environs using the integration of GIS and remote sensing techniques. The soft wares such as ArcGIS 10.4, Erdas imagine 2014, Google earth were used in this research. The data used were sentinel 2 image of 2017 of the study area, Google earth and GPS point locations. As usual running habitat suitability model requires estimation of weights by expertise for each individual criterion on GIS software. Analytical hierarchy process (AHP) was used to classify the Hadejia-Nguru wetlands and its environments into classes from highly suitable habitat, moderately suitable, less suitable to not suitable habitat for the Red-billed Quelea species. It was shown that 13.90 % of the study area covers highly suitable area with an area coverage of 13816.3 hectares, about 23.68 % comprises of moderately suitable area with an area coverage of 23531.5 hectares, about 36.52 % of the study area covers less suitable habitat with an area coverage of 36296.3 Hectares and 25.88 % of the area covers not suitable habitat with an area coverage of 25725.4 hectares. Based on the findings of this research the Typha swamp provides the highly suitable habitat for the Red-billed Quelea and the rapid spread and invasion of the wetland by the aquatic weeds (Typha latifolia) create a very conducive environment for nesting and hide out for the Red-billed Quelea. The natural habitat of the speices has been Acacia shrub which has been destroyed by man for farmland expansion and quest for fuel wood. In conclusion, there is need for clearing and removal of the Typha vegetation which serve as nesting site and hide out for the bird species. Mass harvesting of Red-billed Quelea as a source of protein should be encouraged to reduce their population. Further research is needed in the application of bio logging to understand more about the behaviour of the bird species.

Keywords: Habitat suitability, Red-billed Quelea, Typha, vegetation

APPLICATIONS OF OPTICAL AND RADAR IMAGES FOR FOREST RESOURCES STUDY IN MONGOLIA

D.Amarsaikhan (1), D.Enkhjargal (1), A.Munkh-Erdene (1), E.Nyamjargal (1), B.Byamdolgor (1)

[1] Institute of Geography and Geoecology, Mongolian Academy of Sciences av.Enkhtaivan-54B, Ulaanbaatar-51, Mongolia
Email: igg.mas1@gmail.com

Abstract: Generally, forests are managed for an evolving constellation of objectives: timber and other commodities production; environmental stability, ecological balance, maintenance of wildlife habitat; water quality protection; wilderness and open space preservation; and, in the coming years, as a buffer against climatic change, and effective management of these resources, requires reliable and timely information about their status and trends. It has been found that much of the existing forests have been destroyed, mainly by shifting cultivation, timber preparation, legal and illegal logging, forest fires and increased number of people involved in agricultural activities. Traditionally, optical remote sensing (RS) images have been widely used for forest monitoring and management. Since the end of the last century, single polarization synthetic aperture radar (SAR) data sets have been increasingly accessible for the forest specialists. As the present space science and technology are so advanced, very high resolution multichannel optical and polarimetric SAR images are available for different forest studies. The combined application of optical and radar data sets can provide unique information for different forest studies, because passive sensor images will represent spectral variations of the top layer of the forest classes, whereas microwave data with its penetrating capabilities can provide some additional information about forest canopy. The aim of this research is to conduct a forest change study in the Bogdkhan Mountain, which is a nature reserve with protected status situated in Central Mongolia using optical and microwave images. For the analysis, multitemporal optical and SAR images as well as some other thematic maps have been used and different RS and GIS techniques were applied.

Keywords: Forest study, Optical data, SAR image

DEVELOPMENT OF MANGROVE ZONATION PATTERN MAP USING OBJECT BASED IMAGE ANALYSIS (OBIA) FOR DENSE MANGROVE COVER

Daeng Siti Maimunah Ishak (1), Ahmad Khairi Abd Wahab (1)(2), Rozaimi Che Hasan (1)(3), Mohamad Hidayat Jamal (1)(2)

[1] Center for Coastal and Ocean Engineering, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
[2] School of Civil Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia
[3] Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
Email: maimunah.kl@utm.my; akhairi@utm.my; rozaimi.kl@utm.my; mhidayat@utm.my

Abstract: Tolerability to the specific ranges of environmental parameters form a limiting factor to the mangrove species distribution. This characteristic is translated into the formation of mangrove zones in mangrove forest. Mapping the mangrove zonation pattern is a challenging task especially when the mangrove cover is thick and dense. The aim of this study is to identify and map the mangrove zonation pattern at Pulau Kukup, Johor using a high resolution WorldView-2 satellite data and Object Based Image Analysis (OBIA) system, SPRING 5.2. Mangrove extent was extracted from multispectral and panchromatic images using region growing segmentation method. Several thresholds were used to identify the best-fit segmentation parameters. Eleven plots of 100m transects were established in the study area to sample the representative mangrove trees. The type of mangrove species, tree height, Diameter at the Breast Height (DBH), elevation, and coordinate location were collected during the field survey based on Point-Centre-Quadrate Method (PCQM). The general characteristics of mangrove tree were investigated and sampled from 186 mangrove trees. *Rhizophora apiculata* and *R.mucronata* were found dominating the outer part of the mangrove island facing the seaward area. From the field analyses, the relative density of *Rhizophora apiculata* and *R.mucronata* are 41.9% and 16.7% respectively. The mangrove coordinate locations were then recorded and used as a reference point for classification process using the Bhatacharyya method. Three multispectral band combinations were tested for classification. Classified map with the highest accuracy level (94.05%) was constructed using the band combination 7 (near infrared-1), 6 (red-edge) and 5 (red) for the study area. From the study, it was found that the application of OBIA technique in mangrove mapping had successfully classified the dense mangrove cover. It concluded that the OBIA technique offers the best solution to map the dense mangrove distribution and can potentially be adopted to other ecosystem.

Keywords: WorldView-2 images, Region growing technique, Bhattacharya technique, dense mangrove cover, mangrove mapping

SPATIALLY VARYING RELATIONSHIPS OF MAMMALS AND FOREST VEGETATION STRUCTURE IN PENINSULAR MALAYSIA

Jamhuri Jamaluddin (1), Norizah Kamarudin (1)(3), Badrul Azhar (1)(2),
Chong Leong Puan (1)

[1] Universiti Putra Malaysia, Faculty of Forestry, 43400 UPM Serdang, Selangor, Malaysia.
[2] Universiti Putra Malaysia,Biodiversity Unit, Institute of Bioscience, 43400 UPM Serdang, Selangor, Malaysia.
[3] Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
Email: norizah_k@upm.edu.my

Abstract: Forests are degraded due to forest conversion to agricultural plantations, especially for oil palm cultivation that led to large-scale removal. Wild animals are sensitive to changes of forest landscapes and these could lead to impact on wildlife occupancies. Preserving the primary forest is an excellent way to sustain the species richness. This study was conducted to gain indepth insights into the existence of wildlife by assessing the numbers of species in two forests with different vegetation structure conditions: i) disturbed forest, and ii) undisturbed forest and to assess the spatially varying relationships that influence species distribution with vegetation structure. A total of 120 camera traps were used to capture the images of the numbers of wildlife in both forest areas. To understand the driving factors of wildlife existence within these two forest conditions, habitat quality attributes were measured; i) trees with diameter of above 45 cm at breast height (DBH) (DM45); ii) trees with DBH below 45 cm (DL45); iii) number of bamboo clumps (BMBO); iv) number of liana species (LANA); v) number of palm trees (PLMT); vi) number of fallen trees (FLTR); vii) number of saplings (SPLG); and viii) number of seedlings (SDLG). . From the images captured, 3,730 smalls to large-size mammal species are identified. Of that, 15 of mammal species with small to large size were taken for analyses. The undisturbed forest (n=2.683) has the highest mammal species occurrences compared with that of the disturbed forest (n=1.383). The images captured in the undisturbed forest are also high (n=50.87) compared with that of the disturbed forest (n=6.43). These comparative figures can be explained by the richness of biodiversity in the native forest. The mammal species occurrences are influenced by several factors; mammal species occurrence = f(LANA, DM45, PLMT, BMBO, SPLG). GWR conducted shows 25.86% of mammal species occurrence can be explained with vegetation structure. The findings of this study about spatial variation of wildlife species richness and occupancy under different forest vegetation structures are indeed very valuable; the wildlife department can utilise this information as guidance for the purpose of conservation management and taking proactive measures at targeted location.

Keywords: GWR, Species richness, Disturbed forest, Undisturbed forest,

DAMAGED EVALUATION OF TREES USING INFRARED CAMERA

Sasahara Hiromichi (1), Mitsuharu Tokunaga (1)

[1] Kanazawa Institute of Technology 7-1 Ohgigaoka, Nonoichi, Ishikawa 921-8501, Japan
Email: b1206249@planet.kanazawa-it.ac.jp; mtoku@neptune.kanazawa-it.ac.jp

Abstract: In Japan, we conducted a large-scale expanded afforestation plan for post-war reconstruction. About 70 years passed since then, trees have weakened, so many fallen-tree accidents occurred. There are visual observations and palpations by tree doctors, but this method spends a lot of time and cost. Therefore, it is necessary to have a simple and low cost method for diagnosing the growth of trees. In this research utilized near infrared responsive to plants and highly effective thermal infrared for detection of stem cavities and corroded parts. Taking pictures of trees using near-infrared cameras and thermographic cameras, we periodically obtained image data. We analyzed from the photographed image and selected trees with high risk of fallen trees. Image analysis revealed that the NDVI value varies depending on the incident amount of sunlight. Therefore, I corrected the NDVI value by sunlight. As a method, a correction formula derived from the correlation between the amount of change in NDVI value and the amount of change in solar radiation amount. As a result, it was possible to calculate the correction of the NDVI value even when the sunlight incident amount is different. As a result of image analysis, it was possible to select trees with high risk and to detect decaying parts of trunk from pine trees. In the future, environmental noise of sunlight and outside air temperature is a problem, so further correction algorithms need to be developed. In addition, it is necessary to increase the shooting frequency of trees and observe the seasonal change of trees.

Keywords: Image analysis, NDVI, near infrared, thermal infrared

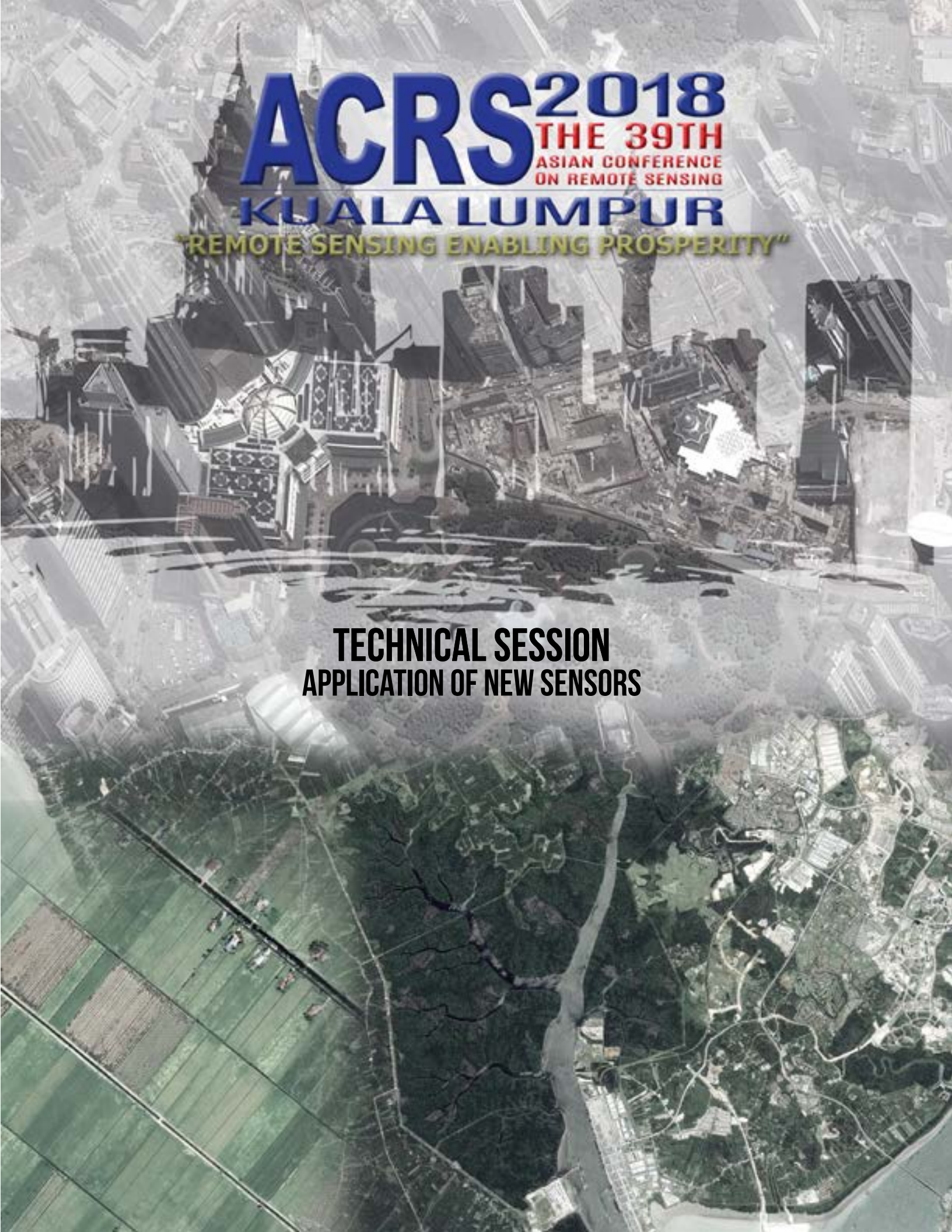
EVALUATION OF SOUTHEAST ASIA MANGROVE FOREST DEFORESTATION USING LONGTERM REMOTE SENSING INDEX DATASETS

Yoki Sepwanto Rajagukguk (1), Anjar Dimara Sakti (1), Lissa Fajri Yayusman (1), Irawan Sumarto (1), Ketut Wikantika (1)

[1] Center for Remote Sensing, Institut Teknologi Bandung, Bandung, Indonesia
Email: yokisepwantorg@students.itb.ac.id; anjardimarasakti@gmail.com; lissafajri@gmail; irawan@gd.itb.ac.id; ketut@gd.itb.ac.id

Abstract: The mangrove forests of Southeast Asia are highly biodiverse and provide multiple ecosystem services upon which millions of people depend but across Southeast Asia, mangrove forests continued to be lost at an average rate of 0.18% per year and converted to alternative land uses. The previous studies have identified the replacement land uses of mangrove deforestation in Southeast Asia. The proportional fluctuations of the satellite-derived vegetation indices (normalized difference vegetation index and normalized difference water index) to the replacement land uses has not been systematically evaluated, however, particularly in recent years. The evaluation of multitemporal satellite-derived vegetation indices improves our understanding of how these indices respond to the replacement land uses of mangrove forest deforestation in Southeast Asia. The replacement types and satellite-derived vegetation indices from the Moderate Resolution Imaging Spectroradiometer (MODIS) provided an opportunity to study the correlation between both vegetation indices respond to the replacement land uses of mangrove deforestation over 2000-2012. Results showed that both indices were highly dependent on replacement land uses. Sites replaced by relatively aquaculture had increased of the NDWI and decreased of the NDVI. Sites replaced by relatively urban had decreased of the NDVI and the NDWI. Site replaced by rice, oil palm, mangrove and other had the changed value of the NDVI and the NDWI. The respond of both indices in sites that replaced by the one specific land uses had each correlation (negatively and positively correlation). Negatively correlation identified in the aquaculture, rice, and palm oil replacement while negatively correlation identified in the urban, mangrove and other replacement land uses. The evaluation of the indices will improve the capability of satellite remote sensing mangrove deforestation monitoring.

Keywords: Mangrove Deforestation, Southeast Asia, MODIS, Index Datasets



TECHNICAL SESSION
APPLICATION OF NEW SENSORS

A CASE STUDY OF THE RELATIONSHIP AMONG AIR QUALITY AND RENTAL ACTIVITIES OF PUBLIC BICYCLE-SHARING SYSTEM IN TAIPEI

Chun-Yi Li (1), Sendo Wang (2)

[1]Graduate Student, Department of Geography, National Taiwan Normal University, No.162, Sec. 1, Heping E. Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.)
[2]Associate Professor, Department of Geography, National Taiwan Normal University, No.162, Sec. 1, Heping E. Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.)
Email: 60523003L@nt nu.edu.t w; se ndo@nt nu.edu.t w

Abstract: Public Bicycle-sharing System (PBS) has developed for a decade that become one of the public transportation system in Taiwan. People use PBS in outdoor environment that affected by weather conditions. In recent years, the occurrence frequency of high concentration of particulate matter (PM) pollution has increased gradually in Taiwan. The study investigated the relationship among air quality conditions and the rental activities of PBS in Taipei. Location Aware Sensor System Airbox (LASS-Airbox) sensors' record and spatio-temporal rental data of PBS in Taipei were received to analysis. LASS-Airbox is a small, tiny sensor that detects and records air pollution PM2.5, temperature and humidity data which are open data that could receive from the Internet; Spatio-temporal rental data of PBS records every rental event as rent time, rent station, return time, return station and usage time that analyzed to the frequency of bike rented at a specific PBS station in an hour. This research focuses on "PBS rental activities in Taipei from January to October, 2017". Linear regression method was applied in the study. The results are as follows: 1. The concentration of air pollution PM2.5 and the rental frequency of PBS present a weak positively linear relationship. 2. Humidity and the rental frequency of PBS present moderate negative linear relationship. 3. Temperature and the rental frequency of PBS present a weak positively linear relationship.

Keywords: Public Bicycle-Sharing System, Air Quality, Particulate Matter, Open Data

POTENTIAL SUPERCOOLED WATER CLOUD DETECTION ALGORITHM USING HIMAWARI-8 SATELLITE MEASUREMENT

Husi Letu (1)(2), Ziming Wang (1)(3), Huazhe Shang (1)

[1] State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing and
[2] Digital Earth, Chinese Academy of Sciences, Beijing, China
[3] Research and Information Center, Tokai University, Tokyo, Japan
University of Chinese Academy of Sciences, Beijing, China

Abstract: Detection of the supercooled water cloud (SWC) is valuable in artificial rain enhancement, prevention of aircraft ice accretion and better understanding of radiative energy balance. Nevertheless, the SWC detection from satellite measurements is challenging, because it is difficult to distinguish SWC from mixed clouds and to speculate in-cloud SWC. The new generation high-resolution geostationary Himawari-8 satellite is equipped with Advanced Himawari Imager (AHI) sensor, which provides the possibility to continuously identify SWC over cloud top. The SWC is supposed to exist in liquid and mixed phase according to microphysical processes of homogeneous and heterogeneous freezing in ice nucleation. There is an objective relationship between SWC's temperature and phase. Effective radius in mixed phase is larger than that in liquid phase in our SWC droplet-size distribution statistics. SWC is often found in thick clouds with larger optical depths/, corresponding to estimation of cloud physical thickness using COT and CTT. Based on cloud microphysics mentioned above, we developed the Himawari-8 Supercooled Water Cloud (HSWC) algorithm to identify the potential SWC using AHI level 2 cloud properties (e.g., cloud phase, cloud top temperature, cloud effective radius and cloud optical thickness). The potential SWC is detected from Himawari-8 measurements by the HSWC algorithm in January, May, August, and October of 2017 from 60°S to 60°N in latitude and from 80 to 180°E in longitude, and is further validated using SWC measurements of Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO). Compared with GOES-R and MODIS SWC testing methods, the HSWC detection accuracy has improved 11.85% and 7.77%, respectively. The hit rate (HR) and the false alarm rate (FAR) are 92.64% and 27.99%. Our HSWC algorithm provides the basis for scientific implementation of artificial rain enhancement.

Keywords: potential supercooled water cloud, Himawari-8, cloud effective radius, cloud optical thickness, CALIPSO

THE APPLICATION OF LORAWAN WIRELESS COMMUNICATION PROTOCOL IN DEVICE POSITIONING

Wei-Ching Lo (1), Chih-Yuan Huang (2)

[1] First year student, Master of Science Program in Remote Sensing Science and Technology, Center for Space and Remote Sensing Research, National Central University, No. 300 Jhongda Rd. Jhongli District, Taoyuan City 32001, Taiwan
[2] PhD, Assistant Professor, Center for Space and Remote Sensing Research, National Central University, No. 300 Jhongda Rd. Jhongli District, Taoyuan City 32001, Taiwan
Email: weiching0000@gmail.com; alechuang192@gmail.com

Abstract: Internet of Things (IoT) has been attracting attention from various domains over the last few years. While IoT devices continuously monitor environmental properties and provide remotely controllable functions, the geospatial location of IoT devices is an expensive information to obtain. Whereas Global Positioning System (GPS) is a commonly-used positioning technology, large power-consumption and excessive cost of adding GPS receiver in every IoT device is not realistic. Therefore, this paper presents a design and implementation of a positioning system using a local wireless communication protocol called LoRaWAN. LoRaWAN is a low-power, wireless communication technology recently proposed to transmit information between IoT devices. A device's position can be estimated by monitoring a location dependent parameter (LDP) such as received signal strength indicator (RSSI), which measures received signal strength, time of arrival (TOA), which measures the time duration of signal travel, and time difference of arrival (TDOA), which measures the TOA differences between gateways. While recent studies show that TDOA has a better accuracy than RSSI and TOA requires a signal's start time, this research aims at examining the applicability of TDOA position algorithm on LoRaWAN. The evaluation result shows that the proposed solution shows acceptable positioning accuracy.

Keywords: Wireless communication positioning, distance measurement, time difference of arrival, LoRaWAN

AIRBUS DS' SATELLITE PARTNER PROGRAMME FEATURING MULTI-SOURCE DATA COMPLEMENTARITY FOR DEMANDING APPLICATIONS

Jérôme Soubirane (1)

[1] Airbus Defence and Space, 5 rue des Satellites, 31030 Toulouse, France
Email: jerome.soubirane@airbus.com

Abstract: Since the launch of the first SPOT satellite in 1986, the SPOT family has been monitoring our World of constant change, covering the total land masses more than 750 times. Available online, this unique archive witnesses the evolution of our planet and the impact of human activity. As a pioneer company in the Earth observation business, Airbus Defence and Space (Airbus DS) is constantly listening to the evolving needs for geo-information of its customers; these needs quite often cannot be satisfied by a single type of data sources. For this reason, Airbus DS initiated integration of third party satellites into its product portfolio in the early 90's, starting with the SAR systems from ESA (ERS 1/2 and Envisat), in order to ensure the best use of data complementarity. This strategy has been later expanded with other missions, Formosat-2, Kompsat-2 and Deimos-1 to offer additional value to our customers: higher temporal frequency for efficient monitoring, capacity to faster cover large areas, various resolution ranges to provide both the big picture and capture the highest level of details, or supplementary spectral bands to discern other types of information. These successful past collaborations with satellite operators, paved the way to a redesigned satellite partnership programme that is presently gearing up at Airbus DS, starting with Azercosmos for Azersky satellite, Kazakhstan Garysh Sapary JSC for the KazEOSat-1 and KazEOSat-2, 21st century Aerospace Technology in China for TripleSat constellation, Hisdesat in Spain for PAZ which is now fully part of the SAR constellation with TerraSAR-X and TanDEM-X, or GISTDA in Thailand for the upcoming satellite Theos-2. These additional sensors, as a halo surrounding Airbus DS' own constellation (SPOT, Pléiades, TerraSAR-X/TanDEM-X, DMC and soon Pléiades Neo), smartly complement data procurement for the benefit of its customers. Airbus DS is thus positioned with a One-StopShop approach featuring a unique expertise in the distribution of multi-source and multiresolution data as well as derived geo-information services. Increasingly solutions will be offered based upon an increasingly complicated and fast-moving ecosystem of sensors. In this context the Airbus DS Satellite Partner Programme takes on its full meaning for the benefit of the users.

Keywords: constellation, partnership, service, imagery

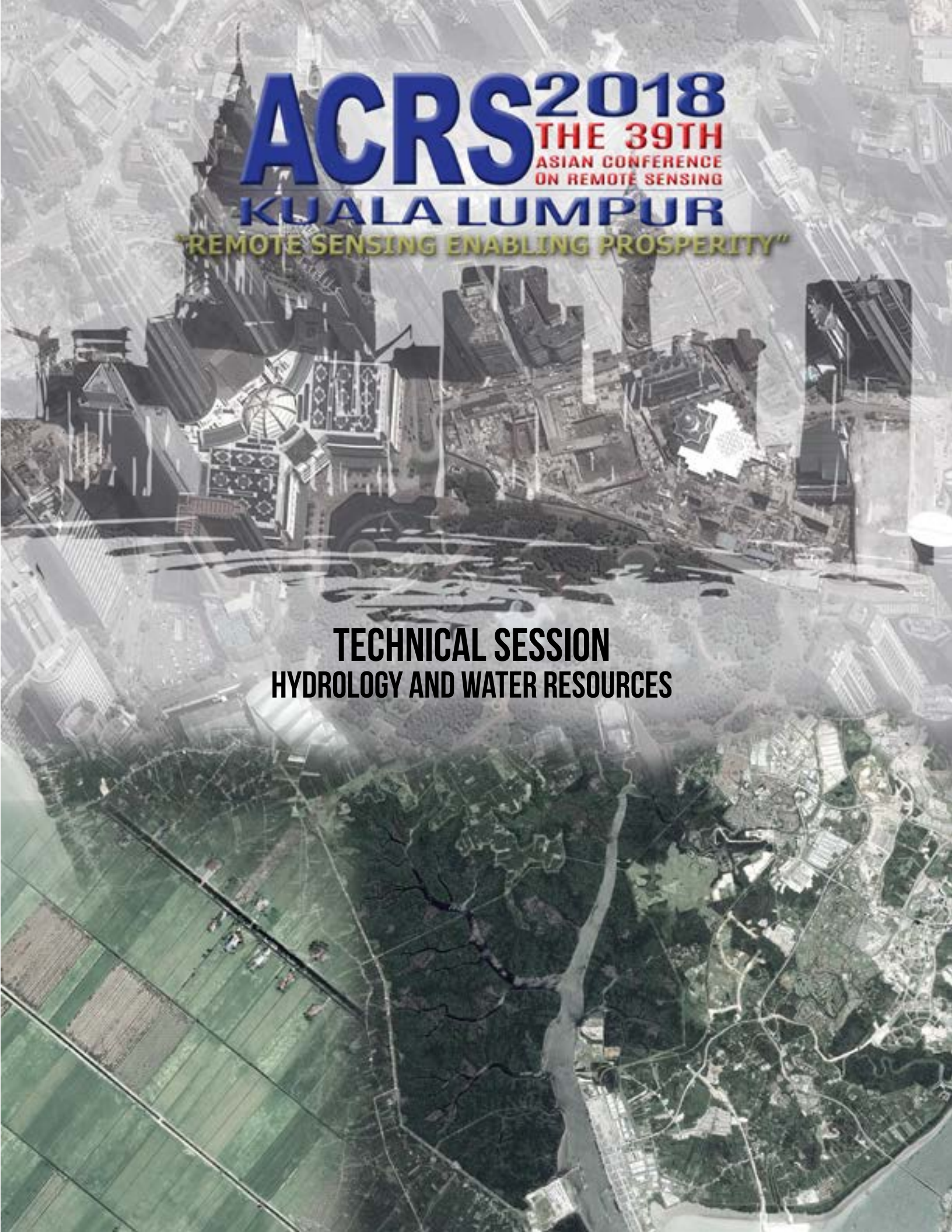
ABOVEGROUND BIOMASS ESTIMATION IN TROPICAL RAIN FOREST BASED ON TERRESTRIAL LASER SCANNING

Hamzah Mohd Ali (1), Hani Safinaz Shaffie (1), Abd Wahid Rasib (1),
Muhammad Zulkarnain Abd Rahman (1), Hamdan Omar (3), Azahari Faidi (3), Rozilawati Dollah (2),
Abdul Razak Mohd Yusoff (1), Muhammad Imzan Hassan (1)

[1] TropicalMap Research Group, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
[2] School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
[3] Geoinformation Programme, Division of Forestry & Environment, Forest Research Institute Malaysia, 52109, Kepong, Selangor, Malaysia.
Email: abdwahid@utm.my

Abstract: Estimating forest biomass is significant for measuring the roles of forests as carbon sources and for supporting sustainable forest management. However, tree biomass is difficult to measure directly. Hence, this study presents an advanced technology non-destructive approach to produce biomass estimation at plot scale using terrestrial laser scanning data in tropical rainforest. This study was carried out in the forest campus of Forest Research Institute Malaysia (FRIM), Kepong, Selangor. Three plots were established with a circular shape of 25 meters radius for each plot and 360º scanned by terrestrial laser scanner. The main tree attributes that will be measured is diameter at breast height that will be extracted by using terrestrial laser scanning and ground measurement of diameter at breast height at these three plot. As the results, the overall total of aboveground biomass using terrestrial laser scanning data is 38.68 ton per hectare while for overall total aboveground biomass of census data is 38.09 ton per hectare. Comparison analyses between biomass terrestrial laser scanning and biomass census indeed root mean square at 0.37 for three plots a t-test -1.206 ($p \leq 0.233$). As conclusions, terrestrial laser scanner techniques is potential to be used as a tool for plot scale aboveground biomass estimation in high density tropical rain forest.

Keywords: Aboveground biomass, Tropical rain forest and terrestrial laser scanning



TECHNICAL SESSION
HYDROLOGY AND WATER RESOURCES

THE ANALYSIS OF WATERSHED VULNERABILITY BASED ON GEOMORPHOMETRY AND LANDSLIDE SUSCEPTIBILITY IN BOGOWONTO WATERSHED

Munawaroh (1), Djati Mardiatno (2), Muh. Aris Marfai (2)

[1] Indonesian Geospatial Agency, Jalan Raya Bogor Km 48, 16911 Cibinong, Indonesia
[2] Faculty of Geography, Universitas Gadjah Mada, Skip Utara Jln Kaliurang Bulaksumur, 55281 Yogyakarta, Indonesia
Email: munawaroh@big.go.id; djati.mardiatno@ugm.ac.id; arismarfai@ugm.ac.id

Abstract: Bogowonto watershed, located in Central Java Province, covers an area of ± 601 km^2. It has steep slopes, high of rainfall intensity and the intensive land use for agriculture have made Bogowonto watershed vulnerable to land degradation. The aims of this research are to analyze the level of vulnerability of Bogowonto sub watershed based on geomorphometry characteristics and landslide vulnerability. Sub watershed Geomorphometry parameters related to the vulnerability of land degradation are quantified. Weighted Sum Analysis (WSA) is used to determine the weight of each parameter of geomorphometry that vulnerable to land degradation. Landslide susceptibility was analyzed by Frequency Ratio Model. The results showed that Loano sub watershed and Kodil II sub watershed had the highest vulnerability rankings in Bogowonto River Basin. That is, the two watersheds become the priority of planning and management of sustainable watersheds in Bogowonto.

Keywords: watershed, Bogowonto, vulnerability, geomorphometry

IMPACTS OF CONVERSION OF FOREST TO AGRICULTURAL OIL PALM PLANTATION ON WATER YIELD IN MALAYSIA

Babangida Ba'iya (1)(2)(3), Mazlan Hashim (1)(2), Suleiman Ibrahim Musa (1)(2)(4)

[1] Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[2] Geoscience and Digital Earth Centre (INSTeG), Research Institute of Sustainability Environment (RISE), Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[3] Federal Polytechnic, Mubi, Adamawa State, Nigeria
[4] Abubakar Tabawa Balewa University Bauchi, Bauchi State Nigeria
Email: babangidabaiya@gmail.com; mazlanhashim@utm.my; sulaimanibrahimmusa@gmail.com

Abstract: The rapid landscape development within a watershed that affect the land-use particularly Forest and oil palm is a challenging basin management issue that has a great vulnerability risk of flood and heavy rainfall events that caused severe damages to properties, infrastructure and loss of lives; mainly due to major changes of certain land use type. Oil palm trees cause higher discharge and runoff because of the scattered canopy and uncovered surface of the ground compared to the original forest. Therefore, forest response towards rainfall is far better than the oil palm. This paper reports preliminary findings for changes from forest to oil palm in Johor River Basin, Malaysia by using multi-temporal satellite data (Landsat-7). Qualitative and quantitative evaluation to analyse the impacts of successive changes from forest to oil palm were performed for the period of 2000-2010. The result indicates that, the conversion of forest to oil palm plantation between 2000-2010 has a considerable effect on the hydrological properties of the Johor River Basin which may not be unconnected with average water yield decrease in the area. Similarly, the expansion of the oil plantation is at the expense of forest areas, which influences global environmental changes thereby leading to high risk of rising temperature that can have an effect on hydrological cycle. This in turn can result to dryer during dry seasons and wetter during rainy seasons. Also, the result shows that forest and oil palm are inversely proportional with $R^2 = 0.9955$. Likewise, forest and water body which are directly proportional with $R^2 = 0.966$, as well as water body and urban which are inversely proportional with $R^2 = 0.9997$. The research proved the capability of Landsat ETM satellite imagery in monitoring the conversion of forest to oil palm and its effect on hydrology, which is vital as outlined in the 2030 agenda of the United Nations Sustainable Development Goals 6. Hence, the authority and stakeholders concerned are urged to come to the round table on the sustainable palm oil guide lines and bring out suitable low impact development strategies and techniques in the oil palm plantation sector.

Keywords: oil palm, forest, land use change, water yield, river basin

RIVERBANK EROSION MODEL IN KELANTAN CATCHMENT

Zainab M. Y. (1), Shahabuddin A. (2), Noraliani A. (1), Ilya Khairanis, O. (1), Ponselvi, J. (1)

[1] Department of Hydraulics and Hydrology, Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru
[2] Department of Geoinformation, Faculty of
Email: zainabyusof@utm.my

Abstract: The riverbank erosion model is used to quantify the amount of runoff in the upper catchment of Kelantan that takes into account effect of land cover change. The study is aimed to develop a model, which allows for great flexibility and GIS that uses a DEM data type representation of the catchment, which allows for a detailed representation of riverbank erosion due to extreme flood, particularly at Kuala Krai, Kelantan. The objective of this study is to demonstrate bank erosion control. The approach is modeled into a hydrodynamic model to protect riverbank erosion of Kelantan River based on the time series and assess soil erosion in sub-watershed, that will be performed to predict the erosion rate. The software so-called Telemac is used to model and investigate the potential of erosion prone areas and analyse the effectiveness of the model adopted. The preliminary results of water column and bed shear stress indicate that the critical erosion was occurred at the river's banks near Kuala Krai and at the upstream at Lebir River.

Keywords: riverbank, erosion, erosion rate, hydrodynamics, erosion prone

DAMS DECISION SUPPORT SYSTEM FOR SITE SELECTION USING REMOTE SENSING AND GIS TECHNIQUES IN YEMEN

Ayoub Ahmed Almhab (1)

[1] Ministry of Agriculture and Irrigation, Researcher, Head MIS-GIS Unit, Sana'a, Republic of Yemen
Email: ayoub.almhab@gmail.com; almhab@live.nl

Abstract: Water is the most important source of the life, which cannot be dispensed without, Water security is one of the biggest challenges facing the national level. The conservation of water is through the establishment of Dams and water barriers to the water harvesting from the little precipitation. This is very old way has shown its beginning establishment, and it was founded on 3000 year before which do there job well till present, providing water for the both the human and the animals and irrigation, Evolved in our present vocation to include the generation of power and provide industries by water. The selection of suitable structures for the construction of partitions and barriers is one of the most critical stages of the establishment of the Dams, so because the selection of good things gives the maximum benefit in addition to the added value can be Production areas also create an area surrounded by the dam. On the contrary, the poor site may lead to effects Harmful. This research has developed a method that has been chosen in the selection and designations of the study area, using remote sensing satellite images data and GIS (Geographic Information System) by using (Buffer) and WLC (Wight linear combination) method. The outputs of this study showed that the developed method showed an sensitivity to natural elements, environmental and economic studies in the area of study, in addition to the techniques of remote sensing and geographic information systems GIS, Install it's useful utility in producing, selecting and extracting layers of data maps related to the study, Provide the best management tools for decision making.

Keywords: Dams, Yemen, decision, GIS, Images

UTILIZING STORMWATER RESOURCES IN DEHRADUN DISTRICT, INDIA

Shray Pathak (1), Chandra S. P. Ojha (1), Rahul D. Garg (1)

[1] Indian Institute of Technology Roorkee, Civil Engineering Department, Roorkee, 247667, Uttarakhand, India
Email: shraypathak@gmail.com; cspojha@gmail.com; rdgarg@gmail.com

Abstract: Growing water scarcity and global climate change call for more effective and efficient alternatives for conservation of water. Among all water harvesting techniques, Storm Water Harvesting (SWH) is the most sustainable approach to reduce pressure on fresh water resources. However, estimation of SWH potential and the selection of suitable sites are very challenging. In present study, suitable zones are identified for sustainable SWH and storage are identified using remote sensing for land use data. Further the location assessment is linked to the decision support system (DSS). The DSS take into consideration by integrating diverse thematic layers such as rainfall surplus, potential runoff coefficient, slope, land cover/use and soil texture. Thus, integrating five thematic maps, the spatial extent for SWH suitability zones are identified by an analytical hierarchy process. For the thematic map of soil texture, a coarse texture class has given least weight and the fine has given the maximum weight of suitability. Large rainfall surplus has given maximum preference whereas deficit areas has given least. Similarly, slope above than 30 percent has allotted least weightage whereas slope less than 2 percent has given maximum. The runoff index above 0.65 has given maximum weightage and runoff index less than 0.03 has given least weight of suitability. The model generated a suitability map for SWH in five categories i.e. excellent, good, moderate, poor and unsuitable. Thus, the methodology demonstrates the benefits of such tools for water professionals for reducing the stress on freshwater assets. The rapid identification of suitable zones for stormwater harvesting can assist planners in prioritizing schemes in areas that will have the most impact on reducing potable water demand.

Keywords: Rainfall-Runoff, GIS, suitable zones, Multi-criteria Evaluation

COMPARISON OF TWO LAND COVER SCENARIOS AND ITS EFFECT ON THE RUNOFF PROCESSES INSIDE THE MANDULOG RIVER BASIN, PHILIPPINES

Alan E. Milano (1), Peter D. Suson (1), Stephanie Mae B. Salcedo (1), Jennifer G. Blasco (1)

[1] MSU-Iligan Institute of Technology, GeoSAFER Mindanao Project, Tibanga, Iligan City, Lanao del Norte, Philippines, 9200
Email: aemilano1960@yahoo.com; petersuson2@gmail.com; stephsalcedo@gmail.com; jennifer.blasco5558@gmail.com

Abstract: This study seeks to determine what happens to runoff volume, peak flow and the lag time between peak rainfall and peak river discharge or peak flow when no proper land use management is done and what happens to it in time. This is represented by the Projected Land Cover. Another is what happens to the runoff processes when sound land use management is adopted. The first land cover scenario was created using a Trend Analysis function from MS Excel derived from the 1973, 1989, 1998, 2008 and 2010 land cover images. The second scenario is the Desired Land Use wherein it makes use of slope as the basis in assigning the different land uses. The SCS CN (Soil Conservation Service – Curve Number) values were determined for the two land cover scenarios. Limitedly available LiDAR DEM (Light Detection and Radar – Digital Elevation Model) strips were integrated into the IFSAR DEM (Interferometric Synthetic Aperture– Digital Elevation Model) to generate a detailed basin model and slope in GIS. The HEC-HMS (Hydrologic Engineering Center-Hydrologic Modeling System) was used for simulating runoff models. The Projected Land Cover has a higher total runoff volume, peak flow and shorter Lag time as compared to the Desired Land Use in the four (4) Rainfall Return Period scenarios. The latter has twice as much forest vegetation than the projected land cover scenario, it has better forest cover quality and plus the presence of agroforestry land use. Such condition helps improve soil infiltration and thus reduces runoff volume and peak time. The study shows that when land cover conditions are left by itself in time without any intervention, runoff which is the input for flooding, is more likely to be magnified. The study also shows that runoff can be reduced if the Desired Land Use will be adopted.

Keywords: runoff, peak flow, peak rainfall, lag time, land cover

DIGITAL IMAGE PROCESSING TECHNIQUE FOR SATELLITE-BASED WATER YIELD EXTRACTION USING WATER BALANCE EQUATION

Babangida Ba'iya (1)(2)(3), Mazlan Hashim (1)(2)

[1] Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[2] Geoscience and Digital Earth Centre (INSTeG), Research Institute of Sustainability Environment (RISE), Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[3] Federal Polytechnic, Mubi, Adamawa State, Nigeria
Email: babangidabaiya@gmail.com; mazlanhashim@utm.my

Abstract: Speedy landscape development within watershed is leading to the modification of land cover status, typically clearance of forest for oil palm plantation. This may result to climate change impacts such as excessive rainfall and flooding, which may in turn leads to loss of lives and properties. The synoptic view of satellite remote sensing images acquired within the visible, shortwave infrared (SWIR) to thermal infrared (TIR) bands have seen the recent emerging techniques on how the water-yield over large watersheds or even river basin could be successfully derived. One of the widely used, and in fact conventional method for water yield is based on the water balance equation; the yields are as a results of precipitation, evapotranspiration of trees and soil moisture enclosed within watershed. Adapting this approach, on the implementation using fully satellite acquired data, the digital image processing technique must be able to integrate all derived satellite precipitation radar data, evapotranspiration rate derived from surface energy balance of SWIR and TIR bands; and derived-soil moisture from passive microwave satellite sensors. This paper reports this digital-image-processing approach, and its implementation in selected watersheds in Johor River Bain, inclusive of it calibration and validation with in-situ observations. The result indicates the good correlation (R^2>0.85) of water yield derived from satellite and the corresponding in-situ observations. The major advantage of this approach is the continues time series of water yields offered by the multi temporal satellite imagery of the watersheds.

Keywords: oil palm, forest, Climate change, water yield, river basin

ESTIMATION OF DAM SEDIMENTATION USING REMOTE SENSING

Nor Asiken Alias (1)

[1] Department of Civil Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor Darul Ehsan.
Email: asiken065568@gmail.com

Abstract: This study outlines the estimation of dam sedimentation of the Batu Dam using remote sensing. The main objective of the study is to estimate and measure the storage capacity and sedimentation of Dam. The specific objectives of this study are to identify of water pixels and water spread area from Image of Surface reflectance Landsat 8 (OLI) data and to get the sedimentation rate by revise the capacity elevation curve and relate with original storage curve. The sedimentation estimation was carried out using satellite data, which are surface reflectance Landsat 8 data and dam water level data from 2013 to 2017 was used. Water spread area was analyzed from satellite of Landsat 8 data. The Normalized Difference Water Index (NDWI) has been used to delineate open water features and to enhance the presence of water surface in satellite imagery of the Batu Dam. Water spread area of the dam at a particular elevation on the date of the passing of the satellite was used to develop an elevation-area-curve. For this study, the linear interpolation/extrapolation technique has been engaged to measure the water spread area of Batu Dam at different elevations. Further, these areas were used to compute the live storage capacity of the dam between two elevations by the trapezoidal formula. From the study, it was found that the sediment volume since 1987 until 2017 the loss of capacity was 7.31 Mm3, which was the 23 percent loss from the original live storage capacity. Based on the Landsat 8 survey the annual sedimentation rate is 0.24 Mm3 per year and is equivalent to 0.8 percent per annum.

Keywords: Sedimentation, Landsat 8, Normalized Difference Water Index (NDWI)

HYDROLOGICAL MODELLING USING GIS CAPABILITIES FOR JOS PLATEAU, CENTRAL NIGERIA

Danboyi Joseph Amusuk (1)(2), Mazlan Hashim (1), and Amin Beiranvand Pour (1)(3)

[1] Geoscience and Digital Earth Centre (INSTeG), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[2] Department of Surveying and Geoinformatics, Waziri Umaru Federal Polytechnic, Birnin Kebbi PMB 1034, Kebbi State-Nigeria
[3] Korea Polar Research Institute (KOPRI) Songdomirae-ro, Yeonsu-gu, Incheon 21990, Republic of Korea
Email: danboyiamusuk64@gmail.com; mazlanhashim@utm.my; amin.beiranvand@kopri.re.kr

Abstract: Hydrological representations of real time measurements using field experiments alone is a complex, difficult and an expensive preposition to embark on due to the relevant spatial scales and especially at regional coverage. Obtaining full knowledge of the landscape characteristics of a region provides and identifies several important elements of the environment such as its hydrologic flow paths, distributed state variables of soil moisture, groundwater flow, run-off, sediment and contamination transport. In this study, computational resources with powerful treatments of uncertainties in hydrological modelling were put to use through the capabilities of GIS and ASTER-DEM data of Plateau state North central Nigeria covering an area of 26,800 km^2. The need for geoscience application to hydraulics, geology and geomorphology has continued to grow because such make available automatic delineation of flow paths, sub watersheds and channel networks of the hydrology in 2D and 3D representations. A composite hydrological model achieved for the Jos Plateau, central Nigeria revealed clearly the source of 5 important rivers that flows into neighbouring states (Bauchi, Kaduna, Hadejia, Yobe and Adamawa) using the hydrology tools of ArcGIS version 10.3 software.

Keywords: GIS, ASTER-DEM, Hydrological modelling, Jos Plateau, Nigeria

SENSITIVITY OF SOIL DIELECTRIC MIXING MODELS FOR SMOS SOIL MOISTURE RETRIEVAL

Prashant K. Srivastava (1)(2), Dawei Han (2), George P. Petropoulos (3), Dharmendra Pandey (4), Rajendra Prasad (5)

[1] Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, India
[2] Department of Civil Engineering, University of Bristol, Bristol, United Kingdom
[3] Department of Soil Water Resources, Institute of Industrial & Forage Crops, Hellenic Agricultural Organization—Demeter, Larissa, Greece
[4] Space Applications Centre, ISRO, Ahmedabad, India
[5] Department of Physics, Indian Institute of Technology (IIT) BHU, Varanasi, India
Email: prashant.iesd@bhu.ac.in; cedh@bristol.ac.uk; petropoulos.george@gmail.com; dkp@sac.isro.gov.in; rprasad.app@itbhu.ac.in

Abstract: Soil moisture is a key variable behind many hydrologic phenomena and applications. Passive L-band microwave satellites such as SMOS or SMAP are promising for retrieval of soil moisture. However, accurate retrieval of soil moisture depends on applying the appropriate soil dielectric mixing model. In this study, three dielectric models are used in integration with single channel algorithm using H polarization for retrieval of soil moisture. Soil moisture deficit (SMD) derived from locally simulated hydrological model--PDM (Probability Distribution Model) is used as a benchmark for all the assessment. The statistical performance indices such as *R2*, *Bias* and *RMSE* indicates that the Mironov is performing better than Dobson and Wang & Schmugge models for SMOS soil moisture retrieval and can be applied for SMD estimation, especially in ungauged basins.

Keywords: SMOS, Dielectric Mixing Models, Soil Moisture Retrieval, Probability Distribution Model, Soil Moisture Deficit

COMPARATIVE HYDROLOGICAL AND FLOODING ANALYSIS OF TWO LANDSCAPE SYSTEMS IN NAAWAN RIVER BASIN

Alan E. Milano (1), Stephanie Mae B. Salcedo (1), Dave Charity C. Gambuta (1), Daniel S. (1)

[1] Mostrales College of Engineering & Technology, MSU-Iligan Institute of Technology, Iligan City, Philippines
Email: alan.milano@g.msuiit.edu.ph; stephsalcedo@gmail.com; davinchi_2015@yahoo.com.ph; daniel.mostrales@g.msuiit.edu.ph

Abstract: As urban area continues to expand due to an increasing trend in human population, there is an urgent need to study and identify the impacts of flooding to the community in relation with the changing urban landscapes. Two (2) landscape systems have been separately set up in this study using the same river basin area. The same parameters (slope, elevation, stream definition and etc.) were extracted for the models except for land use parameter. The land use extracted for basin model 1 has no built-ups and roads, while basin model 2 uses building footprints and roads extracted from Light Detection and Ranging (LiDAR) data which were then integrated to the same land use used in basin model 1. The land cover/use classification is associated with different Curve Number (CN) values derived from the soil type and land cover itself, which was—in this study—considered as the main parameter that affects the amount of surface runoff from hypothetical events simulated in Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS). The meteorological model was derived from the frequency storm method which uses statistical data to extract the balanced storms with a specific exceedance probability. The study uses 50%, 2%, and 1% probability. There are three (3) flood results (2yr, 50yr and 100yr rainfall return periods) in each set which were compared through their flood depth values. Generally, this study focuses on the dynamics of runoff in a given river basin area assuming all other parameters are the same except for the land use. Peak time of the hydrographs, volume generated, and peak outflow were thoroughly compared. Evidently, given the two (2) different basin models, it was expected that the model which has built-ups classification and roads would result into faster stream flow velocities, greater peak flows and volume. Conversely, the model which has no built-up classification would most likely result in lower peak discharges and volume. This could be helpful in the crafting of appropriate mitigating measures to reduce flooding such as efficient drainage master plan, sustainable relocation sites for the vulnerable population, and by improving urban landscapes.

Keywords: Hydrology, Urban Flooding, Flood Mitigation

UTILIZING SERIOUS GAMING IN FLOOD DISASTER PREPARATION

DaisukeA.Tatsuda (1), Christine A. Parcon (1), Judy Rose D. Hollite (1), Gus Kali R. Oguis (1), Joseph E. Acosta (2), Vicente B. Calag (2)

[1] Geo-SAFER Southeastern Mindanao, College of Science and Mathematics, University of the Philippines Mindanao, Davao City, 8022, Philippines
[2] Department of Mathematics, Physics and Computer Sciences, College of Science and Mathematics,
University of the Philippines Mindanao, Davao City, 8022, Philippines
Email: datatsuda@up.edu.ph; caparcon@up.edu.ph; jdhollite@up.edu.ph; goguis@upmin.edu.ph; jeacosta@up.edu.ph; vbcalag@up.edu.ph

Abstract: The Philippines is no stranger to various types of disaster events, particularly flooding which affects millions of people each year. Mitigation efforts ranging from community-based solutions and hazard mapping have been implemented. However, these traditional approaches lack the essence of connecting with an ever-changing society – in particular, a method of connecting with the community using modern paradigms in technology. The recent advent of Visual Novels in games show potential not only in storytelling, but also in educating its players – an approach called 'Serious gaming'. This gamification strategy has been used in teaching basic knowledge on disaster mitigation efforts such as flood infrastructure and climate change hazards. This study thus utilizes the visual novel game genre with a serious gaming approach to deliver a personalized, hands-on experience, as well as provide basic training and assessment of player reactions when they are evacuating during a simulated flood event in the story. The game story uses decision theory in evaluating each choice with corresponding weights eventually determining the survival of the player. This aims to (1) introduce to users about concepts in flood evacuation preparations while maintaining engagement in the game; (2) empower users through educating them in the means of self-preservation: what to prepare, when to anticipate, and how to recover; and (3) introduce flood hazard map concepts to enhance readability of these products. The results of this study showed a consistent enthusiasm of this renewed approach to educating communities across all ages. A learning curve has also been observed, with participants who are proficient with computers being able to play the game smoothly and picking up concepts faster than those who were not. This game has the potential to be exported across easily-accessible platforms like smartphones and tablets to further enhance the coverage of people that can be educated about flood event evacuation processes. Similar games that would emulate this study should also consider local situations and practices to further be personalized and integrated into their own existing community disaster mitigation efforts not only in flood-related events but also in other emergency situations requiring preparation and evacuation.

Keywords: Serious Gaming, Visual Novel, Disaster Preparation, Edutainment

DECLINE OF GROUNDWATER LEVEL IN DIVULAPITIYA DIVISIONAL SECRETARIAT DIVISION IN SRI LANKA

W.D.K. Madushanka (1), V.P.I.S. Wijerathne (1)

[1] Department of Geography, Faculty of Arts, University of Colombo, Colombo 03, Sri Lanka
Email: kalana4534@gmail.com; sandamali@geo.cmb.ac.lk

Abstract: Groundwater is a very important natural resource and has a significant role in the economy. It is the main source of water for irrigation and the food industry. But declining of ground water has become one of the major issues today due to both natural and anthropogenic activities. This study therefore mainly focused on the declining of groundwater in Divulapitiya Divisional Secretariat Division. Objectives of the study are to identify the spatio-temporal fluctuations of groundwater and to identify the physical and anthropogenic activities influencing on the changes of groundwater. Both primary and secondary data were used and measures of ground water levels. Fish net by three kilometer grid has overlay on the study area and total of 35 wells have selected representing one well from each grid. Continuous measurements have taken from July 2017 to February 2018 representing both wet and dry periods of the region. Spatial Analysis techniques have used to draw the groundwater contours with using Arc GIS 10.1 as the main tool of analysis. Cross sections of groundwater levels, groundwater flow detection and some statistical analysis were also used along with groundwater interpolation. Maps have used as the main mode of data visualization. According to the analysis, during the south west monsoon period ground water levels have indicate considerably low amount. Considering the spatial arrangement almost all the wells which indicate less amounts of water located near the left bank of Maha Oya. Ground water flow is also towards Maha Oya and the base flow of Maha Oya has declined rapidly due to sand mining. It is the main activity which influence on declining of ground water. Rock mining and extraction of clay and top soil for the development projects as land filling, are two other reasons for the declining of ground water along with over exploitation of ground water for the industrial purpose. Therefore, it is high time to take necessary actions to prevent such activities and preserve ground water for the future communities.

Keywords: Ground Water, Maha Oya, Spatio-Temporal Fluctuation

ASSESSMENT OF LANDSAT 8-BASED INDICES FOR WATER QUALITY PARAMETER ESTIMATION IN LAGUNA DE BAY, PHILIPPINES

Kristina Di V. Ticman (1), Jommer M. Medina (1), Edgardo V. Gubatanga Jr. (1), Rey L. Jalbuena (1), Justin Ace S. Santos (1), Raymund Rhommel C. Sta. Ana (1), Ariel C. Blanco (1)(2)

[1] Multi-platform and Cross-sensor Water Quality Monitoring Project, UP Training Center for Applied Geodesy and Photogrammetry (UP TCAGP), University of the Philippines, Diliman, Quezon City 1101, Philippines
[2] Department of Geodetic Engineering (DGE), College of Engineering, University of the Philippines, Diliman, Quezon City 1101, Philippines
Email: kvticman@gmail.com; acblanco@up.edu.ph

Abstract: The Laguna Lake is the largest inland body of water in the Philippines. With an aggregate area surface area of 900 km^2, it is also one of the largest lakes in Southeast Asia. Comprehensive monitoring of the Lake is needed to manage this multi-use resource in order to prevent further degradation and preserve the environmental processes within it. Remote Sensing technologies have been proven effective in the large scale monitoring of coastal and inland water resources by analyzing the spectral characteristics of water and its pollutants, and relating these with the data collected by different airborne and space-borne sensors. This study was conducted to investigate how in situ water quality data relates with Landsat 8 spectral bands by evaluating various band ratios, indices, and algorithms developed by previous research to estimate chlorophyll and turbidity. This contributes to the development of a remote sensingbased water quality monitoring system for the Laguna Lake. The study made use of water quality measurements taken at field sampling stations and along transects using multi-parameter water quality instrument and data-logging-type turbidity and chl-a sensor. These were then compared with concurrent or near-date Landsat 8 images. Results show the strongest relationships—with the highest R^2 among the band ratios, of the NIR-R band ratios with chl-a concentration and turbidity. Indices developed for detecting algal blooms and vegetation from freshwater, such as the SABI (Surface Algal Bloom Index) and Normalized Difference Vegetation Index (NDVI) demonstrated strong relationships, having R^2 values greater than 0.5, with the in situ chl-a data. The results from this study can be used as basis in the development of water quality models for lake monitoring using in situ measurements together with satellite images. The research demonstrates how Remote Sensing technologies enable efficient water quality assessment and monitoring, and how such technologies may contribute the effective planning and management of the Laguna Lake.

Keywords: Laguna de Bay, Water Quality, Remote Sensing, Landsat 8

POTENTIAL USE OF MODIS SATELLITE DATA TO EXTRACT SPATIAL TEMPORAL PATTERNS OF RIVER TURBID FLUMES AROUND SRI LANKA

I. M. Jayathilaka (1), C. D. Iddagoda (1), K. Gunasekara (2), L. Deshapriya (2)

[1] Geoinformatics Centre (GIC), Asian Institute of Technology (AIT), PO Box 04, Klong Luang, Pathumthani, Thailand
[2] Department of Spatial Science,Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defence University - Southern Campus, Kiribbanwewa,Sooriyawewa, Sri Lanka
Emails: imadushan390@gmail.com; daupadieiddagoda@gmail.com; kavinda@ait.ac,th; lakmal@ait.ac.th

Abstract: Sri Lanka consists of sixteen major rivers which enter the ocean around the island. There are four monsoon seasons which carry high river discharge over a year with consider amount of turbid water. With comparison to major rivers of the region like the Red River, Sri Lankan rivers produce less amount of turbid water. In contrast, Sri Lanka has annual flooding situation almost all the recent years which able to produce high turbid discharge for short period of time. The presence of cloud along the coastline is also at higher percentage which limits the use of optical satellite data for this kind of studies. This paper develops a satellite-based monitoring system based on Moderate Resolution Imaging Spectro-radiometer (MODIS) for observations of spatial and temporal variations of river turbid flumes. A nearshore cloud masking algorithm and zonal-based analysis have been introduced to overcome the presence of cloud coverage. The data processing has been conducted using Google Earth Engine resources and analysis procedures discussed thoroughly in the paper. Furthermore, results describe the potential use of MODIS eighteen years dataset for this kind of study around Sri Lanka and illustrate the availability of cloud free dates along the river mouth.

Keywords: River discharge, Turbid flumes, MODIS, Google Earth Engine

GROUND WATER QUALITY ASSESSMENT OF NEEMRANA USING GEO-SPATIAL TECHNIQUES

Pronoy Dey (1), Anul Haq (2)

[1] M.Tech GIS, NIIT University, Neemrana, Rajasthan, India 301705
[2] Associate Professor, NIIT University, Neemrana, Rajasthan, India 301705
Email: pronoy.dey@st.niituniversity.in; Anul.haq@niituniversity.in

Abstract: The main objective of this paper is to examine pollution threat, especially to the groundwater resources, around Neemrana tehsil industrial area (also called the Neemrana RIICO (Rajasthan State Industrial Development and Investment Corporation) industrial area located in Alwar District of Rajasthan State, India. Panchayat wise samples were collected from NRDWP (National Rural Drinking Water Programme) web site (samples were collected from deep tube well) for Geo-statistical analyses. Understand the geochemistry of the groundwater and to assess the overall physiochemical faces in the study area. Neemrana tehsil lies between the latitudes 27°55'30'' N to 28°13'30" N and longitudes 76°10'30" E to 76°30'30" E and covering an area of 396 km2. The study area is underlain by The Bhilwara Gneissic Complex basement is about 2.5 Ga old (2500 million years ago) surrounded by Aravalli hills. The physical and chemical parameters of the analytical results of groundwater were compared with the standard guideline of values recommended by the BIS (Bureau of Indian Standards), WHO (World Health Organization) and ICMR (Indian Council of Medical Research) for irrigational suitability, domestic usage further hydro-geochemical data have been plotted in a standard graph. Based on the NDBI (Normalized Difference Built-Up Index), Geo-spatial analysis and Geo-statistical analysis, the groundwater near the non-built-up areas are relatively good for irrigation and the contamination are found to be high in some built-up places.

Keywords: Geo-spatial, Geo-statistical, Groundwater Quality

EFFECTIVENESS OF THE LEVEE AGAINST FLOODING AT DIFFERENT RAINFALL RETURN PERIODS IN MANDULOG RIVER, ILIGAN CITY, PHILIPPINES

Alan E. Milano (1), Sheila N. Frias (1), Peter D. Suson (1), and Daniel S. Mostrales (1)

[1] MSU-Iligan Institute of Technology, GeoSAFER Mindanao Project, Tibanga, Iligan City, Lanao del Norte, Philippines, 9200
Email: aemilano1960@yahoo.com; frias.sheila123@gmail.com; petersuson2@gmail.com; dsmostrales@gmail.com

Abstract: The Mandulog river levee located in Hinaplanon, Iligan City, Philippines is one of the engineering mitigating measures undertaken by the national government in order to prevent another devastating flood, like the one brought by TS Washi (locally known as Typhoon Sendong) that badly hit Iligan City and Cagayan de Oro City in December, 2011 resulting to thousands of death toll. The study determines the effectiveness of the levee against possible flood overtopping using a 50-year and 100-year rainfall return periods. Hydrologic simulation and 2D flood modelling were done using HEC-HMS 4.1 and HEC-RAS 5.0.3. The LiDAR dataset and bathymetric river survey in 2012 is used in river and floodplain geometric data generation. Results of the 2D flood model shows that the levee can prevent river flooding for the two rainfall scenarios. It also shows that the levee is effective against flood overtopping. However, it blocks the runoff from the land side outside the levee, thereby causing flooding in the nearby areas. The model and the river basin's calibrated hydrologic parameters are very useful in planning, constructing and maintaining a levee.

Keywords: levee, rainfall return period, flooding

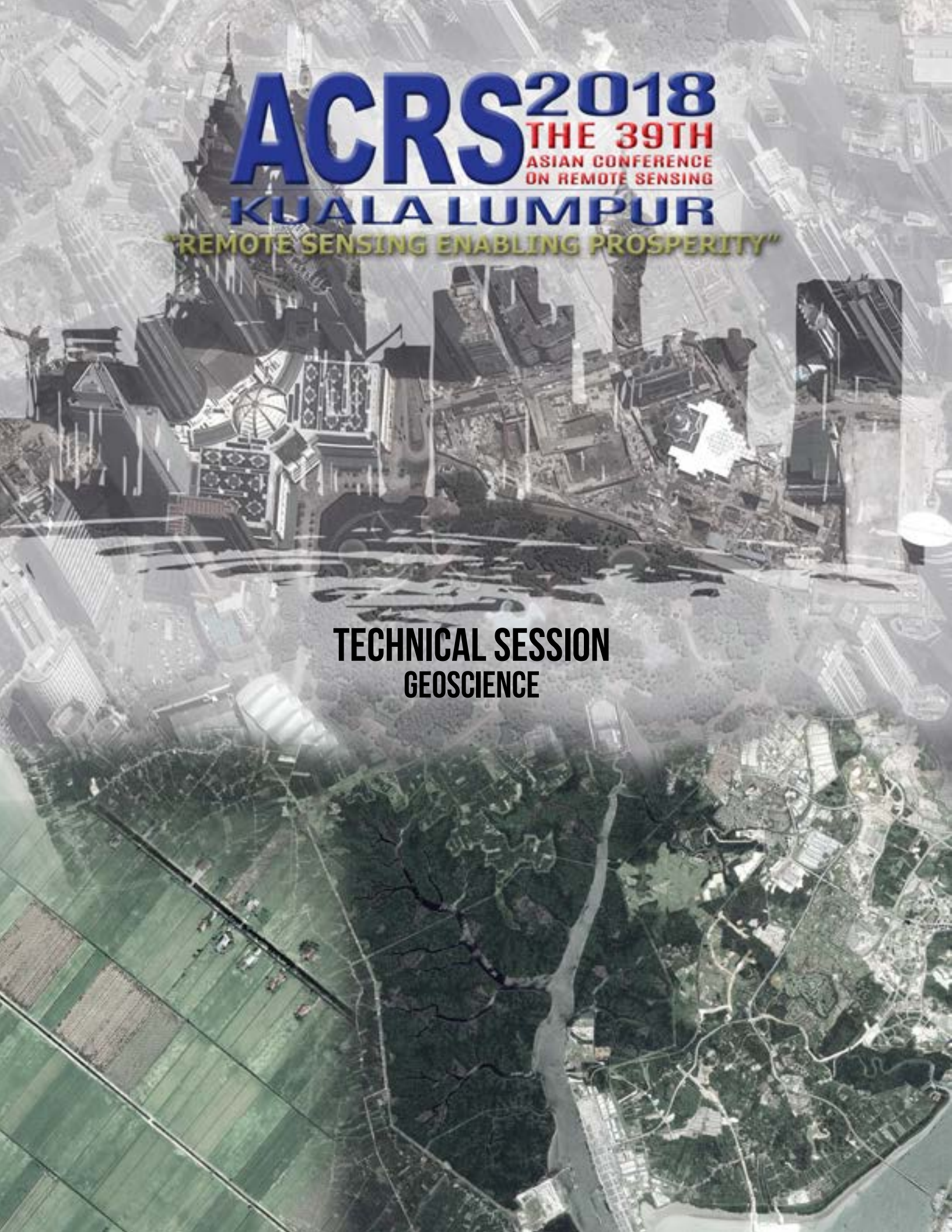
REMOTE SENSING AS A TOOL OF REGENERATING WATER INVESTMENT IN SEMARANG CITY

Yosef Prihanto (1), Raldi H Koestoer (2), Dwita Sutjiningsih (3), Linda Darmajanti (4)

[1] Geospatial Information Agency of Indonesia, Cibinong 16911, Indonesia
[2] School of Environmental Science, Universitas Indonesia, Jakarta 10430, Indonesia
[3] Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Depok 16424, Indonesia
[4] Department of Sociology, Faculty of Social and Political Science, Universitas Indonesia, Depok 16424, Indonesia
Email: putranusa212@yahoo.com

Abstract: Water is the basic necessity of human life. This fact drove the development of the bottled water industry in many places. The use of bottled water in urban areas extends to the fulfilment of daily household water consumption needs. Semarang as a dynamic developing city faces such a problem of water limitations. While, Semarang city has a unique landscape in terms of morphology & it affects the pattern of settlements, transportation and social systems. Despite the fact that, development of water industry requires supported spatial information, to make its business efficiently workable. The objectives of this study are twofold, the first is to examine the extent to which remote sensing can support the proximating investment and the second is to explore the pattern of urban bottled water utilization by urban dwellers. Independent variables observed involves road network, building roof-top density, slope strata, employment groups, education level, population and family members. The observed dependent variables observed are the average of household water requirements and the cost of bottled water consumption. The data used are a combination of remote sensing information, questionnaires and interviews as primary data, and population statistics as secondary data. The analytical method uses spatial modelling, descriptive and non-parametric calculations. The first result obtained is an implication of the role of remote sensing in predetermined water investment. The second result is the pattern and spatial distribution of the average volume for bottled water used by households in Semarang City. The conclusion are, Remote sensing can play a significant role in predetermine water investment in urban area and consumption pattern of bottled water utilization influenced by social group, transportation amenity, and landscape area.

Keywords: Remote Sensing, Regenerating, Water, Investment, Urban



TECHNICAL SESSION
GEOSCIENCE

SPECTRAL QUALITY ASSESSMENT OF LANDSAT 8 AND SENTINEL 2 BANDS FOR GLACIER IDENTIFICATION IN UPPER INDUS BASIN

Syed Najam ul Hassan (1)(2)(3), Mohd Nadzri Md. Reba (1)(2), Dostdar Hussain (3), Aftab Ahmed (3)

[1] Geoscience & Digital Earth Centre (INSTeG), Research Institute for Sustainability & Environment (RISE), Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.
[2] Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.
[3] Department of Computer Science, Karakoram International University, Pakistan.
Email: syed.najam@kiu.edu.pk; nadzri@utm.my; dostdar.hussan@kiu.edu.pk; aftab.ahmed@kiu.edu.pk

Abstract: Glacier studies of Hindu Kush Karakoram Himalaya (HKKH) are inadequate where, the stability of glaciers in the Upper Indus Basin (UIB) of HKKH is known for anomaly studies. Despite of satellite based synoptic measuring schema, the quality of glacier anomaly estimate is always on debate. The advancement in Operational Land Imager (OLI) and Multi Spectral Instrument (MSI) offers the potential future of glacier measurement in UIB. Therefore, this study assesses the quality of OLI and MSI in mapping the glacier anomaly for glaciers of Hunzza in UIB. The methodology is based on acquisition of Landsat Enhanced Thematic Mapper Plus (ETM+) Level 1C and OLI Level 2 data, while for Sentinel MSI Level 2A data was derived using Level 1C. Both OLI and MSI were calibrated with uncertainty of 3% than 5% of the raw ETM+. Glacier outlines extracted from the Randolph Glacier Inventory and the snow line altitude (SLA) demarcated through contour generation from Global Digital Elevation Model (GDEM) to differentiate permanent snow and clear ice in the overall glacier polygon. Reflectance of each band was derived and Normalized Snow Differential Index (NDSI) calculated. Statistics applied in spectral quality assessment for glacier parameters. Overall glacier surface exhibited range of reflectance about 0.08 to 0.12, 0.07 to 0.11 and 0.06 to 0.09 at visible bands of OLI that was differed about 20%, 22% and 25% than that of MSI. Where, in infrared band both sensors agreed by the reflectance of 0.10. Reflectance correlation between both sensors derived as 0.7 to 0.9 at visible band and 0.5 to 0.6 at infrared which, allows clear discrimination between the clear ice and snow. But the overlap of reflectance within 0.2 to 0.5 and 0.35 and 1.0 in MSI bands led to erroneous identification. To complement the results, NDSI of OLI with 0 to 0.25 and 0.75 to 1.0 becomes good indicator to distinguish different glacier features with disadvantage of inconsistent in MSI. These results clearly show that OLI and MSI have promising capability to map glacier anomaly and both variants can be synergized for better interpretation in climacterically intrinsic high-altitude zone of UIB.

Keywords: Glaciers, Upper Indus Basin, Sen2Core, Operational Land Imager, Multi Spectral Instrument

USING DTMs TO DELINEATE ACTIVE FAULTS OF THE PROXIMAL PART OF THE GANGA PLAIN, UTTARAKHAND, INDIA

Pradeep K Goswami (1)

[1] Centre of Advanced Study, Department of Geology, Kumaun University, Nainital – 263002, India
E-mail: drpgoswami@yahoo.com

Abstract: The present study pertains to effective use of Digital Terrain Models (DTMs) in identifying and mapping active faults in a large, proximal part of the Ganga (also called Gangetic) plain, where field geological investigations are mostly refrained due to inaccessibility owing to dense, multistoried forest cover. The SRTM (Shuttle Radar Topography Mission) 90 m DEMs were used to make a reconnaissance of the study area, but for detailed investigations the DTMs were prepared from relief information given in toposheets. Several hydrologically correct, grid-based DEMs were prepared in a Geographic Information System (GIS) for different resolutions. 2-D profiles along a number of longitudinal and transverse sections were drawn. Several 3-D perspective views were generated by draping the enhanced IRS imagery over the DEMs, for different exaggeration factors of the z-value, Sun azimuth and Sun angles to emphasize subtle topographic variations. These DTMs were then visually analysed in conjunction with the satellite imagery to delineate the morpho-tectonic features. Throughout the analysis of DTMs, special emphasis was placed on drainage characteristics. Subsequently, the maps were verified during extensive fieldwork, and required corrections were made by incorporating the field data. The investigations reveal that the area is traversed by a number of criss-crossing lineaments. Some of these lineaments are active faults. Most of the active faults are generally concealed below the alluvium, but they could be identified and demarcated on the basis of their geomorphic characteristics as discernible on the satellite image or various DTMs. In the north is the active Himalayan Frontal Thrust (HFT), which defines the northern structural limit of the Ganga basin against the Himalayan mountains. Parallel to HFT in the south is the blind Najibabad Fault (NF); however, it is identifiable only in the western part of the area. The HFT is offset by a number of dip-slip, oblique-slip and strike-slip faults, some of which extend northward into Himalaya and are related to the basement structures of the basin. Ongoing activities along these faults/thrusts have pronounced control on the river dynamics and landscape of the Ganga foreland basin and adjoining Himalayan mountain-front.

Keywords: Geomorphology, Tectonics, DTM, IRS Imagery

DETECTION OF HYDROTHERMAL ALTERATION ZONES AND LINEAMENTS ASSOCIATED WITH OROGENIC GOLD MINERALIZATION USING ASTER REMOTE SENSING DATA IN SANANDAJ-SIRJAN ZONE, EAST IRAN

Abdollah Sheikhrahimi (1), Amin Beiranvand Pour (2)

[1] Department of Geography and Urban Planning, Tabriz University, Tabriz, Iran
[2] Korea Polar Research Institute (KOPRI) Songdomirae-ro,Yeonsu-gu, Incheon 21990, Republic of Korea
Email:abdola.sheikhrahimi@gmail.com;beiranvand.amin80@gmail.com;amin.beiranvand@kopri.re.kr

Abstract: The Sanandaj-Sirjan Zone (SSZ) is considered as an important region for exploration of orogenic gold mineralization in the eastern sector of Iran. Mountainous topography and relatively lack of accessible route are challenging for researchers and costly for mining companies for gold exploration in the SSZ. Gold mineralization mainly occurs as irregular to lenticular sulfide veins along shear zones in extremely altered and deformed mafic to intermediate metavolcanic and metasedimentary rocks. In this investigation, the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite data were used for mapping indicator hydrothermal alteration minerals and geological structural features associated with orogenic gold mineralization in the Saqqez plot of the SSZ. Image transformation techniques such as specialized band ratioing and Principal Component Analysis were used to delineate lithological units and alteration minerals. Supervised classification, namely Spectral Angle Mapper (SAM) and Spectral Information Divergence (SID) supervised classification methods were used to detect subtle differences between indicator alteration minerals associated with gold mineralization in the study area. Directional filtering was implemented to trace structural features. Results demonstrate that the integration of image transformation techniques and supervised classification derived from ASTER remote sensing analysis with fieldwork and previous stream geochemical study has a great ability for targeting new prospects of gold mineralization in the Saqqez plot of the SSZ.

Keywords: Saqqez, ASTER, CA, SAM, SID, Alteration Zones, Lineaments, Gold Exploration

SPACE-BORNE SATELLITE SENSORS FOR MINERAL EXPLORATION IN HIGH ARCTIC REGIONS

Amin Beiranvand Pour (1), Tae-Yoon S. Park (1), Mazlan Hashim (2), Yongcheol Park (1), Jong Kuk Hong (1)

[1] Korea Polar Research Institute (KOPRI) Songdomirae-ro,Yeonsu-gu, Incheon 21990, Republic of Korea
[2] Geoscience and Digital Earth Centre (INSTeG), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
Email: beiranvand.amin80@gmail.com; amin.beiranvand@kopri.re.kr; typark@kopri.re.kr; mazlanhashim@utm.my; ypark@kopri.re.kr; jkhong@kopri.re.kr

Abstract: The Franklinian Basin in North Greenland has a distinctive potential for exploration of world-class zinc deposits. In this study, image processing algorithms are implemented on satellite remote sensing datasets define hydrothermal alteration halos associated with Zn-Pb±Ag sulfide mineralization in the trough sequences and shelf-platform carbonate of the Franklinian Basin. Directed Principal Component Analysis (DPCA) is applied to selected Landsat-8 mineral indices to map carbonate and clay alteration. Major lineaments, intersections, curvilinear structures and sedimentary formations are traced by the application of Feature-oriented Principal Components Selection (FPCS) to cross-polarized backscatter PALSAR ratio images. PC image with strong textural variations was selected as input band for directional filtering and consequently mapping geological structures. Mixture Tuned Matched Filtering (MTMF) algorithm is applied the to ASTER VNIR/SWIR bands for subpixel detection and classification of hematite, goethite, jarosite, alunite, gypsum, chalcedony, kaolinite, muscovite, chlorite, epidote, and carbonate. The resultant MF score images were subsequently used for virtual verification. We identified several high potential zones with distinct alteration mineral assemblages and structural fabrics that could represent undiscovered Zn-Pb sulfide deposits in the region.

Keywords: Arctic regions, Landsat-8, ASTER, PALSAR, The Franklinian Basin, Zinc exploration, North Greenland

CHANGE MONITORING OF BHAGIRATHI & ALAKHNANDA BASIN GLACIER USING SATELLITE IMAGE

Darshit Savani (1), R. D. Shah (1), I. M. Bahuguna (2), B. P. Rathore (2)

[1] Department of Geology, M. G. Science Institute, Gujarat University, Ahmedabad, India.
[2] Space Applications Centre, ISRO, Ahmedabad, India
E-mail: darshit.savani1994@gmail.com

Abstract: The Himalayas possess one of the largest concentrations of glaciers outside the Polar Regions in its high-altitude regions. The mountain ranges of the Himalayas stretch for a distance of about 2,400 kilometers from east to west direction in the shape of an arc along the northern border of India covering an area of about 500,000 square kilometers. The history of glacier fluctuations serves as a reliable indicator of the past climate. The front positions of Alaknanda and Bhagirathi area situated in Uttarakhand state are drained by a river having the huge glacier in agreement with those followed. Glacier's changes have been monitored using IRS LISS-III and Landsat 8 data. There are total 592 glaciers accounted in the basin of Alaknanda and Bhagirathi. 24 glacier has retreated in the year 2016 in comparison to the year 2001 which is been interpreted through IRS LISS-III satellite images. Glacier variations were mapped and analyzed; discrepancies between images could be detected and removed from the integrated data using remap tables in Arc/Info grid both graphically and numerically. Our results show that glaciers in the region both retreated and advanced during the last 15 years; difference between the year 2001 and 2016, average Alakhnanda & Bhagirathi basin glacier area decreased from 1.71 km^2 and 1.11 km^2.

Keywords: Himalayan glacier, Alaknanda basin, Bhagirathi basin, Remote sensing, change ditection

GEOMORPHIC CHARACTERIZATION OF THE IMPHAL INTERMONTANE VALLEY, NE INDIA: AN APPLICATION OF REMOTE SENSING AND GIS TECHNIQUE

Alexander Singh Kshetrimayum (1), Pradeep K Goswami (1)

[1] Center of Advanced Study, Department of Geology, Kumaun University, 263002 Nainital, India
Email: 1alexkshetri83@gmail.com; 2drpgoswami@yahoo.com

Abstract: Comprehensive study of the landscape of seismotectonically active Imphal intermontane valley have been carried out to create baseline data for further studies to be aimed at identifying the areas of severe crustal deformation. Owing to inaccessibility of many parts and extensive anthropogenic modifications in other parts, the study is based on GIS analysis of the remote sensing data from IRS LISS III sensor, ASTER-DEM, and information given in toposheets. Gently, nearly centripetally-sloping, rectangular Imphal valley covers an area of ~1826 km2, with an average length of 68 km and width of 32 km. Located at 760-900 m amsl, it is enclosed by up to ~2400 m asml high hills in the west and ~2100 m asml high hills in the east. From margins to centre, the landscape of the valley comprises planar-faceted, marginal hills, piedmont zones off the margin, and alluvial plains and lakes/ponds with surrounding mash in the central part. Additionally, there also exist many residual hills within the valley. Having dentritic, subdentritic, semirectangular and trellis pattern in different parts of the enclosing mountains, the streams enter into the valley trough deeply cut, V-shaped valley. The Imphal River, flowing from north to south is the main river. Iril, Toubal, Chakpi and Khunga are its main tributaries. In the Imphal valley, paired-unpaired terraces are developed along different reaches of the main streams, like Imphal River, Thoubal River, Sekmai River, and Khuga River. The Imphal river exits the valley trough narrow gorge in the south and flows to Myanmar and joins the Myittha river, a tributary of the Chindwin river of the Irrawaddy river system. The geomorphic features and its distribution pattern suggest that, (i) the landscape of the Imphal valley is of fluvial and lacustrine origin, and (ii) tectonic and climatic activity have influenced the landscape development in the area.

Keywords: Geomorphology, Landscape, Imphal Valley, Indo-Myanmar Ranges.

LANDFORM MAPPING USING RADARSAT AND ASTER DATA FOR GROUNDWATER POTENTIAL DETERMINATION

Nur Hazwani Izehar (1), Nurul Nadia Abdul Malek (1), Zuraimi Suleiman (1), Zahid Ahmad (1), Mohd Zahir Harun (1), Roziah Che Musa (1), Mohd Idham Mansor (1), Sabrina Shahri (1)

[1] Malaysia Remote Sensing Agency (MRSA) No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: hazwani@remotesensing.gov.my; nadia@remotesensing.gov.my; zuraimi@remotesensing.gov.my, zahid@remotesensing.gov.my, zahir@remotesensing.gov.my; roziah@remotesensing.gov.my; idham@remotesensing.gov.my; sabrina@remotesensing.gov.my

Abstract: Remote sensing data enable direct monitoring of land surfaces at repetitive intervals and therefore allow mapping of a large extent of the land surfaces. Remote sensing data also provides many advantages in landform mapping process. One of the applications of landform map is it is appropriate as one of the thematic maps (parameters) in groundwater potential determination. Landform maps were produced for all states in Malaysia and in this study Ampang Jaya has been selected as case study to demonstrate the results and techniques used. The multiple thematic maps, field data, and satellite image were processed, classified, and weighted using analytical hierarchical process for their contribution to groundwater potential. However, this study will focus on producing a landform map using Digital Elevation Model (DEM) from RADARSAT and ASTER. The elevation from DEM will be classified as alluvial plain (0-20m), undulating hill (21-30m), foot slope (31-150m), side slope (>150m) and hillcrest (>150m). The produced landform maps from both RADARSAT and ASTER data were compared in order to identify which DEM is more suitable. Verification was done by overlaying the landform maps with 3 Dimension (3D) image RADARSAT and 3D image ASTER with PLEIADES image. This study shows the ability of the remote sensing data to produce landform maps with synoptic view especially in the remote area, and groundwater potential determination can be easily mapped by using integrated approach of remote sensing and Geographical Information System (GIS).

Keywords: Landform Map, analytical hierarchical, DEM, GIS

WEIGHT OF EVIDENCE METHOD IN ASSESSING AERIAL GEOPHYSICS MAPPING OF HIDDEN MINERAL DEPOSITS USING ASTER AND GEOCHEMICAL DATA (CASE STUDY: ARDESTAN, IRAN)

Sahar Mahmoudishad (1), Abbass Malian (1), Farhad Hosseinali (1), Abolfazl Soltani (1)

[1] Dept. of Geomatic Engineering, Shahid Rajaee Teacher Training University, Tehran, Iran.
Email: S.mahmoodishad@sru.ac.ir; A.malian@sru.ac.ir; F.hosseinali@sru.ac.ir; AbolfazlSoltani@sru.ac.ir

Abstract: Located in NW-SE direction of central Iranian volcanic belt, Ardestan reportedly hosts many well-known porphyry copper and gold deposits. In this paper, performance of aerial and satellite data is evaluated by analysis of Geochemical data. These data have been obtained without physical contact with the vast study area, spending less time and cost. In this study, the geochemical anomalies of Cu, Fe, Au, Mn and pb are separated by statistical analysis. The weight of evidence method is a statistical analysis procedure that shows the maximum presence probability of geochemical anomalies in the study area is in 1.25 km distance of the deep Geological lineaments extracted from the geophysics map. The maximum presence probability of geochemical anomalies calculated for major and minor fault in the geological map is in 1.25 and 0.3 km distance, respectively. The fault maps fusion results in the probable-hidden mineral location. Independent Component Analysis (ICA) components are then used to identify the iron oxide and hydrothermal alteration zones in the visible and near infrared (VNIR) and shortwave infrared (SWIR) subsystems of ASTER data. So, this research investigates the major absorption wavelengths of the indicator minerals. The results show that the argillic alteration zones detected by applying ICA are mostly located around the extracted hidden mineral. The situations of identified hydrothermal alteration zones indicate that surface sections in the study area contain porphyry copper and gold deposits. The high potential copper mineral location obtained by the fusion maps as well as the detected promising areas of Iron oxide and hydrothermal alteration zones match precisely with the locations of intrusions of geophysics data near the explored mines in the region.

Keywords: Weight of Evidence, Aerial Geophysics, Independent Component Analysis (ICA), Geochemical Anomaly, Remote Sensing

APPLICATION OF LANDSAT-8 AND ASTER DATA IN LITHOLOGICAL MAPPING OF PRECAMBRIAN BASEMENT ROCKS AT GABAL ABU DAHR AREA, SOUTH EASTERN DESERT OF EGYPT

Mohamed F. Sadek (1), Safaa M. Hassan (1), Mohamed W. Ali-Bik (2)

[1] National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt.
[2] Geological Sciences Dept., National Research Centre, Cairo, Egypt.
Email: mfsadek@gmail.com

Abstract: The Precambrian basement sequence exposed at Gabal Abu Dahr area in the South Eastern Desert of Egypt consists of gneisses and island-arc metavolcanosedimentary rocks. These rock units are overthrusted by serpentinite-talc carbonate rocks which form the Abu Dahr ophiolitic mass. The ophiolitic rocks and the island arc metavolcanics are intruded by gabbro-diorite, granodiorite-tonalite, late tectonic gabbro and monzogranite intrusions. The exposed lithological units in the study area have been discriminated on the basis of field investigation and the remotely sensed data extracted from landsat-8 and ASTER images. The present study revealed that, the principal component images (PC4, PC5, PC2) of landsat-8 images in addition to ASTER principal component images (PC2, PC6, PC5) are very effective in discrimination the widely exposed rock units. On the other hand, the ASTER indices kaolinite, clay and sericite-muscovite, calcite and carbonate indices images are very useful in identifying the exposed basement rock units in the study area. The detailed geological map for Gabal Abu Dahr area has been produced based on the integrated remote sensing data, field investigation and petrographic study.

Keywords: Gabal Adu Dahr; Eastern Desert; Egypt; ASTER; Landsat-8.

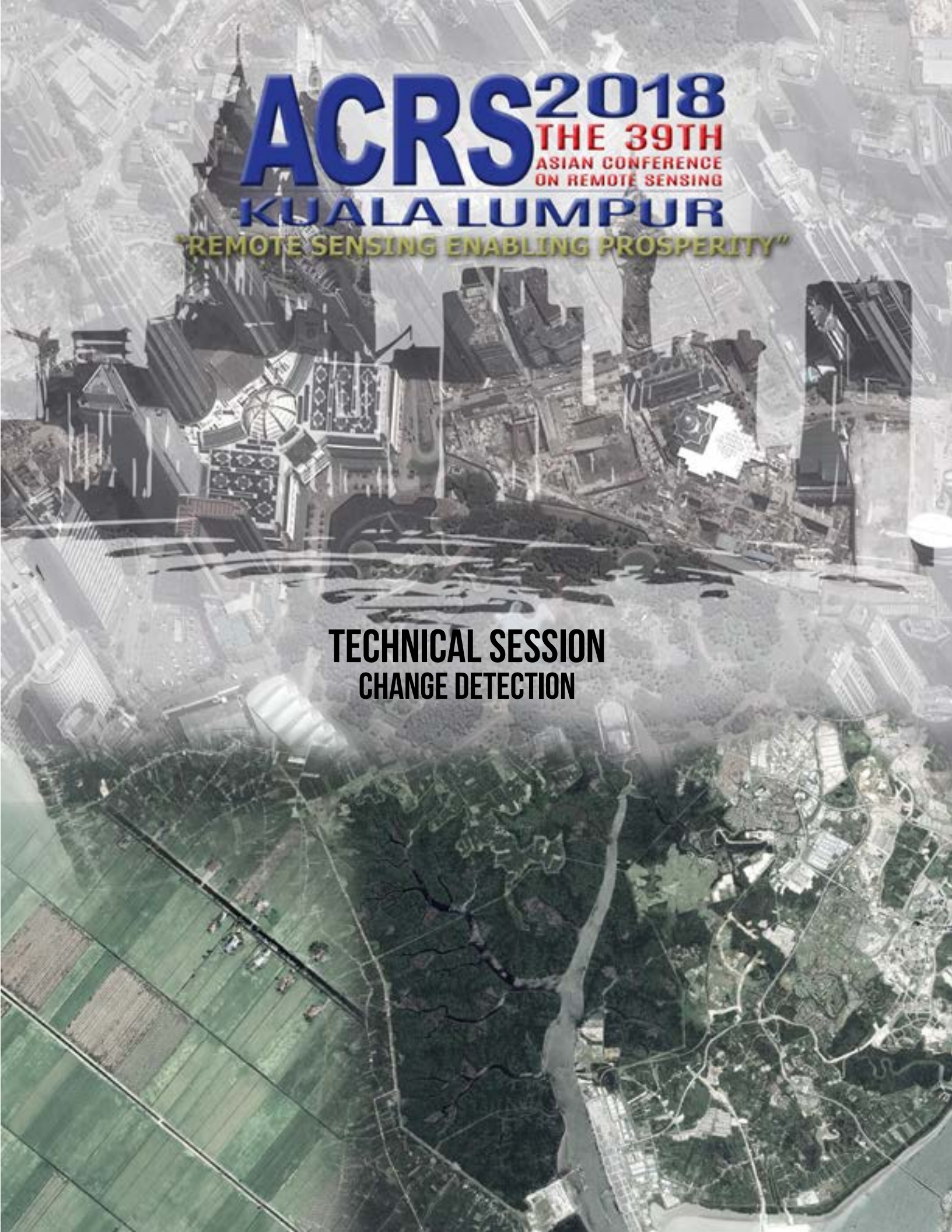
THE SPATIAL DISTRIBUTION OF SUBSURFACE SOIL PROPERTIES IN THAKETA TOWNSHIP, YANGON

Dr. Mu Mu Than (1), Dr. Khin Mar Yee (1), Dr. Kyi Lint (2), Kyaw Myo Tun (3)

[1] Associate Professor, Department of Geography, Dagon University
[2] Professor (Head), Department of Geography, Dagon University
[3] Candidate, PGD GIS, Department of Geography, Dagon University

Abstract: Thaketa Township is located in the eastern part of Yangon, Myanmar. The township comprises 19 wards. The Pazundaung Creek flows through the township. Its number of population is 220,556 according to Census 2014. It has the third largest number of population in East Yangon District. There are many High-Rise buildings such as banks, plaza and condo, industrial zone, overhead bridge, and etc. The Stability of these infrastructures is very important. Soil properties determine the Stability of these structures. The objectives of the study are to examine soil properties with depths and to identify the subsurface soil conditions. To accomplish objectives of the research the spatial analysis of the distribution of soil types and properties in Thaketa Township are analysed by using Geographic Information System & Remote Sensing. Their spatial distribution patterns are examined on sample points of various sources in the study area. Seventeen boreholes are selected to collect the primary data. Satellite Image for Land Cover Classification, Standard Deviational Ellipse with Mean Center and interpolation method (IDW) for density distribution are used. This area is high moisture content and low wet density. Alluvial soil is occurred in the study area. The results show that the soil distribution in 5 feet to 10 feet depth is of moisture content and the strength of the soil is over 0.7 ton/ ft^2 around 15 ft depth.

Keywords:



TECHNICAL SESSION
CHANGE DETECTION

EFFECT OF LAND USE CHANGE ON SURFACE TEMPERATURE OF BANJARMASIN CITY USING LANDSAT IMAGE DATA

Kartika Pratiwi (1)

[1] Department of Geography, Faculty of Mathematics and Natural Sciences, University of Indonesia Jl. Margonda Raya, Beji, Pondok Cina, 16424, Depok, Indonesia
Email: kartika.pratiwi51@ui.ac.id

Abstract: One of the most important problems on the earth, especially in urban areas is the increased in surface temperature due to the transfer of vegetation land into non-vegetation. Detection of changes in land use digitally using multi-spectral satellite imagery in the form of Landsat imagery helps in understanding the dynamics of land use. In addition, the Landsat image can also be used to detect the LST (Land Surface Temperature) of an area. Land use is closely related to the LST of a region. The development of Banjarmasin City makes the use of land that is used as a built-up area the higher and affects LST because the more built-up area then the LST around the area is higher. The purpose of this study is to see the relationship between land use changes / land cover (LULC) Banjarmasin city with LST Banjarmasin city in 2000-2017. Land use / land cover data were obtained from Supervised Landsat 8 image classification for 2017 and Landsat 5 for 2000 and 2009. LST was obtained from Landsat image processing. There is a positive correlation between LST with NDBI value (Normalized Difference Building Index) and NDWI (Normalized Difference Water Index), whereas the negative correlation between LST and NDVI value (Normalized Difference Vegetation Index). The increase of widespread land area and reduced vegetation in Banjarmasin City positively correlated with increasing LST Kota Banjarmasin.

Keywords: Landsat, LST, LULC, Supervised

AN INTEGRATED GEOSPATIAL APPROACH TO MANGROVE VEGETATION MAPPING ON THE ISLAND OF TOBAGO.

Deanesh Ramsewak (1), Naimah Mohammed (1)

[1] Maritime and Ocean Studies, the University of Trinidad and Tobago, Chaguaramas, Trinidad, W.I.

Abstract: Mangrove forests are negatively impacted by climatic and anthropogenic forces globally. On the island of Tobago mangroves have suffered significant loss within recent years. Geospatial techniques can provide current, reliable and accurate information on mangrove coverage which is imperative for sustainable management of this critical resource. This study utilized remotely sensed data integrated with geographic information systems (GIS) to update the mangrove baseline for the island of Tobago. Mangrove forests were delineated from high resolution colour aerial photography and Sentinel-2 satellite imagery using ArcGIS 10.5 software. Mangrove areal extent and spatial distribution were mapped for the year 2018. A change detection over a ten-year period (2008-2018) was then conducted by comparing the present outcome to a 2008 study. Results indicated that over the last decade overall mangrove coverage decreased from 216.4 ha to 201.2 ha. The largest mangroves areas persist in south-west Tobago while the majority of the systems situated along the south-eastern coastline are still intact. A change assessment revealed that although there was significant loss of mangrove in some areas there was also gain in others. Major impacts to mangroves observed included high levels of solid waste dumping as well as clearing for development.

Keywords: GIS, Remote Sensing, Mangrove mapping, Sentinel-2, Aerial photography.

LAND USE LAND COVER CHANGE (LULCC) AROUND TAMAN NEGARA NATIONAL PARK (TNNP): IMPACT ON ASIAN ELEPHANT DISTRIBUTION AND HABITAT SUITABILITY

Fauzul Azim Zainal Abidin (1), Helmi Zulhaidi Mohd Shafri (2), David Magintan (1), Taufik Abdul Rahman (1), Nur Shafira Nisa Shaharum (3)

[1] Protected Area Division, Department of Wildlife and National Park (DWNP) Peninsular Malaysia, KM 10 Jalan Cheras, 56100 Kuala Lumpur
[2] Coordinator of Remote Sensing and GIS programme, Department of Civil Engineering, Faculty of Engineering, University Putra Malaysia (UPM), 43400 Serdang, Selangor
[3] Department of Civil Engineering, Faculty of Engineering, University Putra Malaysia (UPM), 43400 Serdang, Selangor
Email: fauzul@wildlife.gov.my; helmi@upm.gov.my; davidm@wildlife.gov.my; taufik@wildife.gov.my; fieranisa94@gmail.com

Abstract: The concerns over land use land cover change (LULCC) have emerged on the national stage due to the realisation that changes occurring on the land surface also influence climate, ecosystem and biodiversity. As a result, the importance of accurate mapping of LULC and its changes over time is increase. LULCC classification from remotely sensed data is an important topic in remote sensing applications. We attempted to investigate the feasibility of using Landsat satellite is a major data source for LULCC mapping in site and around Taman Negara National Park (TNNP). TNNP is situated at the centre of Peninsular Malaysia and it covers three states, namely Pahang (2,477 km^2), Terengganu (853 km^2) and Kelantan (1,013 km^2), giving a total of approximately 4,343 km^2 (DWNP, 2000a). It has wide range of habitats including lowland that consists of riverine vegetation, hill dipterocarp forest, lower montane forest and upper montane forest, heath forest and riparian forest. This national park supports large mammals which include elephants, Malayan tapir, gaur, tiger, and sun bear as well as small mammals such as bats, rodents, pangolin and tree shrews (Siti-Hawa et al. 1985). The objective of this study focuses on the comparison of three classification tools for Landsat images, which are maximum likelihood classification (MLC), support vector machine (SVM) and artificial neural network (ANN), in order to select the best method among them and to understand impact of land use and land cover change for Asian Elephant distribution and their habitat suitability in Taman Negara National Park using remote sensing and geoprocessing technique. Two significant factors which contribute to the impact on Asian elephant distribution and habitat suitability have been identified in the study, which are the increase in agriculture areas and sprawl development pattern.

Keywords: Land Use Land Cover Change (LULCC), Maximum Likelihood Classification (MLC), Support Vector Machine (SVM), Artificial Neural Network (ANN), Asian Elephant

EXTRACTION OF LAND USE/LAND COVER USING MULTI-TEMPORAL SENTINEL-1A AND LANDSAT INTEGRATION: CASE STUDY OF HANOI

Le Minh Hang (1), Vu Van Truong (1), Tran Van Anh (2)

[1] Insitute of Techniques for Special Engineering, Le Quy Don Technical University, 236 Hoang Quoc Viet, Hanoi, Vietnam
[2] Photogrammetry and Remote sensing, Faculty of Geomatics and Land Administration, Hanoi University of Mining and Geology, No.18, Pho Vien Street, Duc Thang Ward, Bac Tu Liem District, Hanoi, Vietnam
Email: leminhhang81@gmail.com; truongvv@mta.edu.vn; tva_ninh@yahoo.com

Abstract: Satellite images is the major source for classification of land-use/land-cover (LULC). For optical satellite images, the classification is usually based on the spectral reflectance characteristics of the objects. However, optical data is affected by clouds and weather conditions. Radar remote sensing data is less affected by weather conditions but the information on SAR images is only backscatter of roughness of objects. Integration of Sentinel-1A and Landsat data has the main advantages of combining the all-weather capability of the radar sensor, rich spectral information in the visible-near infrared spectrum, with the short revisit period of both satellites. In this paper, a method of integrating multi-temporal Sentinel-1A data and Landsat data were proposed to classify LULC mapping. Normalized difference vegetation index (NDVI), a Normalized Difference Water Index (NDWI) and Enhanced Built-Up and Bareness Index (EBBI) were combinated with the standard deviation, the average of backscatter value of multi-temporal Sentinel-1A and phenology of double-cropped rice. A case study is Hanoi, Vietnam with data included 12 scences of Sentinel-1A, single-polarization VV, Interferometric Wide Swath mode (IW) and GRDH level acquired from Sep 2014 to Nov 2015 and 1 scence of Landsat 8OLI in May 2015. The integrated dataset was classified with Decision tree classification method, which showed the overall classification accuracy of 89%.

Keywords: LULC, Sentinel-1A, Landsat, decision tree classification, data fusion

CHANGE DETECTION OF LAND USE AND LAND COVER BY NORMALIZED DIFFERENCE VEGETATION INDEX DIFFERENCING IN THE CITY OF CHIANG MAI, THAILAND

Patiya Pattanasak (1)

[1] Department of Geography, Faculty of Education, Ramkhamhaeng University, Bangkok, THAILAND
E-mail: Patiya13@gmail.com

Abstract: This study of change detection of land use and land cover by normalized difference vegetation index (NDVI) differencing in the city of Chiang Mai, THAILAND aimed to 1) analyze patterns of land use and land cover by NDVI and image classification in the city of Chiang Mai and 2) analyze changes in land use and land cover in the city of Chiang Mai from the year 2000 to 2015. The study of change detection used normalized difference vegetation index differencing and maximum likelihood classification from Landsat 7 ETM+ in year 2000 and Landsat 8 OLI in year 2015. The accuracy assessment used confusion matrix and the changes of land use was based on geographic information systems (GIS). The study found that land use can be classified into 7 types which were urban areas, paddy field, horticulture, evergreen forest, deciduous forest, forest plantation and water bodies. The greatest change in land use and land cover from 2000 – 2015 was an increase of NDVI of less than 10 percent. The accuracy assessment used total accuracy and kappa statistics. In 2000, the results show total accuracy and kappa statistics of 68.29 percent and 58.74 percent, while in 2015 they were 67.14 and 57.42 percent, respectively. The study found that urban areas and horticultural area increased by 15.21 percent and 2.55 percent. Meanwhile, paddy field, deciduous forest, evergreen forest, forest plantation and water bodies decreased by 10.41, 2.81, 2.58, 0.73 and 0.22 percent, respectively. The most changed areas were paddy fields and deciduous forests which had become urban areas with the outward expansion from the center of Chiang Mai city to the surrounding areas.

Keywords: Change detection, Normalized Difference Vegetation Index, Land use, Land cover

IDENTIFICATION OF MAJOR TRENDS AND PATTERNS OF LAND USE AND LAND COVER CHANGE (LULCC) IN SRI LANKA USING LANDSAT TIME SERIES IMAGERY

Chithrangani WM Rathnayake (1), Simon Jones (1), Mariela Soto-Berelov (1)

[1] School of Science, RMIT University, Melbourne, VIC 3000, Australia.
Email: chithrangani.rathnayake@rmit.edu.au; simon.jones@rmit.edu.au;
mariela.soto-berelov@rmit.edu.au

Abstract: Land use and land cover change (LULCC) is intrinsically dynamic over time and space due to human and biophysical factors. Accurate and up-to-date on land use/cover information is a mandatory requirement in environmental change analysis and natural resource management. Satellite earth observation is being increasingly applied in LULCC detection across the world. Freely available Landsat remote sensing data from 1972 onwards and advancements in computer processing capabilities have enabled a time series approach in LULCC analysis that is now widespread in assessing temperate forest and woodlands. Studies on time series LULCC in tropical regions less common; having many challenges including high cloud occurrence. Land cover in Sri Lanka has changed significantly in the past 30 years due to human population pressure and socio-political reforms. The civil war and insurgency that dominated the period 1983-2009 means accurate and consistent information on LULCC is absent. This paper aims to investigate the major trends and patterns of LULCC over the last 20 years using Landsat time series imagery. It presents a map of changes by land cover class cross the highly dynamic central region (approximately 33,000km2) of Sri Lanka. Eight major land cover classes were identified and tracked for 20 years and mapped with an accuracy of 15% using a combination of random forest, spectral time series change metrics and ancillary variables.

Keywords: Land use and land cover change, time series, change drivers, Landsat, Sri Lanka

IDENTIFICATION OF HUMAN ELEPHANT CONFLICT (HEC) BY USING REMOTE SENSING TECHNIQUES

Nuraina Afiqah Khalim (1), Noordyana Hassan (1)

[1] University Technology of Malaysia, Department of Geoinformation Faculty of Geoinformation and Real Estate, 81310 Johor Bahru, Malaysia
[2] Geoscience and Digital Earth Centre, Research Institute for Sustainability and Environment, University Technology of Malaysia, 81310, Johor Bahru, Malaysia
Email: ainafiqahkhalim@gmail.com; noordyana@utm.my

Abstract: There are records that elephant has been seen as one of the 'endangered' species by IUCN's red book with approximately 1200 to 1500 elephants left in peninsular Malaysia. This habitat has been intruded by human in the early 1950s and has created massive issues of human- elephant conflicts (HEC) ever since. The hypothesis that can be concluded is that these issues can be decrease; and crop raiding; deaths of both parties can be control. Maximum Likelihood Classification (MLC) is the suitable Remote Sensing (RS) method that will be used in classifying the classes in the Landsat 8 OLI and TIRS bands to compute the changes of urban growth and development in study area within 5 years of time. These study uses the STRM DEM data in identifying the habitat suitability of the elephant by using the RS techniques, thus, the identification of the elephant intrusion can be founded and the deaths of both human and elephant can be decrease by time to time. The in-situ data collection is being used to analyse the community loss and occurrence of the intrusion by elephant happened in order to mapping the path of the elephant in search of the food. The results for this study are the relationship graph between the change detection and the habitat of the elephant, and also habitat suitability map. So, the government can take actions to manage these long-time issues. Thus, these HEC issues are a serious matter that involved the extinction of the wildlife that plays an important role in an ecosystem. The habitat of elephant must be preserved for the further generation.

Keywords: MLC, HEC, RS

INFLUENCE OF HUMAN ACTIVITIES ON WETLAND EVOLUTION IN THE YANGTZE DELTA

Lei Zhang (1)

[1] Key Laboratory of Digital Earth Science, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, P. O. Box 9718, Beijing 100101, China
E-mail: Zhanglei@radi.ac.cn

Abstract: The wetland in the Yangtze Delta plays an important role in coastal protection against erosion, water purification, and habitat maintenance of migratory birds. The Yangtze Delta is one of the largest economic zones (e.g., Shanghai) in China. Human activities severely affect wet land evolution. Wetland mapping was performed from multi-temporal remote sensing data of Landsat during the period of 2000 – 2010 at intervals of about 5 years, and spatio-temporal changes in wetland characteristics as well as driving forces for such changes were analyzed. Results indicated the Yangtze River estuarine wetland area experienced a net increase of 63% during the period of 2000 – 2010; from 2005 onwards, however, the rate of increase has decreased. Human activities, including upstream dam construction, estuarine engineering, land reclamation, and ecological engineering, played an important role in wet land evolution during this short period. Reduction of riverine sediment loads led to decreases in the increase rate of estuary wetland; 95% of the estuarine shoreline is embanked by seawalls, which exerts negative effects because closure promotes substantial degradation of wet land areas. Urbanization and expansion of Shanghai facilitated regular land reclamation of wetland and led to 35% wetland loss. Intentional artificial planting of aquatic plants and groyne construction accelerated sediment deposition and wetland formation to compensate for coastal wetland loss.

Keywords: estuarine wetland, human activities, spatial pattern

LAND USE CHANGE DETECTION METHOD WITH OBJECT-BASED IMAGE ANALYSIS (OBIA) USING LANDSAT 7 AND LANDSAT 8

Hafidh Muhammad Hakim (1), Munawaroh (2)

[1] Sustainability Implementation Division SMART Tbk, Jl. MH Thamrin No. 51, 10350 Jakarta, Indonesia
[2] Indonesian Geospatial Agency, Jalan Raya Bogor Km 48, 16911 Cibinong, Indonesia
Email: hafidh.m.hakim@sinarmas-agri.com; munawaroh@big.go.id

Abstract: Land use changes refers to the extent of urbanization, which is a global phenomenon mainly driven by population growth and large scale migration. This phenomenon could be a problem if not detected, including for urban area and its surrounding areas. The use of remote sensing data for information extraction have been carried out now, one of them with 30-meters resolution Landsat imagery, Landsat 7 ETM+ and Landsat 8 OLI. Remote sensing analysis for extraction an information also varied today. Object-Based Image Analysis (OBIA) is a method that not only consider the spectral aspect information but also the spatial aspect. The selected study area is in a suburb of Yogyakarta City that have heterogeneous land use. This study was conducted to determine OBIA approach for landuse extraction, its accuracy, and land use change detection using Landsat Imagery for 2002 and 2017. OBIA has done in two main processes, image segmentation using region growing algorithm type and image classification using Bhattacharya algorithm. Region growing segmentation use two parameters, similarity threshold and area threshold. Both of them are determined by doing trial and error. Accuracy test for classification image is done with Short method. The process of land use change detection performed by comparing the land use classification image between 2002 and 2017. The results showed that extraction of information in the research area can be done by using Object-Based Image Analysis (OBIA), producing 5 land use classes for analysis. Land use classification image of 2002 giving 41 % overall accuracy, than classification image of 2017 giving 55% overall accuracy. Land use changes to built up area is the most happened in the study area.

Keywords: land use change, OBIA, region growing segmentation, Bhattacharya, Spring

COMPARISON OF SEGMENTATION FUSION METHODS FOR UNSUPERVISED CHANGE DETECTION BETWEEN VERY-HIGH-RESOLUTION BI-TEMPORAL IMAGES

Youkyung Han (1), Taeheon Kim (1), Changhui Lee (1)

[1] School of Convergence & Fusion System Engineering, Kyungpook National University, Sangju 37224, Korea
Email: han602@knu.ac.kr; rlaxogjs77@gmail.com; lch970914@gmail.com

Abstract: Due to a high level of spatial complexity and heterogeneity in very-high-resolution (VHR) imagery, an object-based unsupervised change detection approach instead of a pixel-based one is generally conducted for the VHR imagery. Segmentation methods that sub-divide an image into meaningful homogeneous regions and organize them into image objects corresponding to ground entities have been developed. However, there are few studies focusing on determining common boundaries of objects in bi-temporal images for the change detection. Therefore, we investigate and compare segmentation fusion methods, which are aiming at minimizing inconsistent boundaries between bi-temporal images, to obtain an optimal unsupervised change detection result. To this end, the simple linear iterative clustering (SLIC) is selected as a segmentation approach due to its computationally efficient. Then, we compared three fusion methods of segmentation results from bi-temporal images: i) applying segmentation approach to one image and using it as an input for change detection ii) applying segmentation approach to difference image of the bi-temporal images iii) applying segmentation approach to both bi-temporal images independently, and combining them by the intersection of the two segmentation results. A change vector analysis (CVA) is implemented for pixel-level unsupervised change detection, and then major voting is performed for refining the pixel-level change detection results to the object-level results. Bi-temporal Kompsat-2 satellite images are used to generate a study site for conducting the experiments. From the experiments, we have demonstrated that using one image or using a difference image for generating the segmentation map shows better change detection results compared to the result by the intersection of the two segmentation results.

Keywords: Unsupervised change detection, Segmentation, Simple linear iterative clustering, Kompsat-2, Very-high-resolution imagery

CHANGE DETECTION OF LAND USE FROM PAIRS OF SATELLITE IMAGES VIA CONVOLUTIONAL NEURAL NETWORK

Riho Ito (1), Shota Iino (1), Shuhei Hikosaka (1)

[1]Satellite Business Division, PASCO Corporation, 3rd Floor Japan Map Center 4-9-6, Aobadai, Meguro-ku, Tokyo, Japan
Email: roithi7072@pasco.co.jp; sohnoi4704@pasco.co.jp; saykua3447@pasco.co.jp

Abstract: Monitoring changes of land use is important for land price analysis. The analysis result is an essential information for urban planning. The land use refers to categories of land classified according to purpose of use such as residential area, road, crop land, paddy land, farmland and waterway. Currently, land use classification has been updated manually. However, it takes long time to perform manual analyses of wide areas regularly. In this research, we propose an automatic change detection method from multi temporal satellite images to support the manual updating of land use classification. Our proposed method will contribute to reduce the time for manual analysis by detecting the candidates of changed areas in land use. The changes are detected from pairs of high spatial resolution satellite images by using Convolutional Neural Network (CNN), which has been successfully used for image classification. To detect actual changes in land use, distinguishing between the actual changes and seasonal changes are required. One example of seasonal changes is paddy land, which looks different every season. The supervised data for training are generated by labelling the class of changes in each 50-metres mesh. The input data to CNN are pairs of small patches, which are cropped from two temporal images. In case of comparing the multi temporal land cover maps which were generated from each image for detecting change, some factors derived from satellite image such as position aberration are detected as changes. Our method attempts to improve the performance by learning the changes which are required to detect by using the pair of satellite images. As the result, candidates of changed areas of land use were detected in 50-metres meshes. The changes are validated by comparing satellite images. In some areas, existence of shadow affected the analysis results. Changes due to shadows were classified as the candidates of the changed areas in land use classification. To reduce such misclassification, the numbers of variations in the supervised data should be increased in the future.

Keywords: Convolutional Neural Network, Deep Learning, Change Detection, Urban Planning, Satellite Image

REMOTE SENSING (RS) AND GEOGRAPHICAL INFORMATION SYSTEM (GIS) FOR MAPPING AND MONITORING LAND COVER AND LAND USE CHANGES IN KELANTAN RIVER BASIN

Faizalhakim AS (1), Nurhidayu S (1)(2), Norizah K (1)(2)

[1] Faculty of Forestry
[2] Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
Email: mohammadfaizalhakim@gmail.com; sitinurhidayu@upm.edu.my; norizah_k@upm.edu.my

Abstract: Rapid land use changes has taken place in Malaysia over the past century due to accelerated industrialization, agriculture boost and urbanization. Perception on the land use changes especially forest conversion and clearing to other land uses often blamed as one of the factors contributing to severe disaster such as flood, particularly in Kelantan State. In order to assist more accurate information to such assumption, this paper used integration of the satellite remote sensing, geographical information system and visual interpretation (ground truthing) to investigate the land use change dynamics in Kelantan River Basin. The results indicated that there has been a notable loss of forest and paddy area between 1994 and 2014. The remarkable intensifying land use progress was an agricultural land such as oil palm, rubber and other agriculture with annual additional rate of 40.6, 14.8 and 9.2 km2/year, respectively. The future land use e.g. forest, rubber and paddy were presumed to gradually diminish as the growth of oil palm plantation and urbanization to boost economy and to meet demand from the population. To some extent this will reflect the adverse consequence during disaster if not consider and implement proper environmental impact assessment and sustainable land use management especially in high sensitivity areas. An integrated river basin management and environmentally sensitive areas in the planning and management of land use and natural resources should be integrated and employed to ensure sustainable development and to minimize disaster impact.

Keywords: land use changes, remote sensing, Landsat-5 and SPOT-5, Kelantan River Basin

ANALYSIS OF LAND USE/LAND COVER CHANGE BASED ON LANDSAT SERIES DATA IN NAKHON PHANOM, THAILAND FROM 1972 TO 2017

Rui Xi (1), Zhanyu Liu (1)

[1] Department of Remote Sensing and Geoscience, Hangzhou Normal University, Hang Zhou 311121, China
Email: samadhixr@gmail.com

Abstract: In order to study the impacts and changes between the river network and the cultivated land in the area of Nakhon Phanom, the main planting area of jasmine rice in north eastern Thailand. This paper selects the Landsat series of images with an average interval of 10 years from 1972 to 2017. The visual interpretation and support vector machine method are used to extract the land use change information. Then the land use transfer matrix analysis method is used to analyze the land. Use the type of time and space changes and development trends and focus on the reasons for the changes in the cultivated land and water system. The results show that from 1972 to 2017, the cultivated land area, the number of reservoirs and ponds in the whole province are increasing year by year, and the amount of cultivated land is revolved around the surrounding areas of the reservoirs and then radiated to the surrounding areas, including the northwest, central and partial mid-points of the government. The south eastern region has changed significantly during these 45 years.

Keywords: Long Time-Series Landsat, Land Use/Cover Analysis, Nakhon Phanom, Support vector machine, Transfer Matrix

LAND USE AND LAND COVER CHANGE AND PREDICTION ANALYSIS IN INLE LAKE WATERSHED, MYANMAR

Moepwint San (1), Intareeya Sutthivanich (2), Suwit Ongsomwang (1)

[1] Sciences Institute, School of Geoinformatic, Suranaree University of Technology, Mueang District, Nakhon Ratchasima, Thailand, 30000
[2] Center for Scientific and Technological Equipment, Suranaree University of Technology, Mueang District, Nakhon Ratchasima, Thailand, 30000
Email: moepwintsan@gmail.com; suttin1@sut.ac.th; suwit@sut.ac.th

Abstract: Inle Lake region is one of the most important watershed area in Myanmar and is located between- 97°.09′ E longitude and 20°05′- 21°17′N Latitude, covered the area of 4354.49 sq. km. Even though the region has been changed significantly, Inle Lake has high attractive to tourist attraction and has included as tentative list for UNESCO world heritage sites since 1996. In order to obtain information about physical environment dynamic and ecosystem change in the Inle Lake watershed, this study aims to analyst and discuss Land Use/Land Cover (LULC) changes and imminent prediction. Landsat 5 and Landsat 8 datasets were used to classify the watershed landscape for 2005, 2010 and 2015. The classification included eight classes; agricultural area, closed forest, opened forest, wooded land, water body, floating garden, urban and bare land. CA- Markov model was used to predict LULC change and distribution in 2015 and 2025 based on the result of LULC in 2005, 2010 datasets and LULC in 2005, 2015 datasets, respectively. The wall to wall assessment was successfully generated in predicting LULC distribution, in 2015 and the results were comparable to the classification of LULC in 2015. Number of sample size for thematic accuracy assessment was estimated based on multinomial distribution with stratified random sampling scheme and 757 points were used for the sample size. LULC classification maps produced overall accuracy of more than 85%. LULC change detection of Inle Lake watershed was assessed based on the classified images in 2005-2010, 2010-2015 and 2015 to 2025. The change detection matrix was performed to obtain the final results which can provide useful information for policy makers, researcher and local government agencies to create an effective decision plan.

Keywords: Inle Lake Watershed, Land Use and Land Cover, CA- Markov, Accuracy Assessment, Change Detection

100-YEARS OF LAND USE CHANGE ANALYSIS WITH OLD TOPOGRAPHIC MAP USING DEEP LEARNING

Sotaro Tashiro (1), Wataru Takeuchi (2)

[1] Graduate school of Civil Engineering, The University of Tokyo, Bw-602, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
[2] Institute of Industial Science, The University of Tokyo, Bw-602, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
Email: sotaro@iis.u-tokyo.ac.jp; wataru@iis.u-tokyo.ac.jp

Abstract: Although databases that are capable of quantitative assessment of land use have been developed since the latter half of the 1970s in Japan, databases that include the period before that have not been developed. That's why it is not possible to conduct quantitative investigation of land cover changes including the period before that. Regarding the old topographic map stocks themselves, in recent years, Stanford Geospatial Center released the map stocks which Japanese army had had in the past, so such stocks are in an increased situation. Processing by machine learning is expected for digitizing stocks of such large amount of old-edition topographic maps. In this research, we aim to construct quantitative geospatial information databases on past land use. First, we try to simplify preprocessing such as cutout of geographical maps and georeference of a large amount of old-edition topographic map stocks dating back to the past 100 years by machine learning. Then we divide them into map tiles. After that, by extracting land use from map tiles by applying image classification technology based on existing deep learning method "pix2pix", we convert old-edition topographic map tiles into land use pixel data tiles. And we also conduct accuracy assessment on this data tiles by comparing them with correct images by conducting some color conversions. It is possible that by using land use pixel data set dating back to past 100 years we assess long-term environment change quantitatively from the viewpoint of long-term land use change. We can also develop regional future disaster prevention plan by visualizing old topography of some area. And we also aim to make proposals like that kind of application of our data set and to consider their possibility and problems for actual application.

Keywords: Map Tile, Pixel Data, Pix2pix

DRIVING FORCE OF HISTORICALLY LAND USE CHANGES IN THE PART OF TOKYO CITY FROM AERIAL PHOTOGRAPHY AND OLD MAPS

Yasuharu Yamada (1)

[1] National Agriculture and Food Research Organization (NARO) 2-1-6, Kannondai, Tsukuba, Ibaraki 305-8609 Japan
Email: yamaday@affrc.go.jp

Abstract: Tokyo metropolitan city divides into 23 wards. Shibuya-ward is one of them and western part of central Tokyo area. It is now famous for pop-culture and information technology companies complex. But when the Meiji-revolution about 150 years ago was done, about half of Shibuya-ward area were a kind of farm belt. The rest of farm region in Shibuya-ward was the "Samurai", a warrior, house district. The land-use in this area was at first transformed to dairy and pasture, horticulture farm growing tea leaves or mulberry leaves for silkworms. It is because of abolition of Samurai warrior class and abrogation of feudal load's alternating "Edo", the old name of Tokyo, residence, addition to the change of eating habits. There are changes in diet from fish and soy beans into meat and dairy products. After that, there are some opportunities to change the land use in this area, such as construction and opening of railway to the central area, tap water supply, the "Kanto" region great earthquake, increasing populations, World-War-II and its damages, changes of industrial structure, the Tokyo-Olympic-Games, the miraculously swift growth of the economy. The old maps and aerial photographs, continuously surveying, will be able to explain the driving forces of lad use changes and to lead to the well understanding of growth or prosperity of cities. Photointerpretation is the key to obtain a cause of such kind of land use changes. The web based Geographic Information Technology is the way how to hold in common among the people.

Keywords: Aerial photography, old maps, land use change, driving force, abstract topic Photointerpretation, Geographic Information System

SUPERVISED AND UNSUPERVISED ACCURACY ASSESSMENT USING SPOT IMAGE FOR LAND COVER AND LAND USE MAPPING OF MANGROVE SPECIES

Hazamy Mohd Suhaimi (1), Mohamad Hidayat Jamal (1)(2), Anuar Ahmad (3), Mohamad Khairul Abdullah Halim (3), Daeng Siti Maimunah Ishak (2)

[1] School of Civil Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia
[2] Center for Coastal and Ocean Engineering (COEI), Research Institute for Sustainable Environment (RISE), 54100 Kuala Lumpur, Malaysia
[3] Faculty of Built Environment & Surveying, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia
Email: mimihazamy@gmail.com; mhidayat@utm.my; anuarahmad@utm.my; mkhairulhalim@gmail.com; maimunah.kl@utm.my

Abstract: Land use and land cover mapping are the most common output or results in remote sensing image application. Accuracy assessment is carried out to determine the classification accuracy by comparing the sampling image with ground truth. In this paper, SPOT image is used for land cover and land use mapping using supervised and unsupervised classification techniques. The accuracy assessments of supervised and unsupervised were used to analyze the suitability of SPOT image in land cover and land use mapping. The land cover mapping is classifies into five classes which is forest, mangrove, water body, urban land and open area. The land use mapping focuses on the mangrove species classification into differentiate five different species of Rhizophora Apiculata, Rhizophora Mucronata, Brugueira Parviflora, Xylocarpus Granatum and Ceriops Tagal. There are 150 mangrove ground sampling data acquired from field. The accuracy assessment of land cover mapping indicates 72.22% in supervised and 59.35% in unsupervised techniques. Therefore, supervised method is better to be used in SPOT image for land cover mapping application. In land use application which focuses in mangrove species classification the results differ from land cover mapping. Due to restriction in pixel size using SPOT image with multispectral resolution 6.0m, supervised classification is best for land cover mapping but work poorly in mangrove species mapping. Therefore, unsupervised classification work best in mangrove species mapping compared to supervised classification.

Keywords: supervised classification, unsupervised classification, SPOT, land use, land cover

A TWENTY-YEAR EVALUATION OF SHORELINE CHANGES AT BARRANG CADDI ISLAND IN SPERMONDE ARCHIPELAGO FROM SATELLITE IMAGERY

Dwi Fajriyati Inaku (1)(2), Nurjannah Nurdin (1)(2), M. Akbar AS (2), Agus Aris (2), M. Nur Fitrah (2), Sarah Hamylton (3)

[1] Research Center for Regional Development and Spatial Information, Hasanuddin University, Jl. Perintis Kemerdekaan km.10, Makassar, 90245. Indonesia
[2] Faculty of Marine Science and Fisheries, Hasanuddin University, Jl. Perintis Kemerdekaan 10, Makassar, 90245, South Sulawesi, Indonesia
[3] GeoQuest Research Centre, Faculty of Science, Medicine and Health, University of Wollongong, Australia
Email: wiwik.inaku@gmail.com; nurj_din@yahoo.com; shamylto@uow.edu.au

Abstract: Coastal zone are highly dynamic environments. Alterations to shorelines, including erosion and accretion, represent a notable feature of island coasts that changes over longer time periods (i.e. decades), as well as displaying shorter, seasonal fluctuations. This research identifies coastal area vulnerability based on the shifting of shore line at Barrang Caddi island of Spermonde Archipelago. Twenty years of Landsat images spanning the period from 1998 until 2018 were obtained for the dry season (April-September) and monsoon season (October- March). Shoreline changes were analyzed with Digital Shoreline Analysis System. Shoreline change patterns in the dry season were consistent: Erosion occurred on the north to the northeast side of the island whereas accretion was more dominant than erosion. Maximum abrasion range from 25.35-33.56 meters. In the monsoon period, erosion occurred from the north side to the northeast side of the island, with a general balance between erosion and accretion. Maximum accretion range from 21.87-35.85 meters. The north to the northeast side of the island experienced erosion all year round. Meanwhile, the southwest side of the island only experienced abrasion during monsoon season. Linear regression analysis between coastline alteration and addition of years was generate R^2 value close to 0, which means addition of years does not have direct correlation with coastline alteration, or it can also be said that X and Y variables only have unrobust cause and effect relation. Comparison between the result of dry season and monsoon season shows that the period of season has a clear, pronounced effect on shoreline movements.

Keywords: coastline, abrasion, Landsat, Spermonde, DSAS

CHANGE DETECTION ON SPATIAL DISTRIBUTION OF CORAL REEF HABITAT USING LANDSAT IMAGE IN TINGGI ISLAND, MERSING

Mazlan Hashim (1)(2),Muhammad Hafiz Saman (2), Syarifuddin Misbari (1)

[1] Geoscience & Digital Earth Centre (INSTEG), Research Institute for Sustainable Environment (RISE), Universiti Teknologi Malaysia, Johor Bahru, Malaysia
[2] Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
Email: mazlanhashim@utm.my

Abstract: Spatial distribution and types of shallow-bottom coral reefs at regional scale could be identified using satellite-based approach, both during high tide and low tide condition. Climate change related sea level rise and increased surface temperature are expected to cause flooding of coastal areas, bleaching events, and an increase of storm frequency and intensity. This paper intends to apply the Operational Land Imager (OLI) Landsat 8 satellite data with 30m resolution in Tinggi Island shoal. The Island and its surrounding water was gazette as Marine Parks in 1994 under the Fisheries Act 1985 (Amended 1993). The data were gone through pre-processing method such as Atmospheric Correction and the removal of the sun glint. Supervised Classification in the area was applied after the Bottom Reflectance Index (BRI). The objective of this study include: a) classify the coral reef area then, and b) relate the classification result with the Sea Surface Temperature (SST). The study found out that the coral reef spatial distribution has increase even despite the rising in temperature. Based on the result, this study is critically necessary for coastal managers and related environmental authority to mitigate an effective action to reduce total number of coral dead as well as bleached coral in huge areal coverage by regular monitoring activities.

Keywords: Landsat 8, Coral Reef, Change Detection, Remote Sensing

LAND COVER CHANGE DETECTION FROM SENTINEL-1 IMAGES USING STATISTICAL ANALYSIS AND CNN

Chen Guang HOU (1), Jun Xiang CHEN (1), Ken Yoong LEE (1), Soo Chin LIEW (1)

[1] Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore,10 Lower Kent Ridge Road, Blk S17, Level 2, Singapore 119076
Email: crshc@nus.edu.sg; crscjx@nus.edu.sg; crslky@nus.edu.sg; scliew@nus.edu.sg

Abstract: In environmental monitoring applications, synthetic aperture radar (SAR) imaging can provide continual data for change detection at night and in bad weather condition. In this study, multi-temporal Sentinel-1 dual-polarization (VH and VV) detected products were employed to identify the land cover changes in Jambi, Sumatra over the period from January to December 2015. There were severe fire events during the months of August to October this year resulting in extensive land cover change over this region. By assuming the multi-look intensity follows Gamma distribution, change detection was carried out based on the intensity ratio, which follows a beta prime (or inverted beta) distribution. Furthermore, a deep learning based CNN architecture was also developed for translating the dual-pol SAR into speckle noise-free visible-like multispectral images. Using the colorized SAR images, clustering analysis was conducted to detect the changed areas.

Keywords: Sentinel-1, Change Detection, Statistical Analysis, Beta Prime Distribution, Machine Learning

CHANGE DETECTION ANALYSIS USING NDVI IN BANDUNG, INDONESIA

Rika Hernawati (1), Soni Darmawan (1)

[1] Department of Geodetic Engineering, Institut of Technology National (Itenas),
Jl. PKH Mustafa No 23, 40124 Bandung, Indonesia
Email: rikah@itenas.ac.id; soni_darmawan@itenas.ac.id

Abstract: Vegetation is an urban component that has many benefits. Vegetation density in Bandung greatly affects of the temperature of the area. The condition and existence of vegetation in urban areas can be identified by various technology, one of them is using remote sensing technology by utilizing the vegetation density index method. This study is to analyzed the differencing level of vegetation in Bandung using the NDVI method derived from Landsat 7 and Landsat 8, then classified to detect vegetation change of Bandung in 1990 and 2017. The results of NDVI showed the index value to determined the density of vegetation and showed a drastic decreased of vegetation index change from 1990 until 2017 ± 70%.

Keywords: NDVI, Vegetation change, Landsat Imagery

APPRAISAL OF CLASSIFICATION TECHNIQUES FOR LAND USE/LAND COVER ASSESSMENT USING HYPERSPECTRAL SATELLITE IMAGE

Dharini Jha (1), Prem Chandra Pandey (2), Prashant kumar Srivastava (3)

[1]Junior Research Fellow, Institute of Environment and sustainable development, Banaras Hindu UniversityVaranasi, 221005 Uttar pradesh, India
[2]National Post Doctoral Fellow, Institute of Environment and sustainable development, Banaras Hindu UniversityVaranasi, 221005 Uttar pradesh, India
[3]Assistant Professor, Institute of Environment and sustainable development, Banaras Hindu University Varanasi, 221005 Uttar pradesh, India
Email: dharinijha92@gmail.com; prem26bit@gmail.com

Abstract: Rapid innovations in the field of remote sensing have ensued the employment of Hyperspectral remote sensing into a wide array of applications ranging from forest, agriculture, mineralogy etc. Higher spectral and spatial resolution of space borne hyperspectral data allows improved quantitative studies in vegetation analysis for agriculture purposes. Accurate vegetation identification can be efficiently obtained through hyperspectral remote sensing technology. The first space borne hyperspectral sensor could obtain a 10-nm sampling interval over the contiguous visible/near-infrared and shortwave infrared spectral data from 356 nm to 2577 nm, and works on 242 potential bands with resolution as high as 30-meter. Consequently, an image obtained through such sensor can proficiently provide information for accurate vegetation identification and comprehensive landuse classification. This analysis uses the Hyperion data for classification and identification of the crops using different classification methods, namely, a) Maximum Likelihood classification, b) Spectral angle mapper (SAM), c) Support Vector Machines (SVM) and d) artificial neural network classifiers. For this study, the hyperspectral data was acquired for Bathinda landscape to perform agriculture land classification and the classification results were further compared. Initially, geometric and radiometric corrections preprocessing were made along with the atmospheric correction of the Hyperion image. Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes (FLAASH) model, rooted in the ENVI software was used to convert the hyperion radiance values into surface reflectance values. Subsequently, the resultant data was used for classification using the different classifiers and were compared. Finally, to verify the results of classification and to evaluate the accuracy of the four classifiers used in the study, a detailed ground-truth data was recorded in the field. On the basis of robust classification algorithm accurate results of biophysical parameters can be obtained.

Keywords: Agriculture, Hyperspectral Remote Sensing, Hyperion, Crop Classification.

A STUDY ON PRECISE UPDATING METHODOLOGY OF SUBDIVIDED LANDCOVER MAP BASED ON VARIOUS SPATIAL DATA FOR NEW TOWN NONPOINT SOURCE MANAGEMENT

Jaehyun Yoo(1), Kyehyun Kim(1), Yonggil Park(1), Gihoon Lee(1)

[1] Dept. of Geoinformatic Engineering, Inha University, 100 Inha-ro, Nam-gu, Incheon(22212), South Korea
E-mail: black-8mm@inha.edu

Abstract: The impervious surfaces are increasing due to urban development, making the securing funding for management of nonpoint sources and runoff by land usage to be urgent. As a measures to secure new sources of funding, the basic date is necessary for management of nonpoint sources and calculation of impervious surface area used in accurate pricing. For this purpose, it is essential to expression the area information by landcover items from GIS environment and to develop landcover map accurately marking the pervious region in the impervious one. Since the landover maps are constructed and revised at irregular intervals, however, it is difficult to identify the latest change in land use. The purpose of this study was, therefore, based on various spatial informations, to propose a method for precise updating of subdivided landcover map of new town regions for management of nonpoint sources. The Sejong City was selected as study region because this city was expected to have a large change in landcover due to the recent relocation of administrative capital and continuous urbanization development. The updating of the subdivided landcover map using various spatial data such as aerial photograph, and digital topographic map was required and preprocessing, first and second updating of landcover information, and quality inspection process were carried out. A total of 19,049 objects were newly created through a first and second updating process, and it was found that the changed landcover items correspond to a total of 26.49 km2. The accuracy of results from the first and second updating was determined as high as 99.78% based on the changed area and rate of change. It is considered that this study provides fundamental data for application of Green infrastructure policy and that further studies are need obtain highly accurate information about impervious surfaces.

Keywords: Subdivided Landcover, Nonpoint Sources, Spatial Data, Stormwater Runoff, Impervious Surfaces

QUANTIFYING LAND USE CHANGES USING REMOTE SENSING AND GIS

Anis Qurratu Ain Apandi (1), Shaparas Daliman (1), Sunisa Suchat (2), Siwipa Pruitikanee (2), Supattra Puttinaovarat (2)

[1] Faculty of Earth Science, Universiti Malaysia Kelantan Jeli Campus, 17600 Jeli, Kelantan, Malaysia
[2] Faculty of Science and Industrial Technology, Prince of Songkla University, Suratthani Campus, Surattani 84000, Thailand
Email: qurratuain96@gmail.com; shaparas@umk.edu.my; sunisa.su@psu.ac.th;siwipa.p@psu.ac.th; supattra.p@psu.ac.th

Abstract: Earth observations, monitoring, and information analysis can be conducted through remote sensing and geographic information system (GIS) techniques. These tools provide valid means of studying land use changes and environmental transformations. In this study, land use changes are monitored and quantified by using geoinformation technologies in Mueang district Surat Thani, Thailand. Landsat Thematic Mapper (TM) images of four different years, which are 2006, 2010, 2014 and 2018 will be compared and classified using supervised classification by using Maximum Likelihood Classifier in Erdas Imagine software 2015. The images of the study were categorized into four classes which are urban, agricultural, forest and water. Patch analyst of ArcGIS in ArcMap10.3 will be used to facilitate the spatial analysis of land use changes. By using remote sensing data and geoinformation system, this study will provide the current analysis data representation of the land use changes for past years that could assist in formulating mitigation measures as well as minimizing the environmental degradation in future development.

Keywords: Land Use Changes, Landsat TM, Patch Analyst

THE SPATIOTEMPORAL TRENDS AND DRIVERS OF LAND COVER/LAND USE ON AN ISLAND PROTECTED AREA: BATANES, PHILIPPINES

Harry Casimir E. Merida (1), Gay Jane P. Perez (1), Rene N. Rollon (1)

[1] Institute of Environmental Science and Meteorology, University of the Philippines, Diliman, Quezon City
Email: hemerida@up.edu.ph; gpperez@up.edu.ph; rrollon@iesm.upd.edu.ph

Abstract: The impact of protected area policy on an island in the Philippines was explored in this study. Batanes was declared as a protected area to protect natural and sociocultural heritage on 2001 through Republic Act (RA) 8991. Landsat image composites from 1989, 1993, 2000, 2007, 2010, and 2016 were geometrically corrected, applied Relative Radiometric Normalization, and classified as Forests, Non-Forests, and Non-Vegetation using Support Vector Machines. A land use map was created to classify agriculture using phenology through Normalized Difference Vegetation Index. Multivariate analysis through Canonical Correspondence Analysis was utilized with a change map (1989 & 2016) and selected anthropogenic and natural variables. The study primarily focused on forests, where most priority species are located. Root mean square error values were <0.024 after normalization. Results show forests increased post-2001 for all islands (Batan = 2319 ha to 2777 ha; Sabtang = 1496 ha to 2071 ha; Itbayat = 2714 ha to 3982 ha) yet temporal trends show covarying change between Forests and Non-Forests. In Itbayat, Non-Forest and Forest showed inverse trends caused by indigenous swidden agriculture. The increasing forest cover at Batan is partially attributed to thickening agriculture hedgerows composed of trees. Analysis at restricted zones (Protected Land) showed similar covarying trends except for Itbayat where the Protected Land, located at the island's edges, is also comprised of Non-Vegetation. Most of the remaining forests are in the mountains for Batan and Sabtang, while portions of Itbayat's forests are used for agriculture. The land use map showed that the Protected Land of Batan contains a noticeable amount of agriculture (~221.4 ha or 7.9%). Statistical analysis indicates that the primary driver of forest change to all islands is accessibility. Slope and Elevation help retain the Forests of Batan and Sabtang. The forests of Itbayat are closely related to Non-Forests as well as agriculture, linking the inverse relationship. Although policies that restrict accessibility may help reduce forest conversion, a common ground should be agreed as Philippine indigenous people law (RA 8371) lists the province as an ancestral domain, allowing the indigenous community practice activities that are otherwise contrary to the context of conservation.

Keywords: Islands, Protected Area, Remote Sensing, Land Cover/Land Use Change, Batanes

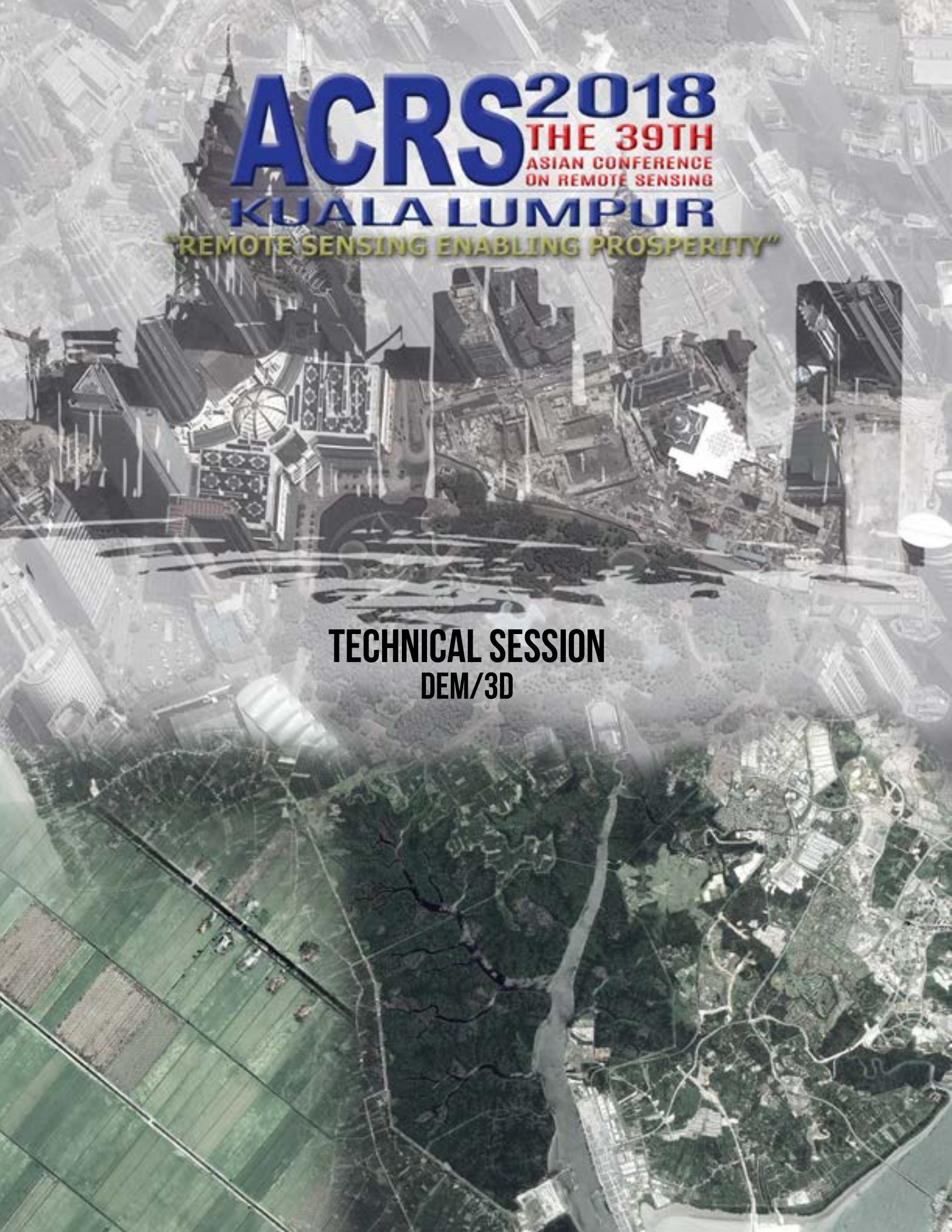
CHANGE DETECTION: A CASE STUDY

Daman Neupane (1)

[1] Pashchimanchal Campus, Institute of Engineering, Tribhuwan University, Raskot municipality, Karnali, Nepal
Email: 71bge513@wrc.edu.np

Abstract: Nepal being a developing country has not been much familiar with remote sensing because of its new terms and techniques. However, its application in Nepal is of great importance. The study of Land cover and land use change has been a dominance application of remote sensing as it leads to the study of the local problem, its solution, the future planning and in the country like Nepal, it can be boon for the planned development and balancing the ecosystem. Land use land cover maps have been prepared in Nepal by National Land Use Planning but change detection: A case study has not been much into practice. This kind of analysis plays a very important role in determining the change in local as well as global ecosystem. In this paper, I have performed a case study for change detection of Nepalgunj sub metropolitan city, of Banke district, which is supposed to reveal the change in agricultural land, agricultural production and its impact on the nation's economy.

Keywords: Multi-spectral, NDVI, Reflectance, ERDAS Imagine



TECHNICAL SESSION
DEM/3D

A METHOD FOR ESTIMATING VIDEO SURVEILLANCE CAMERA PARAMETERS

Zhang Lishuo (1), Cheng Xiaojun (1)

[1] College of Surveying and Geo-Informatics, Tongji University, No. 1239, Siping Road, 200092 Shanghai, China,
Email: 2009302590086@whu.edu.cn; cxj@tongji.edu.cn

Abstract: Real-time video surveillance is playing an increasingly significant role in surveillance systems for numerous security, law enforcement, and military applications. However, conventional video surveillance systems have various problems with multi-point surveillance. A typical system for conventional video surveillance directly connects each video camera to a corresponding monitor. When the scale of the surveillance system grows larger than the human capacity for monitoring, serious problems can occur. Security operators must mentally map each surveillance monitor image to a corresponding area in the real world, and this complex task requires training and experience. A common reference frame to which these cameras can be mapped is significant to facilitate multi-camera coordination and tracking. Geographic information system (GIS) can be used as a common frame of reference because it not only presents a solid ground truth but more importantly is also used to store semantic information for use in applications such as tracking and activity analysis. The integration of a surveillance camera video with a GIS requires the georeferencing of video frame. A camera view in 3D space is completely determined by the camera position, orientation, and field-of-view. Since the accurate measuring of these parameters can be extremely difficult, in this paper we propose a method for their estimation based on matching video frame coordinates of certain point and line features with their 3D geographic locations. Once an adequate number of points and lines are matched, robust iterative optimization is applied to find the most suitable video frame georeference, i.e., position and orientation of the camera. The results of the research provide a reference for integration of GIS and video surveillance.

Keywords: video surveillance, GIS, camera calibration, georeferenced

3D RECONSTRUCTION OF FRAGMENTS BASED ON ARTIFICIAL FISH SCHOOL ALGORITHM

Ensheng Liu (1)(3), Xiaojun Cheng (1)(2), Quan Li (1)

[1] College of Surveying and Geo-Informatics, Tongji University, Shanghai, China
[2] Key Laboratory of Modern Industry Surveying, National Administration of Surveying, Mapping and Geoinformation, Shanghai, China
[3] Jing Gang Shan University, Ji'an, China
E-mail: 273808715@qq.com; cxj@tongji.edu.cn; springlee329@hotmail.com

Abstract: Vision allows us more convenient comprehensive understanding the real world. Machine vision imitates the human vision through the electronic means such as computer and camera to perceive and understand the image. 3D reconstruction is an important issue of the machine vision technology, which has broad applications in culture relics protection, aircraft assembly, reverse engineering and other fields. Previous approaches for reconstructing fragments rely mainly on a single characteristic and thus may cause accumulative errors. In this paper, we present a global optimal matching method for 3D fragments based on artificial fish school algorithm. The proposed method first extracts multi-featured elements from the point cloud of the fragments. The boundary curve point sets acquired from edge detection are applied to arc fitting to obtain feature information, such as center of circle, axis, and radius. The moving least radius ball detection algorithm is adopted to detect edge points, and radius and center of circle are obtained by 3D centering filter arc fitting algorithm. Combined with texture and expert knowledge, rough set theory is then applied to classify multiple types of fragments. The artificial fish school algorithm is subsequently adopted to achieve optimal matching results. Global matching of fragments is a non-linear and multi-featured matching optimization problem. First, reflect the feature matching scheme space into a coding space using encoding mechanism. Search the coding space using AFSA with the given constraints to get the optimal resolution. The results obtained can be used to match the fragments. All possible matching scheme can be reflected into an encoding space based on the encoded fractured surface through the encoding mechanism, thus, these codes are likened to a school of fish. Results indicate that the proposed method is powerful, robust, and independent of initial position. Rough set classification can effectively prevent false matching between fragments with the same radius but from different artifacts. The method can also achieve accurate matching even when certain fragments are missing. The proposed method can be a new efficient tool for the global matching of fragments.

Keywords: 3D laser scanning, feature extraction, artificial fish school algorithm, global matching

HEIGHT ACCURACY ASSESSMENT OF ALOS WORLD 3D (AW3D30) DSM AND ITS UTILITY FOR IDENTIFYING FLOOD-PRONE AREAS OF COASTAL MYANMAR

Akira Hirano (1)

[1] Social Sciences Division, Japan International Research Center for Agricultural Sciences,
1-1 Ohwashi, Tsukuba, Ibaraki 305-8686 Japan
Email: akhirano@affrc.go.jp

Abstract: The recent release of the "ALOS World 3D" digital surface model (DSM) of 30 m resolution (AW3D30), currently at version 2.1, by the Japan Aerospace Exploration Agency (JAXA) was yet another addition to the globally available fine resolution DSM datasets for users of broad communities in various application fields. The dataset is unique in that it is made available free of charge not only for research and scientific use but also for commercial use in the fields of geospatial information and application. In an effort to test the utility of the AW3D30 dataset in a flat, flood-prone areas of the Ayeyarwady Delta in Myanmar, the author evaluated its height accuracy in comparison with another freely available global DEM data of comparable resolution—ASTER GDEM version 2 (GDEM2). The accuracy was assessed using 985 well distributed spot heights from eight 1:50,000-scale topographic maps of Myanmar (published in 2014) encompassing approximately 6,000 km^2 with elevation ranging 0.1–300 m. The height accuracy for the AW3D30 resulted in 4.2 m (RMSE) and 3.5 m (Std. dev.) that met its target accuracy of 5 m (RMSE), consistent with other reported validation efforts being conducted worldwide. The height accuracy for the GDEM2 using the same spot heights resulted in 9.4 m (RMSE) and 8.6 m (Std. dev.), also in accordance with the final report by the ASTER GDEM Validation Team in 2011. The results signified the comparative advantage of the AW3D30 among the two datasets. However, preliminary hydrological analyses revealed systematic artifacts of AW3D30 originating in the number of stacks that had been used to generate the dataset and the AW3D30 proved short in identifying flood-prone areas in the delta region of interest.

Keywords: AW3D30, GDEM2, Ayeyarwady Delta

USE OF ECOLOGICAL AND TOPOGRAPHIC VARIABLES DERIVED FROM REMOTELY SENSED DATA IN DETERMINING THE COMPLEXITY OF AN URBAN REFORESTED LANDSCAPE

John Odindi (1), Sithole Kusasa (1), Onisimo Mutanga (1)

[1]Discipline of Geography, School of Agricultural, Earth & Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209, Pietermaritzburg, South Africa
Email: Odindi@ukzn.ac.za; skusasalethu@gmail.com; MutangaO@ukzn.ac.za

Abstract: The transformation from natural to impervious landscape that characterise urbanization is known to significantly compromise urban ecological integrity. Recently, urban re-forestation has been identified as an ideal mitigation approach against the impacts associated with urbanization. However, the high competition with other lucrative urban land uses like real estate, retail, manufacturing and urban agriculture necessitates an optimization of the ecological benefits within limited reforested area. Advancement in remotely sensed datasets offer a unique opportunity to determine tree stands structural complexity (SSC), useful for determining the ecological performance of reforested landscape. In this study, we evaluate the utility of integrating Sentinel-2 image based Vegetation Indices (VIs) with topographic variables derived from high resolution Digital Elevation Models (DEMs) for predicting SSC in a reforested area. Results show that the performance of the optimal topographic variables was superior to VIs. However, better results were achieved when VIs were integrated with the optimal topographic variables. The study underscores the value of ecological and topographic variables derived for remotely sensed datasets in understanding the performance of reforested areas within an urban landscape.

Keywords: Ecological, topographic, remotely sensed, urban, reforestation

3D GEOMOPHIC PREDICTION FOR FLOOD RISK SIMULATION IN MONSOON REGION OF KUALA TERENGGANU MALAYSIA

Ibrahim Sufiyan (1), Dr. Razak Bin Zakariya (1), Rosnan Yaacob (1)

[1] School of Marine and Environmental Sciences Remote Sensing and GIS
Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia.
Email: ibrahimsufiyan0@gmail.com; ajak@umt.edu.my; rosnan@umt.edu.my

Abstract: Everyday it rains heavily during the monsoon period around December to January in Terengganu watershed especially near to the South China Sea has being experiencing flash flood. The flood is usually occur in most of the States in the Peninsular Malaysia. The use of Geographic information system to identify those zones which are vulnerable to flood risk was employed. The method is to characterise different hydrologic response units into sub basins which was adopted using SWAT. The geomorphic factors of soil, land use and slope has greatly influenced the water flow that causes the flood. The Terengganu watershed was delineated and the flood risk at individual sub basin parameter was simulated in form real time simulation. All the scenario within the catchment was calculated for easy mitigation. The flood risk models were developed for the purpose of planning and management.

Keywords: GIS, HRUs, Delineation, Watershed, Flood Risk

THE GEOGRAPHICAL STUDY ON SITE AND CAPABILITY OF AN INTERNATIONAL AIRPORT IN HANTHERWADY, BAGO, MYANMAR

Kyi Lint (1), Mu Mu Than (2), Khin Mar Yee (2), Yan Naing Tun (3)

[1] Professor (Head), Department of Geography, Dagon University
[2] Associate Professor, Department of Geography, Dagon University
[3] Candidate, PGD GIS, Department of Geography, Dagon University

Abstract: Air transport may provide the transportation means in remote areas. For international transportation, international airports play a vital role. Myanmar has totally three international airports and Yangon International Airport is most crowded one and in 2016, 7,500,000 visitors were landed to Yangon International Airport. Since it was built after World War II, 1947, it is old enough to face difficulties such as building of new infrastructures and other modern airport system equipment. In 2016 new Hanthawaddy International Airport was constructed. Hanthawaddy International Airport site was chosen between Bago and Yangon. It is located north to Yangon and only 48 miles away from Yangon International Airport. The objectives of the paper are to study the location, proximity, demography, terrain, accessibility and land use coverage of vicinity area with GIS and Remote Sensing Technology. The following criteria show the site and situation of Hantharwady International Airport: geography and morphology, geology and vulnerability study, accessibility and proximity study.

Keywords: vulnerability, accessibility, proximity

3D LASER SCANNING IN THE RENOVATION AND PRESERVATION OF HISTORIC TEMPLE ARCHITECTURE, THAILAND

Intareeya Sutthivanich (1), Udomvit Maneewan (1), Punya Suemkumpung (1),
Benja Klinjundaeng (1), Sirilak Tanang (1), Suriporn Charungthanakij (2)

[1] SuranareeUniversity of Technology, Mueang District, Nakhon Ratchasima, Thailand, 30000
[2] Silpakorn University, Mueang Nakhon Pathom District, Nakhon Pathom, Thailand, 73000
Email: suttin1@sut.ac.th; udomvit@sut.ac.th; punya@sut.ac.th; banja@sut.ac.th; sirilak@sut.ac.th; scharung@hotmail.com

Abstract: Watpasatharuam is a long historic temple of Buddhism and is located in Nakhon Ratchasima province, northeast region of Thailand. The temple was established in 2475 B.E (1932 A.D.) and covered the area of 0.25 sq.km. (134 rai). It is a significant center of spiritual and religious practices for the surrounding local communities. The temple nourishes the natural landscape and traditional architecture building. Up to date, new technology takes part in renovation and preservation of historic temple processes. A 3D laser scanning can play an important role in the renovation and preservation of historic architecture. It can be expanded beyond the traditional dependence on 2D representations. The products from 3D laser scanning can be integrated into commercial Building Information Model (BIM)/Computer Aided Design (CAD) and modeling applications that can be used from initial concept, throughout the design process to construction drawing. This paper discusses how 3D laser scanning is used to record the temple features and its 3D point cloud dataset can assist the architect exploring potential alternative design. The design solutions can be established within an accurate framework. Along with cost estimation can be calculated in the renovation process. 3D models built from laser scanning dataset ultimately improve the quality and understanding of a planned design for architectural reconstruction. A proposed renovation of the Watpasatharuam temple provides a case study illustrating how data derived from 3D laser scanning can form the basis of an accurate 3D model which can be integrated seamlessly into the architectural design process.

Keywords: 3D Laser Scanning, Point Cloud, 3D Modelling, Renovation, Preservation

ASSESSMENT OF SRTM ELEVATION DATA FOR LANDSLIDE SUSCEPTIBILITY MAPPING

Kelvin Kang Wee Tang (1), Alhaji Hussaini (1)(2)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia
[2] Department of Geography, Aminu Saleh College of Education Azare, PMB 044, Bauchi, Nigeria
Email: tkwkelvin2@live.utm.my; alhaji2@live.utm.my

Abstract: Landslide has been defined as a massive mass of soil and rock debris that move downhill because of the action of gravity. Essentially, landslide is one of the most costly and damaging natural disasters that brings harsh damage to properties and even claims human lives. The causes of landslides are usually related to instabilities in slope, which include geological factors, morphological factors, as well as physical factors associated to irresponsible man-made activities which affect the environments. This study utilises the freely accessible Shuttle Radar Topography Mission (STRM) in conducting accuracy assessment for landside susceptibility mapping. In this paper, the quality and vertical accuracy of 3 arc-second SRTM derived digital elevation model (DEM) data has been evaluated against the topographical data digitized via conventional stereo-photogrammetric technique. The chosen test area is located at Sungai Ruil, Cameron Highlands, Malaysia since this hilly terrain area had experienced a destructive slope failure back in year 2011. Quite a few topographical characteristics such as relative heights, slope gradients and slope aspects have been compared and analysed. The results show that the interpolated contour lines and topographic profiles derived from the SRTM data appear to be comparable to those vital features generated from the stereo pair images.

Keywords: Digital Elevation Model (DEM), Shuttle Radar Topography Mission (SRTM), Landslide Susceptibility Mapping

GENERATION OF DIGITAL ELEVATION MODEL USING CARTOSAT -1 SATELLITE DATA IN HILLY AREAS OF HIMACHAL PRADESH

Meena Kumari (1), Dr Alka Shrama (1)

[1] Aryabhata Geo-informatics & Space Application Centre, Bemloi, Shimla. (H.P.)
Email: agisac.meena@gmail; dr_alkasharma@rediffmail.com

Abstract: The Digital Elevation Model (DEM), also referred to as the Digital Terrain Model (DTM) is a digital representation of earth's topography. The DEMs are used to derive topographic attributes, geo-morphometric parameters, morphometric variables or terrain information in general. In combination with other spatial data, digital elevation models are an important database for topography-related analyses. The use of elevation data improves information extraction especially in hilly states like Himachal Pradesh having remote and in accessible areas. The elevation data, integrated with imagery have been extensively used for wetlands and forest management, urban development tourism and route planning. The high-resolution stereo data have great potential to produce high-quality DEM. This paper describes the evaluation of the Cartosat-1 stereo data, mainly through the generation and validation of DEM for moderately undulating and hilly areas. CARTOSAT-1 is an Indian satellite – the 11th one in the IRS (Indian Remote Sensing) series designed to provide quality Earth imagery for telemetry and digital mapping. The stereo data from this satellite along with the Rational Polynomial Coefficients (RPC) were used to generate Digital Elevation Model. The Cartosat-1 stereo pairs were ingested along with corresponding RPC files and interior orientation and exterior orientation. The tie points were automatically generated throughout the image overlap areas using the LPS software with parameters. Manual method of identifying tie points was also employed in the regions under dense forest and snow cover. DEM editing tools available in Terrain Editor of LPS software has been used to ensure that the terrain dataset does conform to model's surface. The visualization, verification and editing (addition and deletion of mass point; dynamic range adjustment of visible area for clarity; addition of break lines) of Digital Elevation Model was done using LPS Terrain Editor facilitates visualization, verification and editing of DEM. The edited DEM was used for ortho-image generation. The contours were also generated at 10m interval.

Keywords: Digital Elevation Model (DEM), Cartosat-1, Leica Photogrammetry suite (LPS), Carto DEM

LAHAR MODELLING OF MT. AGUNG 1963-1964 AND 2017-2018 ERUPTIONS USING THREE DEM DATASETS: TERRASAR-X, SRTM 1-ARC GLOBAL, AND DTM DERIVED FROM INDONESIAN TOPOGRAPHIC MAP 1:25000

I Gede Dalem Elang Erlangga (1)(2), Ketut Wikantika (1)(2), Agung Budi Harto (1)(2)

[1] Center for Remote Sensing, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[2] Remote Sensing and Geographic Information Science Research Group, Faculty of Earth Science and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
Email: dalemelang@students.itb.ac.id; ketut@gd.itb.ac.id; agung@gd.itb.ac.id

Abstract: Lahar is a secondary hazard of volcanic eruption which was formed when unconsolidated or loose volcanic materials mixed with water flowing down the volcano slopes at relatively high velocity. Since 1500 AD, at least lahars claimed 56,315 victims, or about 26 % of all volcanic eruption fatalities (Brown et al, 2017). When erupted at 1963, rain-triggered lahar from Mt. Agung claimed around 200 fatalities in Subagan village alone. Lahar hazard zone assesment is highly needed and important in mitigation purposes espescially when Mt. Agung begin to reactivate in the late 2017. Lahar hazard zone will be assesed with LAHARZ modelling methods, using three DEM inputs: DTM derived from Indonesian topographic map, SRTM 1-Arc Second Global, and TerraSAR-X DSM datasets. Planimetric and cross sectional area of lahar inundation zone was modelled according to the given volumes parameter. The modelling results indicates that the usage of those three different DEMs data has it is own advantages and disadvantages. DTM from topographic map and SRTM 1-Arc Second Global are not good enough when used in wide flat area such as in northen and southwestern sector of Mt Agung volcano due to their relatively low vertical accuracy. While SRTM data will generalize the stream drainage with it is low spatial resolution. From this research, we conclude that DTM data with horizontal resolution no more than 10 x 10 m and vertical acurracy better than 10 m, will yields the best lahar model. Lahar volume estimation is succesfully done using the reversed Iverson (1998) empirical formulas. The estimated lahar total volumes 1963-1964 eruption is around 53.4 x 10^6 m^3, and lahar volumes from 2017-2018 eruption was estimated around 3.5 x 10^6 m^3.

Keywords: lahar, H/L cone, lahar modelling, proximal zone, distal zone

POTENTIAL OF COCONUT PLANTATION MANAGEMENT USING 3D VISUALIZATION OF GIS DATA: A CASE STUDY OF SOUTHWESTERN GEOGRAPHICAL REGION

Gonesh Chandra Saha (1)(2), Ruzinoor Che Mat (3)

[1] School of Multimedia Technology and Communication, Universiti Utara Malaysia, Malaysia
[2] Computer Science & Information Technology, BSMRAU, Bangladesh
[3] School of Creative Industry Management and Performing Arts, Universiti Utara Malaysia, Malaysia
Email: gcsaha@bsmrau.edu.bd; ruzinoor@gmail.com

Abstract: Modern agricultural farming supported by 3D visualization and Geographic Information System (GIS) techniques has turned into a very powerful subject, which has effectively exhibited its capacities to provide information on natural resources such as soils, land use, forest and crop on regular basis. Spatial idea of the crop including its farming view is essential to take for proper management decision in agriculture. In this research, an attempt has been taken to explore the existing coconut cultivation practices with a view in southwestern districts from Bangladesh and find for the scope of 3D visualization integrated with GIS in coconut plantation management. This study looks at the potential factors of 3D visualization of GIS data in managing and monitoring coconut plantation. With the help of observational study, face to face interview with farmers, and also with scientific officers it has been comprehended that coconut is a very important crop and there is tremendous potential for cultivation of coconut in considered geographical location. But it has been found that coconut farmers are facing difficulties in sustaining their livelihood from coconut farming, and the production with coconut cultivation under study area are in decreasing trends. The outcomes found from the coconut field interview and observation about the systems for coconut based cultivating that are traditional problematic manual farming practices and there is likewise absence of legitimate monitoring exercises are the fundamental difficulties could be feature for presenting new technologies. The present investigation on the coconut cultivation demonstrates in distinguishing the reasonable difficulties and opportunities that could be feature in adopting advance technologies like 3D visualization of GIS data can be effectively applied to generate timely information for monitoring of coconut area which would aid in forecasting production. It will also be adapted for advancing decision makers in order to increase the crop production and other activities related to the crop.

Keywords: Coconut, Plantation, Management, 3D visualization, GIS

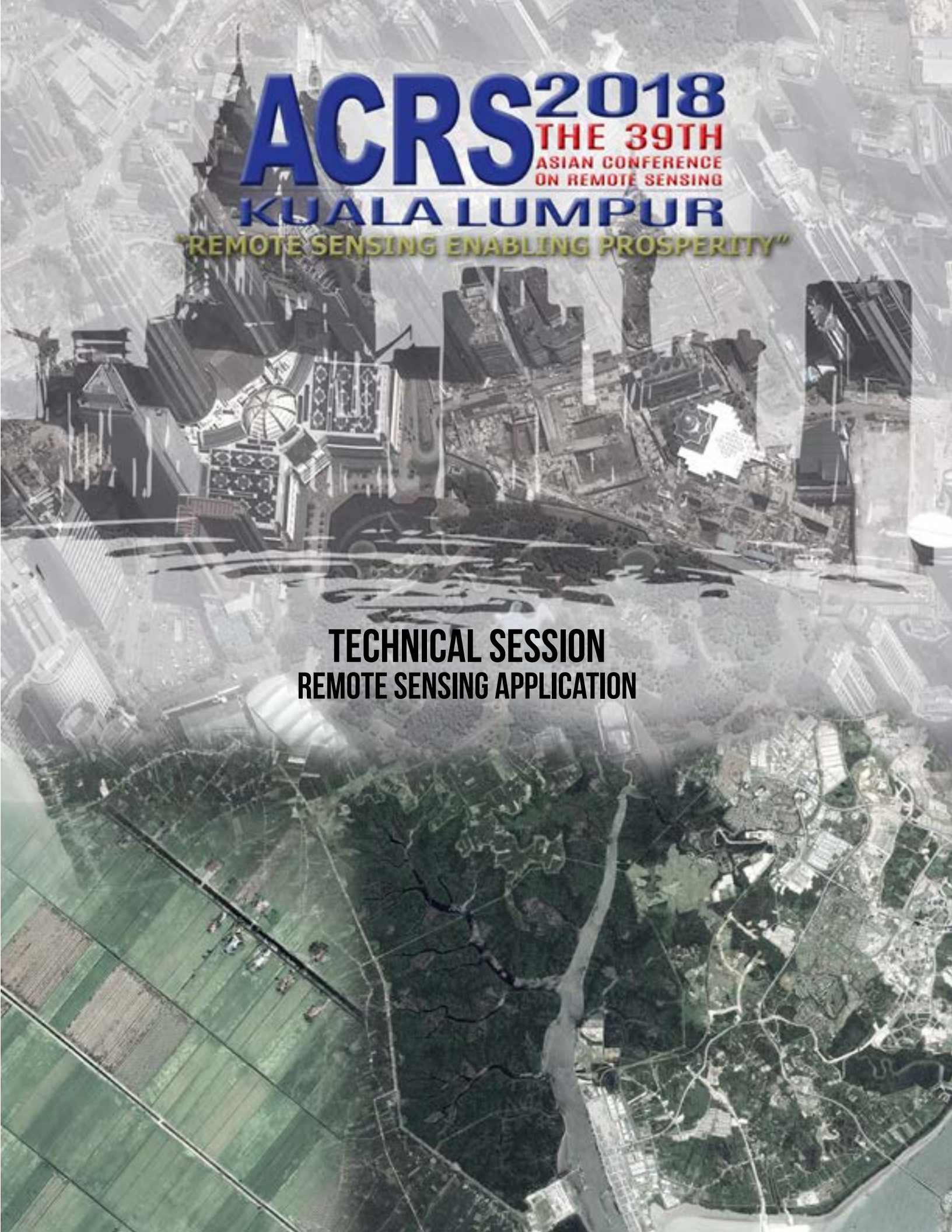
ASSESSING THE QUALITY OF DIGITAL ELEVATION MODEL BASED ON STATISTICAL METHOD

Yu-Shiang Hou (1), Shou-Hao Chiang (1)

[1] Center for Space and Remote Sensing Research, Department of Civil Engineering, National Central University, No. 300, Zhongda Rd., Zhongli District, 32001 Taoyuan City, Taiwan Email: skynine-9@hotmail.com; gilbert@csrsr.ncu.edu.tw

Abstract: The use of Digital Elevation Model (DEM) is important to scientific and engineering applications. In recent years, there are many DEMs that are free or available through the application such as SRTM (Shuttle Radar Topography Mission) and ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), which is the global digital elevation model of open to download. In general, producers give the digital elevation model the overall accuracy summary report, which includes the overall production method, horizontal and vertical accuracy assessment. However, there is no systematic description of the quality. Based on many previous studies, the accuracy of different digital elevation models has been compared to explore their quality, but these methods are not enough to define the quality of digital elevation models. Therefore, this study referring ISO 19113 (International Organization for Standardization, ISO) for assessing the quality of digital elevation model. The quality of a spatial dataset can be described as five elements: completeness, logical consistency, positional accuracy, temporal accuracy, and thematic accuracy, and each element has sub-element. This study selected sub-elements that are suitable for assessment. Besides, this study also utilizes the visualization of analysis by elevation, slope, aspect when assessing the quality because the high quality of digital elevation model can show the best visualization. Finally, this study aims to create the assessment method to define digital elevation model of quality.

Keywords: Digital Elevation Model, Quality, SRTM, ASTER, ISO19113



TECHNICAL SESSION
REMOTE SENSING APPLICATION

APPLICATION OF AERIAL PHOTOGRAPH TO ANALYZE CONSERVATION ACTIVITIES OF PLAOSAN TEMPLE IN KLATEN REGENCY, CENTRAL JAVA PROVINCE, INDONESIA

Gerry Utama (1), Yamuna Jiwaningrat (1), Suratman (1), Andi Abdul Manaf (2)

[1] Department of Environmental Geography, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang, Sekip Utara, Bulaksumur, Kabupaten Sleman, Daerah Istimewa Yogyakarta, 55281 Indonesia
[2] Department of Development Geography, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang, Sekip Utara, Bulaksumur, Kabupaten Sleman, Daerah Istimewa Yogyakarta, 55281 Indonesia
Email: gerry.utama@mail.ugm.ac.id; yamunajiwaningrat@gmail.com; suratman@ugm.ac.id; manaf_sinjai@yahoo.com

Abstract: Plaosan Temple is one of Hindus temple as a part of Mataram Kingdom heritage which is located in Prambanan District, Klaten Regency, Central Java Province. Limitation in conducting the management of The Plaosan Temple comprehensively. causes the temple to be less well maintained. Utilization of aerial photography related to the evaluation of the conservation of the temple is considered effective in conducting spatial inventory. Information and analysis of Plaosan Temple condition spatially gives easiness in determining priority of handling and determination of zoning utilization area. The study was conducted by utilizing the aerial photograph data that has been done geometric correction that generates orthophoto throughout the Plaosan Temple building. The data is then processed into Digital Elevation Model (DEM) data used in conducting analysis of the handling of temple conservation and priority handling of Plaosan Temple. The result of the research shows that the temples are interpreted by temple type, the level of damage that becomes the reference concerning the priority of handling of Plaosan Temple and other information which become supporting data in conducting analysis related to the management of Plaosan Temple presented spatially. This research became one of the breakthrough in heritage mapping, the establishment of well-integrated zoning handling and temple management.

Keywords: aerial photos, Plaosan Temple, DEM, conservation, heritage

CRACK DETECTION FROM HIGH-RESOLUTION AERIAL TRIPLET IMAGES FOR SAFER COLLAPSE INVESTIGATIONS IN HIGH MOUNTAIN AREAS

Masafumi Nakagawa (1), Ryusei Igusa (1), Nobuhiro Usuki (2), Masanori Takigawa (2), Naoki Nishimura (2), Yoshiaki Katsumata (2), Tomoaki Eguchi (2)

[1] Shibaura Institute of Technology, 3-7-5, Toyosu, Koto-ku, Tokyo 135-8548 Japan
[2] Asia Air Survey Co., Ltd, 1-2-2 Manpukuji, Asao-ku, Kawasaki-shi, Kanagawa 215-0004, Japan
Email: mnaka@shibaura-it.ac.jp; ah14005@shibaura-it.ac.jp; usu.usuki@ajiko.co.jp; msa.takigawa@ajiko.co.jp; nok.nishimura@ajiko.co.jp; ysk.katumata@ajiko.co.jp; tma.eguchi@ajiko.co.jp

Abstract: Table 1 compares investigation and 3D measurement approaches in high mountain areas (elevations above 3000 m). A collapse investigation is generally conducted by field surveys using handheld digital cameras and tape measures. Recently, various approaches have been proposed to improve the safety of collapse investigations. High-resolution data can be acquired with a terrestrial LiDAR, unmanned aerial vehicle-borne photogrammetry and LiDAR, or helicopter-borne photogrammetry and LiDAR. However, these approaches are not easy to apply to collapse investigations in high mountain areas. On the other hand, aerial LiDAR, aerial photogrammetry, and satellite photogrammetry can achieve higher availability and safety. Although aerial LiDAR and photogrammetry can acquire very accurate point clouds, aerial photogrammetry can acquire higher spatial resolution data than aerial LiDAR. Satellite photogrametry can also acquire point cloud data and surface models, but its accuracy and spatial resolution are lower than those of aerial surveying. Thus, we focus on aerial photogrammetry to improve collapse investigations.

Table 1. Investigation and 3D measurement approaches in high mountain areas

	Ground survey	Terrestrial LiDAR	UAV ıgrammetry / LiDAR	Helicopter-borne ıgrammetry / LiDAR	Aerial LiDAR	Aerial Photogrammetry	Photogrammetry (Satellite)
Availability	High	Low	Low	Low	High	High	High
Safety	Low	N/A	N/A	N/A	High	High	High
Accuracy	Moderate	N/A	N/A	N/A	High	High	Moderate
Spatial resolution	Low	N/A	N/A	N/A	Moderate	High	Moderate

Cracks caused by gravity and freeze thaw effects can be factors in large-scale mountain collapses. Cracks can be classified by their formation processes, as shown in Table 2.

Table 2. Cracks classified by the formation process

Primary	Lava flow process	Compressed wrinkles on lava surfaces	
		Stretched cracks on lava surfaces	
	Lava consolidation process	Slide cracks in lava interior	
		Cooled cracks / shrunken cracks	

	Lava consolidation process	Slide cracks in lava interior	
		Cooled cracks / shrunken cracks	
Secondary	Lava weathering process	Ice-wedge cracks	
		Sand-wedge cracks	

First, cracks are grouped into two types based on the whether the formation process is primary or secondary. The primary formation process consists of the lava flow process and the lava consolidation process. In the lava flow process, compressed wrinkles and stretched cracks form on lava surfaces. In the lava consolidation process, slide cracks form in the lava interior together with cooled cracks and shrunken cracks. In the secondary formation process, ice-wedge cracks and sand-wedge cracks form during the lava weathering process. In general collapse surveying, cracks generated through the lava weathering process are investigated. Aerial photogrammetry has already been used for presurveys with image-processing approaches to achieve more efficient surveying. However, cracks must be identified from various edges in aerial images using manual processes. We propose a methodology to automate crack detection using multiple aerial images. We have verified our methodology through an experiment using aerial images.

Keywords: triplet image matching, edge detection, crack classification, point cloud

STUDY ON IMPROVING THE ACCURACY OF GPS LEVELLING USING GENETIC ALGORITHM BASED LEAST SQUARES SUPPORT VECTOR MACHINE (LSSVM)

Chia-Hsin Chen (1), Lao-Sheng Lin (1)

[1] National Chengchi University, Department of Land Economics
No. 64, Sec.2, Zhi-Nan Rd, Wenshan District, Taipei City 11605, Taiwan (R. O. C)
Email: 106257032@nccu.edu.tw; lslin@nccu.edu.tw

Abstract: The orthometric height, the distance of a point on the earth from the geoid along curved plumb line, can be derived by leveling. The orthometric height can be used in engineering application, but it requires higher cost of labor and time. On the other hand, the ellipsoidal height, the distance of a point on the earth from the surface of the reference ellipsoid along the normal, is derived by Global Positioning System (GPS) with the advantage of low cost and receiving data continuously. Therefore, if we can use GPS derived data to derive orthometric height (GPS Levelling) which meets the required accuracy, the overall working efficiency can be improved significantly. And within the process of GPS levelling, obtaining the undulation model that satisfies the required accuracy is the main study goal. Least Squares Support Vector Machine (LSSVM) was proposed by Suykens in1999. In addition to inheriting the characteristics of Support Vector Machine (SVM), which can solve the problems of small sample size, nonlinearity, high dimension and local minimum, LSSVM also has the advantage of requiring fewer parameters and solving the problem faster, which can be used to estimate the undulation model. However, many papers have shown that the parameters selection of LSSVM is still the problem to be solved. Therefore, in this study, the Genetic Algorithm (GA), which has the ability to obtain the globally optimal solution, will be used to search and optimize the parameters of LSSVM to improve the accuracy of the undulation. In this paper, 2065 bench mark points distributed throughout the Taiwan region with the orthometric height, the ellipsoidal height and plane coordinates at the same time, were used as test data. According to the preliminary test results, they indicate that the accuracies of GPS levelling are improved after using genetic algorithm based least squares support machine.

Keywords: Geoidal Undulation, Least Squares Support Vector Machine (LSSVM), Genetic Algorithm (GA), Orthometric height, Ellipsoidal height

3D GIS MODELING TECHNIQUES FOR DOCUMENTATION AND PRESERVATION OF CULTURAL HERITAGE: SOUTHEAST ASIAN CHAPTER

Ahmad Afiq Aiman (1), Norzailawati Mohd Noor (1), Alias Abdullah (1)

[1] Kuliyyah Architecture and Environmental Design, International Islamic University Malaysia (IIUM), Jalan Gombak,51000 Gombak, Selangor
Email: irme.aiman@gmail.com; norzailawati@iium.edu.my; dralias@iium.edu.my

Abstract: Documentation and preservation techniques have always been an important concern for the cultural heritage study particularly in the context of building in Southeast Asian. The recent disappearance of the high value of heritage building structured due to the urban renewal and redevelopment planning strategies lead to failure of conservation effort and achieving vision of cultural safeguarding by United nation. This paper attempt to critical review on efforts that implemented in Southeast Asian countries through the 3D GIS modelling techniques by other scholars using an integration of other geospatial approach photogrammetry on laser scanning considered as a mechanism to increase the effectiveness of heritage preservation approach. The prominent sources of publications from web of science, Scopus and other related publisher have been used in summarize the finding according the latest year of 2015-2019 publications. The finding shows that the various techniques and approaches of 3D GIS modelling that implemented with considering the integration of other geospatial approach in effort to documenting and preserving cultural heritage structures in Southeast Asian. Hence, this effort brings up the technologies approaches giving a positive vibe in conservation and preservation of cultural heritage in Southeast Asian.

Keywords: Cultural Heritage, 3D GIS, Laser Scanning, Photogrammetry, Southeast Asian

ESTIMATING LAND-USE CHANGE IMPACTS ON URBAN AIR QUALITY IN INDIA USING HIERARCHICAL BAYESIAN APPROACH

Prakhar Misra (1), Wataru Takeuchi (1)

[1] Institute of Industrial Science, The University of Tokyo, Tokyo 153-8505, Japan
Email: prakharmisra90@gmail.com; wataru@iis.u-tokyo.ac.jp

Abstract: Outdoor air pollution is responsible for 3.7 million premature deaths annually. 90% of these deaths occur in developing countries and are estimated to rise in future with socio-economic growth. It is important to focus on urban regions as they have high pollutant concentrations of particulate matter ($PM_{2.5}$) which impact large population densities. Currently statistical dataset or intensive ground studies are used to evaluate emission contribution from different sources which are used for mitigation and control policies. However, lack of high resolution emission inventory data, temporally and spatially pollutant concentrations as well as continually changing urban land-use pose challenges for such studies in developing cities.

Keywords: MODIS, PM2.5, AW3D, emission inventory

OIL PALM VEGETATION INDICES AT DIFFERENT GROWING STAGES USING SENTINEL-2B SATELLITE IMAGERY

Hana Mohamed Jamil (1), Shahruddin Ahmad (1), Noryusdiana Mohamad Yusoff (1), Nurul Suliana Ahmad Hazmi (1), Nur Dhuha Dzulkifli (1)

[1]Malaysian Remote Sensing Agency, Ministry of Energy, Science, Technology, Environment and Climate Change, No 13, Jalan Tun Ismail, 50480, Kuala Lumpur, Malaysia.
Email: hana@remotesensing.gov.my

Abstract: The oil palm is a perennial crop, which starts yielding palm fruits for oil about 3 years after planting, and it has a continual productive lifespan of 25-30 years. Oil palm is the most important supplier for the industrial production of vegetable oil in the world with the total yield of about 4.5 tonne (4 tonne palm oil and 0.5 tonne palm kernel oil) per hectare. This study aims to evaluate reflectance patterns and to compare various Vegetation Indices (VIs) observed over different oil palm growth stages using Sentinel-2B satellite imagery. Carey Island Estate is selected for this study, which consists of different growing stages, varying from young to matured age. Eleven VIs were adopted (i.e Band Ratio (RATIO), Normalized Difference Vegetation Index (NDVI), Transformed Vegetation Index (TVI), Infrared Percentage Vegetation Index (IPVI), Perpendicular Vegetation Index (PVI), Soil Adjusted Vegetation Index (SAVI), Transformed Soil Adjusted Vegetation Index (TSAVI), Modified Soil Adjusted Vegetation Index (MSAVI), Difference Vegetation Index (DVI), Renormalized Difference Vegetation Index (RDVI) and Weighted Difference Vegetation Index (WDVI)) to monitor different oil palm growing stages. The results show that R^2 for DVI = 0.612, PVI = 0.607, WDVI = 0.607, SAVI = 0.557, RDVI = 0.551, MSAVI = 0.555, TSAVI = 0.570, NDVI = 0.570, IPVI = 0.570, TVI = 0.571 and RATIO = 0.527. DVI produces the best correlation (R^2 = 0.612) value with oil palm at different growth stages because it is sensitive to the amount of vegetation, and a good indicator to distinguish between vegetation and soil. DVI value is the highest at 6 years old palms and starts to decline by age.

Keywords: Sentinel 2-B; Vegetation Index; Oil Palm; Growth Stages; Correlation Analysis

CRATER MORPHOLOGY AND VOLCANIC PRODUCTS COVERAGE ANALYSES AT AGUNG VOLCANO BASED ON POLARIMETIC DECOMPOSITION OF SENTINEL-1A SAR DATA

Jeremy Linggom Mangarajum Panjaitan (1)(2), Asep Saepuloh (1)(3), Ketut Wikantika (1)(2)

[1] Center for Remote Sensing, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[2] Remote Sensing and Geographic Information Science Research Group, Faculty of Earth Science and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[3] Research Group of Petrology, Volcanology, and Geochemistry, Faculty of Earth Sciences and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
Email: jeremy.linggom@students.itb.ac.id; saepuloh@gc.itb.ac.id; ketut@gd.itb.ac.id

Abstract: Agung Volcano is a composite volcano located in Bali Province (Indonesia). It is classified as "A" type Volcanoes defined by the Centre for Volcanology and Geological Hazard Mitigation (CVGHM). The A type volcano means that the volcano has been active in 19th and 20th centuries. Following the resting period about 50 years, this volcano enter a new eruption phase, that is identified by solfatara activities in early November 2017, followed by a phreatic eruption at 21 November 2017 and magmatic eruption at 25 November 2017, 24 December 2017, 11 January 2018, 11 March 2018, 28-29 June 2018, and 2 July 2018. Mitigation scenarios are necessary to prevent inevitable loss of thousand lives. Therefore, this study is raised to assist to decision maker especially for mapping the hazard near the summit correctly. To obtain the morphological change related to the eruptions, a topographical change detection technique is proposed using series of Synthetic Aperture Radar (SAR) remote sensing images. The SAR images of Sentinel 1A were selected, due to its ability to record the data without being influenced by weather and volcanic ash coverage. Polarimetric Decomposition method was selected to identify the properties of target at surface (i.e. Agung Volcano) based on backscattering intensity measurement. The analyses were taken into account based on entropy (H) and alpha (α) produced by polarimetric backscattering decomposition. In addition, the optic sensor image from Sentinel 2 was also used to clarify the analyses of polarimetric decomposition method. According to the proposed method, the temporal variation of H and α angle could be detected because of the distribution of new volcanic products (e.g. lava flow and solfatara smoke) inside and outside the crater. The lava flows were distributed at western part in the crater rim about 20.251 ha. Meanwhile, solfatara was distributed mostly at northern part in the crater rim about 13.216 ha.

Keywords: Agung Volcano, Backscattering Intensity of Surface, Topographical Change Detection

GOOGLE EARTH ENGINE-BASED ASSESSMENT OF EXPANSION OF BAKHAWAN ECO-PARK USING VEGETATION AND WATER INDICES DERIVED FROM LANDSAT IMAGES

Keith Paolo Landicho, Ariel C. Blanco, Raquel Raiza Francisco, Nerissa Gatdula

Department of Geodetic Engineering, University of the Philippines
Training Center for Applied Geodesy and Photogrammetry, University of the Philippines Diliman, Quezon City, Philippines
Email: kclandicho1@up.edu.ph; acblanco@up.edu.ph; rtfrancisco@up.edu.ph; nbgatdula@up.edu.ph

Abstract: Bakhawan Eco-Park is a mangrove forest located near the mouth of the Aklan River in Kalibo, Aklan, Philippines. Sediment export and deposition in this area is believed to be enhanced by upland deforestation and land cover changes in the watershed. Mangrove reforestation efforts in the Eco-Park dating back to 1990 possibly enhanced its sediment trapping function, thus its expansion. The expansion of this blue carbon ecosystem implies greater potential to sequester and store carbon. Analyses of remotely and spatially derived data using a cloud-computing geospatial platform like Google Earth Engine (GEE) have proven to facilitate spatio-temporal studies. This study is conducted to detect and quantify the expansion of the Bakhawan Eco-park over periods of time. Landsat 5 Thematic Mapper (TM) and Landsat 8 Operational Land Imager/Thermal Infrared Sensor (OLI/TIRS) satellite images from years 1985 to 2017 were utilized in this study. Due to the area being persistently covered with clouds, composite images for 5-year epochs, namely, (1) 1985-1989, (2) 1990-1994, (3) 1995-1999, (4) 2000-2004, (5) 2005-2009, (6) 2010-2012, and (7) 2013-2017, were created using a GEE built-in algorithm. Normalized Difference Index values for vegetation (NDVI) and water (NDWI & Modified NDWI) were derived and then experimentally thresholded, to derive land and water information. Temporal area of the study site was computed using its most recent extent as basis. Expansion rates based on thresholded NDVI, NDWI, and MNDWI values, respectively, for each consecutive epoch-pair are as follows: epoch 1-2: 68.94%, 69.18%, 12.20%; epoch 2-3: 16.72%, 12.26%, 23.42%; epoch 3-4: 31.80%, 29.84%, 17.64%; epoch 4-5: 6.14%, 5.15%, 18.04%; epoch 5-6: 13.44%, 13.83%, 19.64%; epoch 6-7: 6.92%, 7.38%, 21.07%. The expansions were validated using topographic maps and high- resolution satellite imagery (Sentinel and PlanetScope products). It was found out that results obtained from NDVI and NDWI are in agreement with the validation data.

Keywords: Mangrove, Blue Carbon Ecosystem, Google Earth Engine, Landsat, NDVI, NDWI

A WORD FREQUENCY ANALYSIS FOR LOGOGRAPHIC GEONAMES IN TAIWAN

Huang Wei-chia (1), Lay Jinn-guey (1)

[1] Department of Geography, National Taiwan University
No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan

Abstract: Place-names are special heritage that document human perception and interaction with their surrounding environment, therefore possess unique geographical and cultural meanings. The place-names of Taiwan have rich connotations due to the diversity of culture, history development and physical environment. As a result, Taiwan has accumulated abundant place- names from different periods. These place-names reflect the development of particular place and provide precious legacy for various studies, including geography, history, culture and ethnic groups. Envisioning the importance of place-names, the Ministry of Interior of Taiwan has developed the Taiwan Gazetteer, which contains nearly 170,000 records. This Taiwan Gazetteer is openly accessible to public through the "Geographic Names Information Service" (GNIS) website. In this paper, we defined 42,000 settlements (24.7% of all records) as research objects. Two types of writing system of geonames in Taiwan can be identified due to the ethic groups. In Taiwan Gazetteer, more than 90% of records are logogram geonames which are cultural heritage accumulated by Chinese and Japanese. We analyze directly the frequency of every logogram (i.e. Chinese character and Japanese Kanji) which helps us to realize the relationship between human and the environment in early stage. We found that most of logographic geonames in Taiwan are natural geographic entities mainly such as 坑 (pit or tunnel), 山 (mountain) and 埔 (plain). Some geonames reflect how people use lands such as 園 (orchard), 埤 (pond) and 溝 (drainage). A typical geonames in Taiwan is usually combined those characters with a prefix like 大埔 (big plain), 新埤 (new pond) or 桃 園 (peach orchard). We also found that it is very rare to find the most common method of naming geonames in other culture – use of names of prominent people. We hope this analysis can be extended to other countries using logographic writing system.

Keywords: logographic geonames, frequency analysis, Taiwan Gazetteer

REMOTE OBSERVATIONS OF LUNAR CRATERS USING HIGH RESOLUTION DATA

Shreekumari Patel (1), Paras Solanki (1)

[1]Department of Geology, M. G. Science Institute, Gujarat University, Ahmedabad, India.
E-mail: ipatelshree@gmail.com; parassolankimg@yahoo.com

Abstract: In this study, Lunar Reconnaissance Orbiter (LRO) Miniature Radio Frequency (Mini-RF) is used in conjunction with the other remote sensing data to characterize the physical and chemical properties of Lunar Craters. Our analysis shows various morphological features and mineralogy associated with craters. Mineralogy is derived using M3 (Moon Mineralogy Mapper). The Ohm crater have melt flows that are radar-bright and exhibits variations in CPR (Circular Polarization Ratio) and m-chi decomposition in comparison to surrounding region. The Circular Polarization Ratio of Ohm crater is high that may be due to impact melt flows, ejecta flows, and debris or boulder fields. In comparison with optical images, Schluter crater have rough and rugged surface texture. The floor of Schluter is characterized by relatively low CPR values. The morphological features such as rilles and fractures exhibit bright radar backscatter and high CPR. Compositionally, M3 data suggest that the Ohm crater is heterogeneous and dominated by High-Ca Pyroxene (HCP) rich rocks, whereas Schluter crater indicates the presence of mafic and pyroclastic minerals evident from the sample spectra collected. The multidisciplinary use of satellite data provides insight into lunar craters physical and chemical properties.

Keywords: Craters, Moon, Radar Observation, Remote sensing

POTENTIAL USE OF HIGH RESOLUTION PLEAIDES IMAGE FOR CADASTRE

Ahmad Zahrullail Safai (1), Zuraimi Suleiman (1), Shahruddin Ahmad (1), Mohd Zahir Harun (1)

Malaysia Remote Sensing Agency (MRSA),
Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC),
No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: zahrullail@remotesensing.gov.my; zuraimi@remotesensing.gov.my;
shahruddin@remotesensing.gov.my; zahir@remotesensing.gov.my

Abstract: With the advancement of space technologies, enabling earth observation system to acquire high resolution satellite image up to 0.31 meter spatial resolution which can provide more applications in various sector including cadastre. The remote sensing approach will assist especially state or district land administrative office in order to expedite the land title application such as Temporary Occupation License (TOL) especially in hilly or remote area. This paper aims to examine the accuracy of cadastre lot/parcel extracted from Pleiades high resolution image. Pleiades image is geometrically corrected with the Ground Control Points (GCP) data observed by using Global Navigation Satellite System (GNSS) and Shuttle Radar Topography Mission (SRTM-90m) DEM as an input to produce Pleiades orthorectified image. Based on 88 well distributed GCPs, rectification model is done by performing the bundle block adjustment with RMSE 0.55 meter. Total of 111 parcels/lots of building were digitized from the Pleiades orthorectified image over the Klang Valley as a study area. For the accuracy analysis, National Digital Cadastral Database (NDCDB) produced by Department of Survey and Mapping Malaysia (JUPEM) were used as a reference data. The result shows that positional accuracy (area, perimeter and position), error that less than 1 meter are 61%, 68% and 68%; error of 1-3 meter are 16%, 18% and 31%; error of 3-5 meter are 12%, 13%, 1% and error larger than 5 meter are 11%, 1%, 0% respectively.

Keywords: Pleiades; Orthorectification; Cadastre

QUANTIFYING PYLON ROUTE CORRIDOR, A REMOTE SENSING APPROACH

Thomas Mumuni Bilintoh (1)

[1] Michigan State University Department of Geography, Environment, and Spatial Sciences, USA
Geography Building 673 Auditorium Rd, Room 116 East Lansing, MI 48824
Email: bilintoh@msu.edu

Abstract: Due to funds and labour constraints, preliminary pylon line route survey has been a challenge to most electricity production firms in Ghana. To avert the above-mentioned constraints a majority of the electricity production firms often plan proposed pylon routes on aerial images from google earth by waypoint digitisation. These images then serve as guides to Geomatics Engineers on the expected contract sum. However, this usually result in problems; there is usually large disparities between what is on ground and in the contract. In this paper we rely on literature from Sohn et al., (2012) as well as Axelsson, (1999) thus using Remote Sensing and GIS to provide insight into how Land Use Land Cover (LULC) maps covering Kumasi and its environs could be used to give more reliable quantitative content to the information used as a contracting guide for pylon routes.

Keywords: pylon, land use land change, route

IDENTIFICATION OF WATER INUNDATION USING SENTINEL-1A IMAGERY (STUDY CASE: SUB-DISTRICTS OF BALEENDAH, BOJONGSOANG AND DAYEUHKOLOT, BANDUNG DISTRICT)

Bernat Simson Fernandes (1), Soni Darmawan (1)

[1] Institut Teknologi Nasional, Geodesy Engineering Department,
Faculty of Civil Engineering and Planning
Email: bernatsimson@gmail.com; soni_darmawan@yahoo.com

Abstract: The floods that hit Bandung District were caused by many factors, including sedimentation of the Citarum River, damage to the upper river of the Citarum, and others. Remote sensing technology using radar imagery has grown, especially for Sentinel-1A imagery that can be used for both flood prevention and handling purposes. The purpose of this research was to identify water inundation and non water inundation, to find out the results of identification's accuracy, and the areal of water inundation and non water inundation in 2017. The study area in three sub-districts namely Baleendah, Dayeuhkolot, and Bojongsoang located in Bandung District. The research methodology consists of data collection, one of the data was Sentinel-1A imagery. The method used to identify water inundation and non water inundation was the Change Detection Methodology and Thresholding. The results of this research were identified of water inundation and non water inundation in the study area. After that, the results were validated with rainfall data and field surveys.

Keywords: water inundation, non water inundation, remote sensing, sentinel-1A imagery, thresholding method

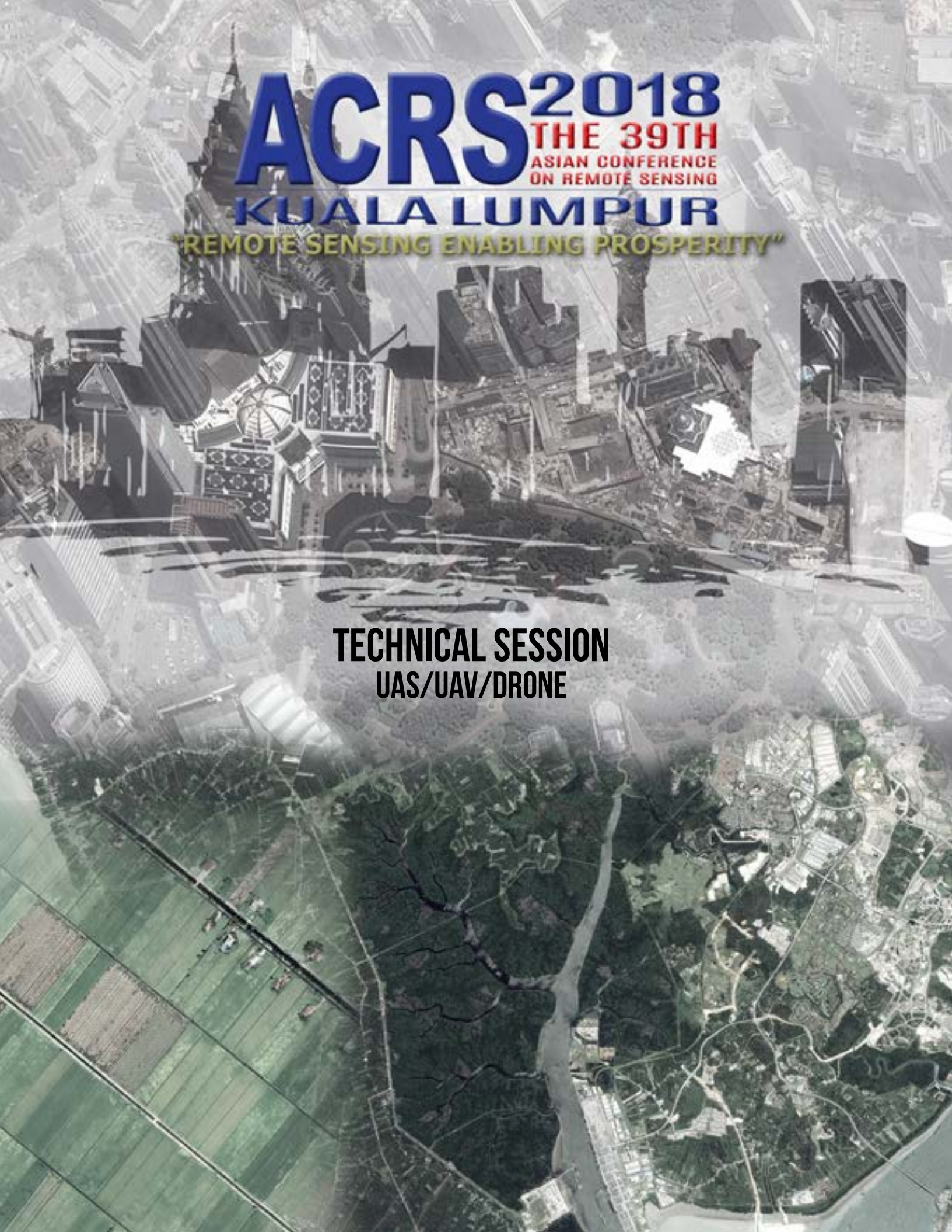
THE SPATIO TEMPORAL ANALYSIS ON THE ASSESSMENT OF LAND USE AND LAND COVER CHANGES IN HLEGU TOWNSHIP, YANGON USING SATELLITE LANDSAT DATA

Dr. Mu Mu Than (1), Dr. Khin Mar Yee (1), Dr. Kyi Lint (2), Dr. May Myat Thu (3), Chit San Ko (4)

[1] Associate Professor, Department of Geography, Dagon University
[2] Professor (Head), Department of Geography, Dagon University
[3] Professor, Department of Geography, Dagon University
[4] Student, PGD GIS, Department of Geography, Dagon University

Abstract: Land use and land cover (LULC) changes led to changes on the climate. It, in turn, changes in forest cover, cultivation crops and method, and food available. The main objectives of the study are to create land use and land cover maps based on the Normalized Difference Vegetation Index (NDVI) and to examine LULC changes in the study area. Landsat imagery was used to monitor the changes and to generate maps of LULC changes between 2007 and 2017. GIS and RS are applied for mapping of land use and land cover changes across a range of spatial and temporal scale and for assessing the extent, direction, causes and effects of the changes. The LULC changes in Hlegu Township are analysed by using supervised classification method and then modified by field verification. The result shows that Hlegu Township had undergone substantial LULC changes mainly due to the use of fuel wood, shifting cultivation and increasing agricultural areas. Within 10 years period, forests are seriously changed into other land uses. Growing population and its associated problems such as the increasing demand for residential areas play an important role in the changes. Poor institutional and socio-economic settings and also government policies such as lack of tenure security and poor infrastructure development, encroachment into reserve forest has been the other major driving forces to LULC changes.

Keywords: land use and land cover changes, Normalized Difference Vegetation Index



TECHNICAL SESSION

UAS/UAV/DRONE

STUDY ON THE RIP CURRENT GENERATION CONDITIONS USING INCIDENT WAVE INFORMATION AND CAMERA IMAGES

Taerim Kim (1), Jaehyuk Lee (1)

[1] Kunsan University, Ocean Engineering Department,
Daehakro 558, Kunsan, Jeonbuk, 54150, Korea
Email: trkim@kunsan.ac.kr; jhyuklee@gmail.com

Abstract: Despite the risk of rip current, its generation mechanism is not exactly known. Therefore, it is difficult to accurately predict the location and time of occurrences of rip current to evacuate swimmers from them. For this reason, it is not easy to execute in-situ field observation of rip currents, either. In order to understand the spatial and temporal characteristics of rip currents, many expensive instruments should be installed at the point where rip current occurs, but accurate information on rip current location and time cannot be estimated. Camera images taken on the top of building nearby the beach can be a good alternative to in-situ field measurements because they can cover wide coast continuously, and it is possible to detect the rip current of which the generation place and time are not fixed. In addition, recent development of image processing and internet technology makes it possible to operate a long term unmanned automatic video monitoring system on the beach so that rip current can be effectively observed. In this study, rip currents observed by three cameras installed in Haeundae beach located in Busan, Korea are analyzed. Each frame separated from the video movie is rectified in order to get quantified geographic information. The Haeundae beach is operating wave measurement system at offshore entrance of the beach. The time series wave information is also compared with the rip current generation time and location analyzed from camera images, in order to find the main characteristics of waves to generate rip currents.

Keywords: rip current, wave information, camera image, video monitoring system

EXPERIMENT ON UAV-BASED NON SURVEY GRADE LASER SCANNING FOR MONITORING RICE PLANT HEIGHT

Anh Thu Thi Phan (1), Naoto Odaka (2), Kazuyoshi Takahashi (2)

[1]Vietnam National University- Ho Chi Minh City University of Technology, Faculty of Civil Engineering, Department of Geomatics Engineering, 268 Ly Thuong Kiet Street., Ward 14, District 10, Ho Chi Minh City, Viet Nam
[2] Nagaoka university of Technology, Environmetal Remote Sensing Laboratory, Kamitomioka Nagaoka, Niigata 940-2188, Japan
Email: ptathu@hcmut.edu.vn; s143293@stn.nagaokaut.ac.jp; ktakaha@nagaokaut.ac.jp

Abstract: UAV systems have an advantage of collecting dataset with high temporal and spatial resolution in the comparison of traditional platforms such as satellites. In the agricultural industry, the growing crops need to observe carefully day by day. Therefore, UAV systems are considered as effective tools to collect information related to crops. In this study, the rice growth was observed by a small UAV-based laser-scanner system from above. For developing the system, DJI S800 was chosen as a platform in which a non- survey grade laser scanner HOKUYO UTM30LX-EW was mounted on. Field experiments were carried out from late June to late July 2016 in Nagaoka city, Niigata prefecture, Japan. A method for estimating rice plant height using point cloud data of rice plants based on percentile analysis was applied. As a results, rice plant heights were estimated and compared to manual measured plant heights. As a result of this comparison, the RMSE of rice plant heights was 7cm. The result shows that developed UAV system has a capability to monitor rice plant height effectively in wide areas.

Keywords: rice growth, rice plant height, laser scanner, UAV

FRACTAL ANALYSIS FOR THE MOUNDED TOMB OF HIMIKO, YAMATAI

Susumu Ogawa (1), Yukiya Taniguchi (2), Takako Sakurai, Shinzo Fukunaga

[1] Institute of Spatial Technology, Tokyo, 3-1-5, Toyo, Koto-ku, Tokyo, Japan
[2] Nagasaki University, Bunkyomachi, Nagasaki, Japan
Email: ogawa_susumu_phd@yahoo.co.jp

Abstract: The mounded tomb of Himiko was discovered at Tagawa, Fukuoka. Himeko was an emperor of Yamatai country in the 3rd century in Japan, but her details are unknown except in Sanguozhi, which described the radius of the mound was more than one hundred steps. This mound was surveyed by using UAV. The diameter of the mound measured by UAV was coincident with the previous literature. The linearity was also checked by fractal analysis. This mound should be Himiko tomb, Yamatai country. The authors showed also the location of Yamatai country where Himiko occupied.

Keywords: archaeology, infrared, NDVI, NDWI, Wei history, Yamatai

DEVELOPMENT OF HYPERSPECTRAL IMAGING SENSOR LAUNCHED FOR DRONE

Genya Saito (1)(5), Haruyuki Seki (2)(5), Kuniaki UTO (3), Yukio KOSUGI (4)(5)

[1] Graduate School of Agricultural and Life Sciences, The University of Tokyo, Room 617, Bldg.7A, Agricultural School Area, 3-1-1 Yayoi, Bunkyo-ku, Tokyo, 113-8657 Japan
[2] Faculty of Agriculture, Shizuoka University 836, Ohya, Suruga-ku, Shizuoka-Shi, Shizuoka-Ken, 422-8529, Japan
[3] School of Computing, Tokyo Institute of Technology J3-153, 4259 Nagatsuta-cho, Midori-ku, Yokohama, 226-8502, Japan
[4] Brain Functions Laboratory, Inc. No.508, Bldg 1, LVP, 75-1 Ono-machi, Tsurumi-ku, Yokohama-shi, 230-0046, Japan
[5] Department of Investigation, Deep Sensing Initiatives Co.Ltd., Room 101, 1-24-6 Jiyugaoka Meguro-ku, Tokyo, 152-0035, Japan
Email: a_genya@mail.ecc.u-tokyo.ac.jp

Abstract: The hyperspectral imaging sensor developed by this study is designed to be light weight for payload and low cost for wide use. The sensor scans an area and acquires data using optical fibers and a swing mirror. Spectral data of a target ground or sea-surface are gathered at one side of optical fibers bundle. At the other side of optical fibers bundle, the spectral data are sequentially sent to optical fibers, which connected micro-spectrometer, by the swing mirror. The swing mirror is controlled by a stepping motor and the swing speed of the mirror is variable. Maximum eight micro-spectrometers manufactured by Hamamatsu Photonics are prepared. Each micro-spectrometer is connected to an optical fiber. One micro-spectrometer is used for sky-light monitoring, and the other micro-spectrometers are used for spectral data of target earth surface. The total weight of the hyperspectral image sensor is less than 3kg. This study was conducted under the project of "Development of three-dimensional mapping system of marine macrophyte beds using hyper- and multi-spectral remote sensing from air and sea-surface" in the research area of "Establishment of core technology for the preservation and regeneration of marine biodiversity and ecosystems". This work was supported by JST CREST Grant Number JPMJCR12A2, Japan.

Keywords: Hyperspectral Imaging Sensor, Drone, Agriculture, Marine Science

COMPOSITE PHOTOGRAPH OF ROAD PAVEMENT REMOVING VEHICLES BY USING MASKING FUNCTION

Y. Nabeshima (1), S. Kusaki (2), T. Mori (2)

[1] National Institute of Technology, Akashi College, Civil Engineering, 679-3 Nishioka-Uozumi, Akashi 6748501 Hyogo, Japan
[2] MR Support Inc., 7-9 Saga-Hirosawasho, Ukyo, 6168301 Kyoto, Japan
Email: nabesima@akashi.ac.jp; mr.support@nike.eonet.ne.jp

Abstract: A masking function is a useful to remove running or parking vehicles from road pavement photographs which were automatically taken by unmanned aerial vehicles (UAV). The masking function can be also applied to remove signals and street trees from photographs. A clear pavement photograph without foreign matters can be composed from many photographs which were treated by the masking function. 3D image can be composed from photographs by using structure from motion (SfM) technique. A clear road pavement photograph and 3D image are effective and necessary for efficient road maintenance and repairs.

Keywords: Pavement, photogrammetry, structure from motion, unmanned aerial vehicles

HYRDOCARBON SEEPAGE OF OIL PALM VEGETATION USING UNMANNED AERIAL VEHICLE (UAV) MUTISPECTRAL DATA

Nur Rashidah Ibrahim (1), Hamzah Sakidin (1), Abd. Nasir Matori (2), Asmala Ahmad (3)

[1] Department of Fundamental and Applied Science, Universiti Teknologi PETRONAS (UTP), Bandar Seri Iskandar, 31750 Tronoh, Perak Darul Ridzuan, Malaysia
[2] Department of Civil and Environmental Engineering, Universiti Teknologi PETRONAS (UTP), Bandar Seri Iskandar, 31750 Tronoh, Perak Darul Ridzuan, Malaysia
[3] Department of Intelligent Computing and Analytics, Universiti Teknikal Malaysia Melaka (UTeM), Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia
Email: nurrashidahibrahim@gmail.com; hamzah.sakidin@utp.edu.my; nasrat@utp.edu.my; asmala@utem.edu.my

Abstract: The hydrocarbon seepage can lead to abnormality of land surface vegetation and soil. This seepage can change the soil environment of plant roots that affect the plant health. These abnormality can be monitored through the reflectance of the plant by using remote sensing technology effectively compared to the typical way in detecting hydrocarbon through geological surveys and seismology experiment which clearly is a long way process and even costly. This paper is to investigate the spectral measurement of oil palm tree under the influence of hydrocarbon using Unmanned Aerial Vehicle (UAV) multispectral data. The vegetation indices is use to indicate vegetation health levels in order to extract the oil and gas seepage information in oil palm tree. This paper use the widely used of vegetation indices which is known as the Normalised Difference Vegetation Index (NDVI). The NDVI is a numerical indicator which is measure the difference between the Near Infrared (NIR) and visible band to indicate the vegetation health. There are 12 tree of oil palm are selected with hydrocarbon seepage of 10 litre, 20 litre, 30 litre and 40 litre of crude oil. Other than that, there are three tree are selected as control. The reflectance spectral oil palm data were obtained from UAV multispectral sensor which content Red, Green, Blue (RGB), red egde and NIR. These spectral are use to calculate the NDVI of all selected oil palm tree for oil seepage detection. For validation and verification purpose, a number of field works will be carried out to correlate the spectral measurements obtained from ground-truth instruments which is known as spectroradiometer with spectral from UAV multispectral data. Thus, this investigation shows that the red edge were shifted to shorter wavelength.

Keywords: Hydrocarbon Seepage, UAV, Oil Palm, Multispectral Data, NIR

PRIMARY RESEARCH ON RIVERBED ROUGHNESS ANALYSIS USING UAV IMAGES TECHNIQUES

Kai Chieh Hung (1), Jen Yu Han (1)

[1] National Taiwan University, Department of Civil Engineering, No.1, Sec. 4, Roosevelt Rd., Da an Dist., Taipei City 10617, Taiwan
Email: R06521803@ntu.edu.tw

Abstract: Surface roughness is an important indicator of river morphology. It is possible to estimate the roughness of riverbeds by surveying grain size, distribution, and type. However, the current method to derive the roughness is time-consuming and less accurate. On the other hand, with the development of Unmanned Aerial Vehicle (UAV) techniques, the acquisition of high quality spatial information becomes much efficient and less pricy. In this study, digital images collected by UAV were used for estimating the grain size of riverbeds. The technique for the discrimination between grain and non-grain was proposed. Texture analysis using Gray-Level Co-Occurrence Matrix (GLCM) and image segmentation techniques were both implemented. Preliminary results show that the varied grain size at different sections in a riverbed can be identified by the proposed approach. Consequently, an efficient technique for analyzing the surface roughness and thus the morphology of a river becomes available.

Keywords: Roughness Analysis, Image Processing, Unmanned Aerial Vehicle (UAV), Gray-Level Co-Occurrence Matrix (GLCM), River Morphology

APPLICATION OF DRONES IN MONITORING OF PHYSICAL CONDITIONS OF WATER CANAL

A. A. Kulkarni (1), R. Nagarajan (1)

[1] Center of Studies in Resources Engineering, Indian Institute of Technology, Bombay, India

Abstract: Collection of rainfall, storage of water and effective utilization for agriculture and drinking without much of leakage/loss is far more pertinent than ever in the light of climate change. Construction of reservoir and open canals that could convey the water to command area is the prevalent practice. Conveyance loss between the reservoir exit gate and the end point of canal section is significant (more than 40% of delivery) and increase with the age of the system. This loss is attributed to degraded status of lined and unlined canal sections, willful human interventions, weed growth, bank failure etc. Water tight canal operation is possible only with the dynamic canal section monitoring (before, during and after water release) from control unit and immediate remedial measures in plugging the leakage. Significant quantity of water is lost from the system prior to its identification and execution of engineering solutions in the present- day management system. This study demonstrates the monitoring mechanism of irrigation of canal in spatial identification of leakage/loss and remedial measure using drones. It highlights the advantage (resolution, cost, coverage etc.) and disadvantages (fly restrictions) of existing practices (satellite, air-borne data and manual reporting), its time, economic etc. The accuracy of information derived from different sources and ground conditions and management options as dependent tool for canal management executives are discussed. Kalamwadi canal section, on Dudhganga River, tributary of Godavari River located in the Peninsular India has been taken for the demonstration of this method. Physical parameters that govern the flow rate/quantity such as growth of Vegetation/weeds on the canal bed and bank slope, Silt deposition/obstructions, Canal degradation – collapse of lining, change in cross sectional area, Cracks, Ponding, Negative Gradient etc. were identified.

Keywords:

LOW-COST UNMANNED AERIAL VEHICLE PHOTOGRAMMETRIC SURVEY AND ITS APPLICATION FOR HIGH-RESOLUTION SHORELINE CHANGES SURVEY

Faiz Arif (1), Abdul Aziz Ab Rahman (1), Khairul Nizam Abd Maulud (1)(2)

[1] Earth Observation Centre, Institute of Climate Change, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Malaysia
[2] Department of Civil and Structural Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Malaysia
Email: p93174@siswa.ukm.edu.my; p90570@siswa.ukm.edu.my; knam@ukm.edu.my

Abstract: Sea level rise is a growing concern among populations who live nearby to a low-lying beach area. The dynamics of the coastal characteristics is capable to erode the coastal profile in the shortest of time. Coastal erosion is recognized as a permanent loss of land and habitat along the shoreline resulting in changes of the coast. The shoreline is highly vulnerable to erosion and flooding that can spawn negative impact on wellbeing of human, environment and ecosystem altogether. Hence, it is important to monitor shoreline changes by identifying the rate of erosion and accretion in order to quantify the losses of land due to climate change. This research suggests the usage of DJI Phantom 3 Pro to monitor the shoreline changes physically at 10 study locations which is badly affected by sea level rise. Sub nadir aerial images were taken from the UAV and flew alongshore at above ground level of 70 m. The flight plan included several parallel flight axes with overlap percentage of the image at 60% endlap and sidelap. GCP for aerotriangulation of the images is observed at 5 different positions near to the beaches. The research was conducted for 3 months (June, September, December) in 2018 to observe the shoreline changes during different monsoon periods. The result shows apparent changes of the shoreline in the west coast of Malaysia produced at high-resolution due to the images taken by the UAV at low-altitude which allows the analysis of the shoreline changes to be intricate. In Pantai Jeram, the result of 3-months observation shows noticeable changes in erosion and accretion. The research shows that UAV is applicable in monitoring shoreline changes along the coastal region which can be useful to assist the authority in making decision on enforcing nature conservation strategy to the affected site.

Keywords: sea-level rise, coastal erosion, shoreline changes, UAV, applications

A CONCEPTUAL DESIGN OF MINI AUTONOMOUS UNDERWATER VEHICLE (AUV) FOR UNDERWATER SURVEILLANCE

Noorazlina Mohamid Salih (1), Ahmad Nasaie Bahri (1), Nordiana Jamil (1), Atzroulnizam Abu (1), Ahmad Makarimi Abdullah (1) Aminatul Hawa Yahaya (1), Mohd Shahrizan Mohd Said (2)

[1] Dataran Industri Teknologi Kejuruteraan Marin, Bandar Teknologi Maritim, Jalan Pantai Remis, 32200 Lumut, Perak, Malaysia
[2] Universiti Teknologi MARA Cawangan Perak, 32610, Seri Iskandar, Perak Darul Ridzuan, Malaysia
Email: noorazlinams@unikl.edu.my; nasaie_an@yahoo.com; ndiana@unikl.edu.my; makarimi@unikl.edu.my; atzroulnizam@unikl.edu.my; aminatulhawa@unikl.edu.my; mohds665@perak.uitm.edu.my;

Abstract: Autonomous underwater vehicle (AUV) in much more simple words are computer-controlled system operating underwater for surveillance. This conceptual design of AUV can be controlled by simple automation that is called Arduino Mega Board (AMB). This autonomous underwater vehicle can move in many ways and random based on their design and applications. They can move, drift, dive or glide from the sea surface to ocean depth controlled and operate from a far. Usually it is designed just to operate under sea level and come with basic parameters. In latest technology, they were built with more efficient design that can operate better beyond any level of the sea. Other than that, autonomous underwater vehicle allow scientist to conduct experiment to collect data elsewhere in the deep ocean and controlled it on the surface or on a ship. They usually come with sensors and camera for research purpose and can changing their mission based on data received. Autonomous underwater vehicle come with many purposes. They usually used for commercial purpose. Oil drilling and subsea drilling companies use the assistance of autonomous underwater vehicle for the purpose of checking the appropriate oceanic area to suit their business necessity. Most of AUV are designed for research and exploring purposes. Additionally, AUVs can also be used to track reefs and other life-forms that exist underwater. For additional information, military also used this autonomous underwater vehicle technology to find out whether there are any booby-traps set in the ocean bed or floor. When it comes to military usage, an AUV is the best scouting technology that can be used for underwater purposes.

Keywords: Autonomous underwater vehicle, Arduino Mega Board, Conceptual Design, sensors, scouting technology.

INVESTIGATION OF SOLAR POWER GENERATION FACILITIES USING DRONES

Youngon Oh (1), Kyoungah Choi (1), Impyeong Lee (1)

[1] University of Seoul, Department of Geoinformatics, 711 21st building 163, Seoulsiripdae-ro, Dongdaemun-gu, Seoul,Republic of Korea
Email: ohrgon@naver.com; shale8282@gmail.com; iplee@uos.ac.kr

Abstract: Recently, the importance of solar power generation has been significant, and the need for efficient management is emerging. The solar panels that make up the solar power facility suffer from a decrease in power generation efficiency when physical and chemical defects occur and the influence of the defects is transferred to surrounding panels and adversely affects the entire system. Therefore, it is very important to investigate the actual state of the solar power generation facility and detect degradation in order to prevent the defects of the solar panel in advance and raise the overall efficiency of the system. Therefore, in this paper, we will provide a multi sensor system of drones equipped with optical and thermal infrared cameras for surveying the actual condition of photovoltaic power generation facility and detecting deterioration. Photograph the solar panel of Gunja depot and Amsa water center with optical image. After that, generating and analyzing the drone ortho-image for checking the solar panel, 3D spatial data such as area and coordinates is calculated. We also discover phenomena such as hot spots, micro cracks and shadow wings through thermal infrared images and check the aging and deterioration of solar panels. We demonstrate the applicability of the drone spatial information utilization platform of solar power generation survey and deterioration detection work and establish a concrete practical application method. As a result, we investigated the possibility of application of the drone spatial information utilization platform, solar panel and actual deterioration detection application. We confirmed the requirements and restrictions to be reflected in the construction of the drone spatial information utilization platform in the future.

Keywords: solar panel, drone

AUTOMATIC DETECTION OF DEAD TREE FROM UAV IMAGERY THROUGH COMBINATION OF RANDOM FOREST AND VEGETATION INDEX

Seungmin Lee (1), Byeong-Hyeok Yu (1)(2)

[1] Sobaeksan National Park Northern Office, Korea National Park Service, 494, Namhangang-ro, Gagok-myeon, Danyang-gun, Chungcheongbuk-do, Republic of Korea
[2] Open Source Geospatial Foundation (OSGeo)
Email: leesm@knps.or.kr; bhyu@knps.or.kr

Abstract: Recently, a number of conifers dying due to climate change are being found in high altitude areas of Korean national parks. The existing tree investigation method has been judged by the human visual interpretation, however, with UAV, it is advantageous to measure large areas at once, and to construct and analyze this as spatial information. In this study, we propose a method to detect the location of wilted or dead trees in UAV orthophoto. A natural monument called Yew Trees at Sobaeksan, located in the highlands of Sobaeksan national park, was selected as an experimental area and an orthophoto image of a 2cm resolution was produced by UAV digital photogrammetry. Image segmentation and image classification were performed sequentially through object-based image analysis (OBIA): The orthophoto image was split by a large-scale mean-shift (LSMS) segmentation method, and a random forest algorithm was applied for classification. Each segment was identified as a dead tree, a living tree, a shadow, and a bare area. Because the UAV used in this study only contained an RGB sensor, the vegetation index was used as an additional feature to improve the accuracy of the dead tree detection. The normalized green-red difference index (NGRDI) applicable to the RGB sensor was chosen. All data processing was done using Free and Open Source Software for Geospatial (FOSS4G) including OpenDroneMap, OrfeoToolBox, and QGIS. Experimental results showed that the dead tree can be automatically detected from UAV imagery with a confidence level of more than 80%. We also confirmed that the combination of random forest and vegetation index can complement the limit of RGB sensor data.

Keywords: UAV, dead tree detection, object-based image analysis, random forest, vegetation index

MULTI SCALE GEOMORPHOLOGICAL MAPPING USING HIGH RESOLUTION SATELLITE IMAGERY AND UNMANNED AERIAL VEHICLE IMAGERY

Muhammad Hamid Chaudhry (1), Anuar Ahmad (1)

[1] Geoinformation Program, Faculty of Built Environment & Surveying, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
Email: hamid.gis@pu.edu.pk; anuarahmad@utm.my

Abstract: Geomorphological maps are inventories of landforms traditionally prepared through ground surveying techniques and interpreted from contour lines. The advancement in remotely sensed sensors, air-borne sensors, Digital Elevation Models (DEM), image processing techniques and spatial analysis capabilities have provided opportunities of landforms structures and evolution mapping on various temporal and spatial scales. Most recent developments in this field is the use of Unmanned Aerial Vehicle (UAV) photogrammetry technique which can be used for rapid spatial data acquisition and produces accurate result. This technique has opened new avenues for geospatial scientists to monitor evolution of geomorphological features. This research aims at comparative analysis of hydro-geomorphological features mapping through high resolution satellite images and UAV images. Since the study area is large, the fixed-wing UAV will be employed to data acquisition. Hydro-geomorphological features are always dynamic in nature even if the river has steady flow. Hydro-geomorphological features of study area will be mapped through two different spatial data sources i.e using high resolution satellite imagery and UAV imagery. The UAV imagery will be processed using ground control points (GCP)'s and accuracy assessment will be determined using check point (CP) where both GCP and CP will be established in the study area through dual frequency Real Time Kinematic (RTK) GPS receiver. This type of inventory of such hydro-geomorphological features can be used as base data for various civil engineering and natural hazard projects.

Keywords: Geomorphological Maps, DEM, UAV, GCP, RTK

MONSOON FLOOD ASSESSMENT AND MITIGATION THROUGH SATELLITE IMAGERY AND DRONE FULL MOTION VIDEO (FMV)

Muhammad Akmal Asraf Mohamad Sharom (1), Mohd Fazuwan Ahmad Fauzi (1), Syariman Samsudin (1), Mohamad Zulkhaibri Mat Azmi (1), Mohd Hakimi Abdul Rahman (1), Sabrina Shahri (1), Mohammad Azizi Fadzil (1), Rohaizi Mohd Jusoh (2)

[1] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
[2] National Disaster Management Agency (NADMA), 62502 Putrajaya, Malaysia
Email: asraf@remotesensing.gov.my; mohdfazuwan@remotesensing.gov.my; syariman@remotesensing.gov.my; zulkhaibri@remotesensing.gov.my; hakimi@remotesensing.gov.my; sabrina@remotesensing.gov.my; azizi@remotesensing.gov.my; rohaizi@nadma.gov.my

Abstract: According to Annual Disaster Statistical Review 2017 by Centre for Research on the Epidemiology of Disasters (CRED), there were 126 reported occurrence on floods that had affected 55 million people, killing 3,331 people and cause a total of US $20,300 million of economic losses in 2017. In Malaysia, monsoon flood is the most devastating natural disaster that occur between November to March for Northeast Monsoon and May to September for Southwest Monsoon. Malaysia experience serious flooding which had a negative impact on several states especially on the economy and to society in general. Flood were natural incidents that could not be avoided but the impact of the flood can be minimize by implementing flood mitigation plan. Actual flood extent and distribution of affected areas difficult to estimate and determine by using convectional flood monitoring method such as using manned aircraft which is not cost effective and too risky. However this matters can be solved by using remote sensing technology. By gaining information through satellite images and drone FMV, the causing of the aggravate flood situation can be identified. The used of radar satellite imagery and land use information, we able to extract waterbody and identify the actual flood extent. Afterwards, the generated flood extent information is overlay on optical satellite images to identify hotspot areas such as possible cause of flood/aggravate flood situation. In order to acquire more details/real time information on the flood hotspot areas, quadrotor drone with capability of FMV sensor is used. The captured FMV data is process using Tacit View software for real time and post event geographic information system (GIS) analysis. Combination of remote sensing satellite imagery and drone FMV data through GIS analysis will produce critical and useful outputs for authorities to draw up more effective and efficient flood mitigation action plan.

Keywords: Flood Mitigation, Drone Full Motion Video (FMV), Satellite Imagery Application

PRODUCTION OF LARGE SCALE TOPOGRAPHIC MAP USING FIXED-WING UNMANNED AERIAL VEHICLE

Mohd Juraidi Ahmad (1), Anuar Ahmad (1)

[1] Geoinformation Program, Faculty of Built Environment & Surveying, Universiti Teknologi Malaysia,81310, Skudai, Johor, Malaysia
Email: juraidy@gmail.com; anuarahmad@utm.my

Abstract: High spatial resolution aerial images acquired using unmanned aerial vehicle (UAV) have proven potential for diversified applications. The use of aerial photogrammetry technique can produce topographic and thematic maps in two dimensions (2D). Also three dimensional (3D) models can be generated from photogrammetry techniques using stereomodel. Photogrammetry technique can be used to generate 2D maps by fulfilling several criteria. Currently there are several softwares which utilised photogrammetry technique can be found on the market for digital image processing of images acquired from UAV. These softwares are able to provide different accuracy in producing 2D map such as Pix4D, Agisoft Photoscan, Correlator 3D and so on. This paper focuses on the use of UAV which employed photogrammetric techniques to produce large scale topographic maps (2D) at the campus of Universiti Teknologi Malaysia, Johor Bahru, Malaysia. Accuracy assessment for orthomosaic generated is investigated based on UAV images acquired at three different flight altitudes of 250m, 300m and 350 m using fixed-wing UAV. In the study, ground control point (GCP) is used for digital image processing and while the check point (CP) is used for accuracy assessment and these points were established using rapid static GPS technique. The results in term of orthomosaic does not show significant differences in accuracy at different flying altitude. The most important parameter to consider when selecting flight altitude is the spatial resolution of the required orthomosaic. The softwares used in the study are Agisoft Photoscan and AutoCAD. The results obtained from these softwares are compared with conventional surveying technique. The results show that sub-meter accuracy can be obtained from Agisoft Photoscan software. In conclusion, accurate large scale topographic map can be produced using UAV and UAV has great potential to be used for other applications.

Keywords: Unmanned Aerial Vehicle, Topographic Map, Orthomosaic, Accuracy, Photogrammetry

BUILDING A LOW COST LONG RANGE MAPPING DRONE

Sasanka L. Madawalagama (1), Hiroshi Inoue (2), Chathumal M. Weththasinghe Arachchige (1), Manzul K. Hazarika (1), Kavinda Gunasekara (1), Treshan N. Perera (3), Manuka P. Gunasekara (3)

[1] Geoinformatics Centre (GIC), Asian Institute of Technology (AIT), PO Box 04, Klong Luang, Pathumthani, Thailand
[2]National Research Institute for Earth Science and Disaster Resilience, Japan
[3] Department of Earth Resources Engineering, University of Moratuwa, Sri Lanka
Email: madawalagama@gmail.com; inoue11316@gmail.com; chathumal93@gmail.com; manzul@ait.asia; kavinda@ait.asia; treshanperera.tp@gmail.com; gunasekaramanuka@gmail.com

Abstract: Drones are becoming popular day by day along with their consumer usages as hobbyist item, photography videography and also for professional applications of mapping in the fields of surveying, agriculture, mining, structural inspection etc. When it comes to mapping, drones are proven to provide accurate and very high-resolution products at low cost compared to other traditional remote sensing or surveying techniques. Today's capable of using for small area mapping applications, which will cost below 2000 USD for the hardware. The major issue of multirotors in mapping applications is less flying time (approximately 30 mins) so it requires multiple flights and frequent change of batteries, so the effective mapping time is significantly reduced. Using fixed wing drone for mapping will solve this issue as fixed wings have high endurance. Considering the advantages of mapping with fixed wing drones, pioneering companies in geomatics industry like Sensefly, Trimble, and Leica etc. have built survey grade drones specifically for mapping purposes. These survey grade drones come reliable end to end package and with very high price tag above 10000 USD. This study is focused on building a low-cost custom made fixed wing drone for long range mapping applications under 2000 USD significantly reducing the cost for the hardware. The drone is equipped with GNSS and Pixhawk open source flight controller, which provide the capability of executing autonomous missions, improving the reliability and adding the crucial safety functions as return to home. Free-sky open source radio system is used for radio link. Propulsion system is optimized in such a way to provide the proper amount of thrust, with the airframe carrying a high-resolution camera as the payload for stable flight performance. Landing of the drone is a well-known problem for fixed wing category and it is addressed by integrating a parachute with automatic deployment. The drone was successfully tested with a 5200mah battery which made it possible to fly over 1h mapping 1km^2 area. It was concluded that it is possible to custom build a long-range mapping UAV with significantly reduced price yet resulting accurate and high-resolution map.

Keywords: Drones, Photogrammetry, Mapping

USING UAV DRONE TECHNOLOGY IN DISASTER REDUCTION IN NEPAL

Ashim Babu Shrestha (1), Sumitra Shrestha (2)

[1] Department of Mines and Geology, Ministry of Industry, Commerce and Supplies, Lainchaur, Kathmandu, Nepal
[2] Geospatial Innovation Solution (GIS) Pvt. Ltd.
Chabahil-7, Gaurighat, Kathmandu, Nepal
Email: ashimbabu@gmail.com; sumitra.shrestha77@gmail.com

Abstract: Nepal is one of the most earthquake vulnerable zones all over the world. In every 70 to 100 years there is history of mega earthquake occurring in Nepal. Nepal lies in the 11th earthquake prone country in the world. On April 25, 2015, a big devastating earthquake of 7.8 magnitudes struck in Nepal. It killed around 10,000 people, shook the lives millions and left many homeless, road block, building collapse, electrical pole broken and hospital house collapse. For emergency response UAV drone is compulsory for quick mapping of the area most affected after earthquake, activating emergency response and delivering foods, medicines for rescue operations. The main objective of this paper is to study potential use of drone in disasters so as to save the lives of human and quick response of injured human and delivery the medicine for primary treatment. From the massive earthquake April 25, 2015 lesson is learnt that UAV drones are more effective in activating quick disaster reduction and rescue operations than traditional ways.

Keywords: UAV Drone, Rescue, Reduction, Disaster, Nepal

LAND USE/LAND COVER MAPPING USING UAV TECHNOLOGY IN KILIM KARST GEOFOREST PARK, LANGKAWI, MALAYSIA

Mohd Khairul Abdullah Halim (1), Anuar Ahmad (1)

[1] Faculty of Built Environment & Surveying, University of Technology Malaysia,
81310 Johor Bahru, Johor, Malaysia
Email: mkhairulhalim@gmail.com; anuarahmad@utm.my

Abstract: Unmanned aerial vehicle (UAV) is one of the data acquisition system in remote sensing field which has great potential especially for land use/land cover (LULC) mapping due to ultra-high resolution imagery acquired at low altitude. The limitation of low spectral resolution of digital camera in UAV for LULC mapping can be reduced by incorporating texture feature and robust classifiers. Object-based nearest neighbour works by considering not only spectral properties of image but also the spatial elements such as texture, shape, geometry and size. This method has been widely used in satellite remote sensing applications, but its usage in UAV image classification has not been well documented notably in Malaysia. The objective of this study is to investigate the accuracy of object-based nearest neighbour classifier applied on UAV imagery. Training and validating samples for five LULC classes like water, urban, open area, forest and mangrove were collected by using handheld GPS and from very high resolution Pleaides 1B satellite image. Object-based nearest neighbour classification technique is applied to the UAV imagery to generate the LULC map for the study area and confusion matrix is used to evaluate the classification results obtained. It was found that object-based nearest neighbour classifier produces superior results and achieved a high degree of accuracy, which is 84.5% of overall accuracy and 0.8 of Kappa statistic. The results indicated that the commercial UAV can be useful and suitable tool for the tropical region, and this technique could reduce the cost and time of acquiring images for LULC mapping.

Keywords: UAV, land use/land cover, classification, object-based

MANUAL CONTROLLING OF UNMANNED AIRCRAFT SYATEM FOR ADMINISTRATIVE DIVISION BOUNDARIES IDENTIFICAITON

Fahrul Hidayat (1), Yulia Indri Astuty (1)

[1] Geospatial Information Agency
Jalan Raya Jakarta – Bogor KM 46, Cibinong 16911, West Java, Indonesia
Email: fahrul.hidayat@big.go.id; yulia.indri@big.go.id

Abstract: Boundary tracking is the one of administrative boundaries affirmation's steps. The purpose of boundary tracking is to identify administrative boundaries. The tracking can be done with cartometric method (based on map) or by field survey. In the implementation, both methods have advantages and disadvantages. For example, the identification of village boundaries, the cartometric method is not effective when the base maps accuracy (e.g. aerial photography, satellite images) are not available in adequate (study in Indonesia, the mapping of village boundaries using ≥1: 5000 scale). Meanwhile, field survey has several weaknesses such as inefficiency of time, effort, and cost, moreover in high topographical areas with limited accessibility. Related to the insistence of demand, the necessity of acceleration of boundary making is a challenge in survey and mapping. Technological developments become an appliance that can be utilized for those necessity. Some countries have developed and utilized of Unmanned Aircraft System (UAS) for many purposes such as survey and mapping, identification of land resources, ecosystem monitoring, the border patrol and used for natural disaster response. The objective of this research is to identify the probability of manual controlled UAS as an alternative method for administrative division boundaries identification. The research method was conducted by desk study with descriptive comparative analysis to several studies and related literature. The results of this research explain the advantages and disadvantages of UAS's manual controlling for administrative boundary identification. Technically, the conclusion of this research is manual controlled UAS can be used for administrative boundary identification because the user can see objects through birdseye view freely and real-time, however the improvisation and customization of some instruments are required on UAS in order to obtain reliability of it process.

Keywords: Administrative Division Boundary, UAS, Real-Time

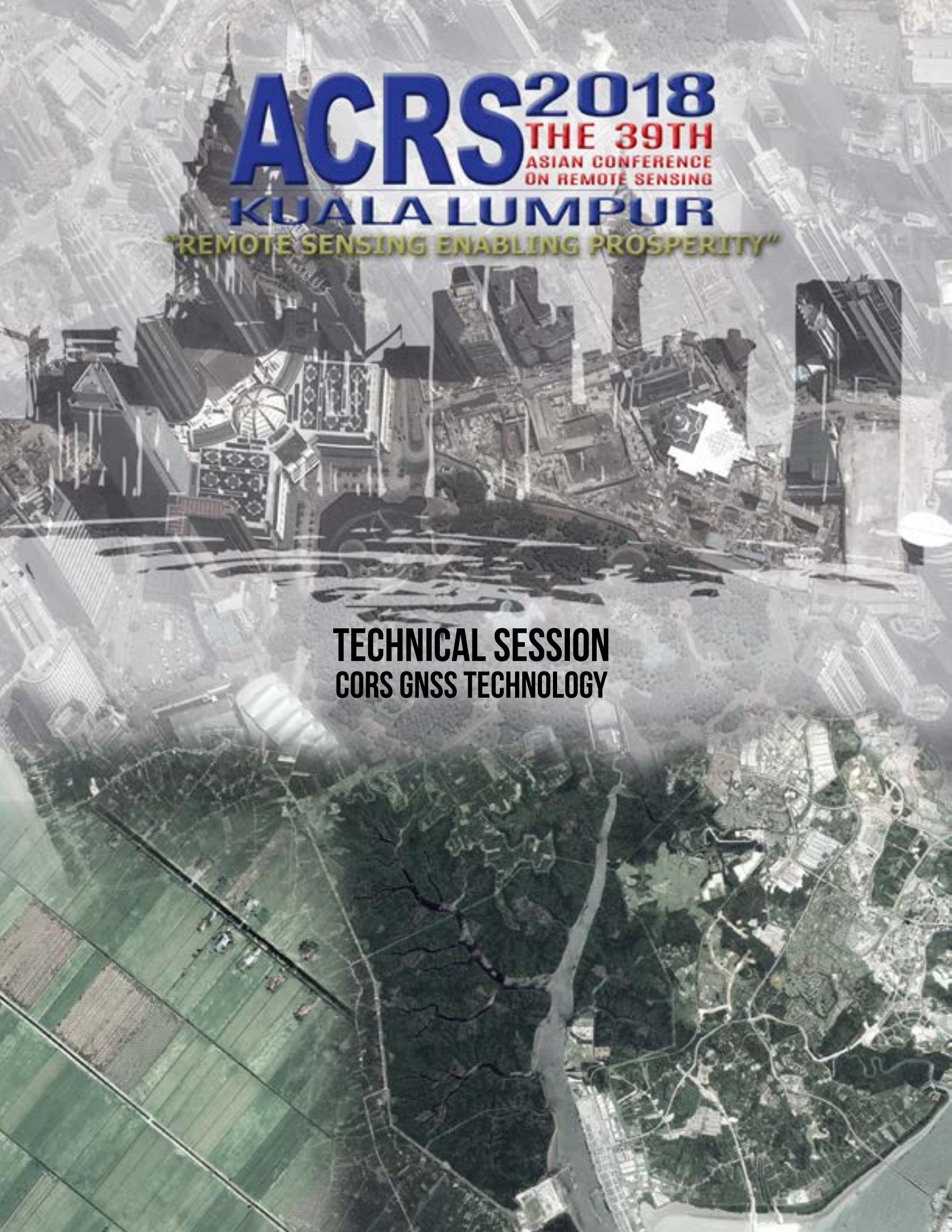
TREE SPECIES MAPPING AT ROYAL BELUM FOREST RESERVE USING UNMANNED AERIAL VEHICLE PLATFORM MULTISPECTRAL IMAGES

Amirul Syazwan Suhaimi (1), Abd Wahid Rasib (1), L.M.S Alvin (1), K.D. Kanniah (1), Nurul Hawani Idris (1), Abdul Razak Mohd Yusoff (1), Hamdan Omar (2), Azahari Faidi (2), Rozilawati Dollah (3)

[1] Tropical Map Research Group, Faculty Built Environment and Surveying, Universiti Teknologi Malaysia, 81310, Skudai, Malaysia
[2] Forestry Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia
[3] School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia, 81310, Skudai, Malaysia
Email: abdwahid@utm.my

Abstract: Mapping of tree species plays an important role in sustainable forest management and resource evaluation, as many benefits and applications inherit from this detailed up-to-date data sources. This study aims to map the tree species in tropical rainforest using Unmanned Aerial Vehicle (UAV) based on multispectral remotely sensed data. The data obtained from low cost camera was mounted on board Unmanned Aerial Vehicle. UAV was fly at average 500 m attitude and 0.05 m spatial resolution on the ground that covering of Sungai Papan experimental plot located in Royal Belum Forest Reserve, Perak. Low cost camera RGB (400650nm) and NIR (830nm) were used as the input for two group of supervised classification methods namely maximum likelihood (ML), Minimum Distance (MD) as spectral distance classification while spectral angle mapper (SAM) and Spectral Information Divergence (SID) as spectral angular distance classification. The region of interest (ROI) was drawn for each of tree species to extract the training set for maximum likelihood (ML) and Minimum Distance (MD) while spectral libraries for tree species were established to aid the spectral angle mapper and spectral information divergence classification. Overall accuracy of ML, MD, SAM and SID classification obtained was is 86.67%, 80.00%, 64.71% and 60.00% respectively. As conclusion, the spectral distance classification is suitable to use to classify tree species in tropical rainforest based on multispectral image acquired using low-cost UAV.

Keywords: Tree species, tropical rainforest, Unmanned Aerial Vehicle, Multispectral Images



TECHNICAL SESSION
CORS GNSS TECHNOLOGY

INVESTIGATIONS ON THE PERFORMANCE OF GPS RT-PPP METHOD USING TRIMBLE CENTERPOINT RTX

Yustisi A. Lumban-Gaol (1), Adnan A. Putra (1)

[1] Geospatial Information Agency Jalan Raya Jakarta-Bogor Km. 46 Cibinong 16911, Bogor, Indonesia
Email: yustisi.ardhitasari@big.go.id; adnan.aditya@big.go.id

Abstract: Real Time Precise Point Positioning (RT-PPP) is an interesting method to be studied because of its real time and precise capability. It is still not commonly used in Indonesia due to the GPS users majorly still use the Real Time Kinematic (RTK) method when the Continuously Operating Reference Station (CORS) is distributed evenly. If CORS is not reachable, then the static method become the option. The static method can produce highly accurate coordinate, but it needs more time to observe and to process than RTK. The results obtained from RTK measurements are sufficient for cm level of accuracy, but it requires internet connection availability. However, the internet networks are not available in some remote locations. Therefore, RT-PPP becomes one of the option that can be used to solve those problems, even the measurements can be done with just one receiver. However, this option needs to be assessed to see the level of accuracy obtained. In this paper, RT-PPP service from Trimble which is CenterPoint RTX is used. The aim of the paper is to study the performance of Trimble CenterPoint RTX by evaluating the root mean square (rms) value against time and comparing its results with those generated using static method. GPS static and RTX observation were done at two sample points, namely TTG.0967 and N1.1115 which located in Riau Province, Indonesia. Both methods were observed on the same time at each point. The results show that RTX measurements in TTG.0967 show instability in the first 35th minute. Meanwhile, N1.1115 took longer time to stabilize, approximately 100 minutes. Furthermore, the measurement was stable with the average rms of 2.9 cm for the horizontal and 5.1 cm for the vertical. The difference between static and RTX result for TTG.0967 was 0.02 to 6.69 cm while N1.1115 was 0.2 to 9.9 cm. These results show that Trimble CenterPoint RTX was able to produce coordinate in cm to sub-dm level of accuracy, but with long vary observation time.

Keywords: RT-PPP, static, RTK, CenterPoint RTX

THE STUDY OF USING SMART PHONE COMBINED INDOOR MAGNETIC MAP AND PEDESTRIAN DEAD RECKONING FOR INDOOR POSITIONING

Yu-Chun Chen (1), Fang-Shii Ning (1)

[1] Department of Land Economics, National Chengchi University, NO.64, Sec.2, ZhiNan Rd., Wenshan District, Taipei City 11605, Taiwan (R.O.C)
Email: 106257031@nccu.edu.tw; fsn@nccu.edu.tw

Abstract: In the past, we often needed a map to find out the destination in an unfamiliar environment. With the appearance of Global Positioning System, the outdoor positioning performance has approached perfection. However, due to the environment obstruction, the indoor signal will reduce the positioning accuracy. Therefore, indoor positioning technology has become the focus of research and development in recent years. In the history of indoor positioning technology, target positions were detected by sensors, radio signals and image or Pedestrian Dead Reckoning (PDR). All the technologies above have their own advantages and disadvantages, like costly or low accuracy. It is necessary to combine the different technologies to achieve a comprehensive consideration of cost, efficiency and accuracy. This study improved the accuracy and efficiency of indoor positioning, using the built-in magnetic function of the smart phones to collect magnetic field maps in the room and also Inertial Measurement Unit (IMU) as an aid to achieve indoor positioning.

Keywords: Indoor Positioning, Magnetic Field Map, Pedestrian Dead Reckoning (PDR)

BASIC RESEARCH ON PREVENTION OF WANDERING ACCIDENT BY USING GNSS

Kentaro Ueshima (1), Masaaki Shikada (1), Riwa Nakamoto (2), Naotake Nakayama (1)

[1] Kanazawa Institute of Technology 7-1 Ogigaoka, Nonoichi City, Ishikawa, Japan
[2] Tokiwa Hospital 4-123 Nakabayashi, Nonoichi City, Ishikawa, Japan
Email: b1363854@planet kanazawa-it.ac.jp

Abstract: As of 2018, the percentage of people over age of65 in Japan is over 25%. Since there are only a few nursing care facilities in Japan. The patient's family often has to take care of them at home. Dementia patients tend to increase as older people increase, and more and more cases of which the dementia patients become missing have been reported. The purpose of our research is to prevent accidents of patients from missing by using GNSS. In this theme we are conducting research with cooperation of local governments, doctor and family members of patients. Through the information exchange with them we got the current problems and the necessary information about the patient. Several companies in Japan are currently taking measures to prevent accidents from missing. However, such equipments recommended by those companies have several disadvantages such as high price, instability, and the risk of information leakage. In this research, we proposed to use GNSS logger as a tool to solve these disadvantages. On the hospital information from our research assisted by the doctor, wandering route tends to be different depending on individuals. Thus we are going to focus on the data of which the hospitals are profiling patients based on exercise intensity. GNSS logger can obtain information on movement trajectory and calorie consumption. On the experiments, we verified that both of these two indicators are valid to the missing dementia patients with dementia.

Keywords: GNSS, logger, Medical, Profiling

THE SECOND AND THIRD ORDER IONOSPHERIC DELAYS EFFECT ON THE GPS BASELINE VECTORS

Lao-Sheng Lin (1), Yi-Hao Yan (1)

[1] Department of Land Economics, National Chengchi University, Taipei, Taiwan
Email: lslin@nccu.edu; 105257031@nccu.edu.tw

Abstract: Ionospheric delays are one of the main error sources of the Global Positioning System (GPS). The ionospheric delays include the first-order, second-order and third-order items. Those second-order and third-order items are denoted as higher-order ionospheric delays (I_H). Supposed that L1 and L2 bands GPS data are available, the first-order item can be eliminated through ionosphere-free linear combination. However, the I_H are left. For higher precision GPS applications, such as national coordinate frame maintenance and deformation monitoring, the I_H should be taken into account. In order to study the higher-order ionospheric delays on the GPS baseline vectors, the main goals of this work include: (1) studying the relationship between the double differences of higher-order ionospheric delays of carrier phases of each baseline, and the baseline length, baseline orientation, geomagnetic latitude, season and solar activity level, etc., (2) studying the effects of the higher-order ionospheric delays on baseline vectors, both with and without considering the higher-order ionospheric delay correction. The GPS data from five satellite tracking stations in the region of Taiwan and six satellite tracking stations in the region of Asia covering the years 2009 to 2015 were used as test data. The software RINEX_HO was used to compute and correct the higher-order ionospheric delays on the GPS L1/L2 data, and the software Bernese 5.2 was used to process the GPS relative positioning. According to the test results: (1) there are several characteristics between the double differences of higher-order ionospheric delays ($\Delta\nabla I_H$) of each baseline, and the baseline length, baseline orientation, geomagnetic latitude, season and solar activity level. $\Delta\nabla I_H$ can reach 16.3mm. (2) the higher-order ionospheric delays still be influenced by season and solar activity. The higher-order ionospheric delays have positive and negative characteristics, as observation time increase, the higher-order ionospheric delays will be offset. In contrast, as observation time decrease, the ability of offset will be unstable. The effect of I_H on baseline vectors can reach 6.94mm.

Keywords: Sun Spot, Global Positioning System (GPS), Relative Positioning, Double difference, Higher-order Ionospheric Delay

PERFORMANCE EVALUATION OF VEHICLE POSITIONING SYSTEM USING MULTI-SENSOR IN GNSS BLOCKAGE AREA

Yong Lee (1), Jong Soo Park (1), Jay Hyoun Kwon (1)

[1] Department of Geoinformatics, University of Seoul, 163 Seoulsiripdaero, Dongdaemun-gu, Seoul 02504 KOREA
Email: acce00@uos.ac.kr; gngl17@uos.ac.kr; jkwon@uos.ac.kr

Abstract: Vehicle navigation systems, which rely on GNSS (Global Navigation Satellite System) signal, have limitations that it is impossible to position the vehicle in GNSS signal shaded areas such as building forests and tunnels. Due to the development of MEMS(Microelectromechanical Systems) technology, a variety of low-cost MEMS-IMU(Inertial Measurement Unit)s have been launched, and studies combining GNSS and MEMS-IMU have been actively conducted. MEMS-based IMU has an advantage in terms of the cost, but its error rapidly increases in a short time, compared with the conventional inertial sensor. To overcome this problem, additional sensors are needed to obtain more observations. Recently, vehicles equipped with ADAS (Advanced Driver Assistance System) have been released for the convenience and the safety of the driver. To run the ADAS, vehicles with various sensors, such as wheel speed sensors, yaw rate sensor and steering angle sensors, are on the market. Therefore, it is expected that the positioning performance will be improved if additional observations are utilized by using various sensors as described above. In addition, with the camera, that it will be helpful in position the vehicle through the image. In this study, GNSS, MEMS-IMU, onboard vehicle sensor, and image-based car positioning system is developed. The vehicle positioning algorithm is implemented based on an extended Kalman filter and adopts a closed loop. As the result, compared with the GNSS and MEMS-IMU combination, performance improves greatly depending on whether the wheel speed sensor is added in the GNSS signal blockage. The most stable positioning performance was confirmed when all available sensors were used.

Keywords: Vehicle Positioning, Multi-sensor Integration, Kalman Filter, GNSS Blockage

GFDPRO: A GNSS REAL-TIME KINEMATICS FIELD DATA PROCESSOR APPLICATION

Oliver L. Arriesgado (1), Danilo Joseph A. Galigao (2), Michael G. Ardaba (3), Daniel S. Mostrales (3), Alan E. Milano (3)

[1] Department of Computer Applications, School of Graduate Studies, Mindanao State University – Iligan Institute of Technology, Iligan City, Philippines
[2] Department of Forestry, College of Environmental Studies, Mindanao State University – Main Campus, Marawi City, Philippines
[3] College of Engineering, Mindanao State University – Iligan Institute of Technology, Iligan City, Philippines

Abstract: Global Navigation Satellite System (GNSS) has revolutionize geospatial positioning paradigm paving the way to a more reliable, convenient, and high precision field survey than the conventional GIS measurements. Real Time Kinematics (RTK), being a popular GNSS survey methodology allows measurements with readily readable information in fast pace, eliminating the need of data post- processing calibration and network adjustments that mainly feeds on manufacturer's software. When combined with sonar (*e.g. echo sounder equipment*), GNSS provides not only the précised points' locations but also the depth information especially when conducting bathymetric surveys. After each survey series, raw field data are extracted from the GNSS equipment set and later processed manually applying mean sea value (MSL) correction in order to produce data points output in readily usable state for further incorporation with Digital Elevation Models (DEM) processing and bathymetric burning. In cases of longer multiple raw field data outputs, such manual processing are becoming tedious and likely redundant applying similar procedures with the same survey activity type. In instances of limited communication signal, separate sonar and GNSS readings are being generated requiring distinct matches between each measurement, combined to create single usable output files. Driven by these circumstances, the study aims to develop a practical graphical user interface (GUI) offline application capable of processing single to multiple extracted raw field data from GNSS equipment in an instant. The application is purposely customized built in Python language in order to eliminate errors and to suit the needed data requirement further by DEM processors. Thus in reducing the processing period for field surveyors and validators, more time can be allocated in gathering ground-truth data, focusing on the actual field methodologies and innovations rather than incorporating much effort in the post-processing of GNSS output data.

Keywords: GNSS, RTK, Sonar, echo sounder, MSL, GUI, Python Language

DEVELOPMENT AND IMPLEMENTATION OF GNSS TECHNOLOGY AND DFMC 2ND GENERATION SBAS IN THAILAND

Piyaparn Khasuwan (1), Wasanchai Vongsantivanich (1), Supatcha Chaimatanan (1), Chalermchon Satirapod (2)

[1] Geo-Informatics and Space Technology Development Agency (Public Organization), 88 Moo 9, Thung Sukala, Siracha, Chonburi 20230 Thailand
[2] Chulalongkorn University, 254 Phayathai Road, Pathumwan, Bangkok 10330 Thailand
Email: piyaparn@gistda.or.th; wasanchaiv@gistda.or.th; supatcha@gistda.or.th; chalermchon.s@chula.ac.th

Abstract: Currently, Global Navigation Satellite System (GNSS) that is being used commonly by general users has a positioning error around five meters. This might be sufficient and satisfy general GNSS users and their applications for ordinary uses. However, for air transportation activities which requires higher standards in terms of precision, accuracy, integrity and reliability. It is crucial to have more precise positioning performance, which the current single GNSS constellation could not fulfill the standards as defined by the International Civil Aviation Organization (ICAO). In addition, Thailand is located at low-latitude where there is higher ionized particle density in the atmosphere over the region. This affects the signal from navigation satellite and induce the localizing error. In order to improve the performance and correct the errors due to these effects, the GNSS augmentation systems, i.e. Aircraft Based Augmentation Systems (ABAS), Ground Based Augmentation Systems (GBAS) and Satellite Based Augmentation Systems (SBAS) have been introduced and implemented specially for the aviation activities. This paper presents about the testing and validation of the second generation SBAS system in Thailand. The recent system makes use of the dual frequency, multi-constellation (DFMC) methodology which could be significantly improvement over the first generation, and requires less investment for the ground station infrastructures. Currently, the testbed is installed in Thailand and the process to test (including the initial results) of the DFMC 2nd generation SBAS is demonstrated in this paper.

Keywords: GNSS, Augmentation System, DFMC 2nd generation SBAS, Multi-constellation GNSS, GNSS for aviation

TECHNICAL SESSION
RADAR

RANGE AND INTENSITY DEPENDENT QUANTITATIVE PRECIPITATION ESTIMATION FROM HIGH RESOLUTION WEATHER RADAR FOR THE TROPICAL RAINFALL.

Nurulhani Roslan (1), Mohd Nadzri Md Reba (1), Achmad Syafiuddin (2), Mazlan Hashim (1)

[1] Geoscience and Digital Earth Centre (INSTeG), Research Institute for Sustainability and Environment (RISE),
[2] School of Graduate Studies, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.
Email: nadzri@utm.my; nhaniroslan@gmail.com; udenfisika@gmail.com; mazlanhashim@utm.my

Abstract: Accurate rainfall estimation from radar reflectivity is crucial in hydrological modelling and quantitative precipitation estimation (QPE). Weather radar offers more advantages than rain gauge rainfall measurement. Generally, rainfall estimation by means of radar reflectivity (Z) and rain gauge (R) is related through the empirical relationship known as Z-R model. The model is highly dependent on the rainfall types, season and geographic location. Various Z-R relationship were devised for different rainfall condition which objective to minimize bias induced from the spatial and temporal variability of rainfall. Inherent discrepancy was attributed from spatio temporal variability when comparing the areal radar with point-based rain gauge. QPE becomes more challenging in tropics because of the unique rainfall pattern and this requires a systematic Z-R modelling. This paper address QPE analysis for massive rainfall during flood in December 2014 at different intensity (low, moderate, high and extreme) and range observation by applying different z-R model using a) least square, b) quantile regression and c) non-linear optimization to estimate coefficients *a* and *b*. hourly rainfall rate and reflectivity were acquired from 60 rain gauges and Kota Bahru single polarization radar station respectively. Typical Z-R model is used in initial rainfall classification and later seven different Z-R models are applied to determine the Z-R coefficients based on rainfall class, range observation and statistical evaluation. Several iterations were made in each Z-R model and the optimum coefficients are anticipated when the higher statistical accuracy had been achieved. This study found that the least square regression is straightforward but sensitive to extreme outliers and normality assumption on the model is required. Quantile regression is robust to outliers and better when normality is violated. Non-linear optimization regression compliments both methods and the best Z-R coefficients were estimated at different rainfall classes and range during the flood. This is the primary study of QPE in Malaysia for flood event and the new *a* and *b* suggests higher precipitation (more than 100 mm/h) were observed near flood area and higher rainfall trend could be determined before the peak flood days.

Keywords: Z-R relationship, radar reflectivity, radar rainfall, optimization

SUBSIDENCE MONITORING OVER RECLAIMED AREAS IN HONG KONG USING MULTI-TEMPORAL SAR INTERFEROMETRY

Guoqiang Shi (1), Hui Lin (1)(2), Peifeng Ma (1)

[1] Institute of Space and Earth Information Science, The Chinese University of Hong Kong, Shatin, NT, Hong Kong, China.
[2] Department of Geography and Resource Management, The Chinese University of Hong Kong, Shatin, NT, Hong Kong, China
Email: guoqiang.shi@link.cuhk.edu.hk; huilin@cuhk.edu.hk; mapeifeng@cuhk.edu.hk

Abstract: As an efficient solution to space shortage, sea reclamation has contributed a considerable amount of land in Hong Kong. Induced by unconsolidated soil and penetration of sea water, uneven subsidence over these lands could pose great threats to the built infrastructures as well as underground facilities. Therefore, a periodic monitoring on such artificial fields is desperately desired from both the economic and safety perspectives. However, ground-based survey techniques can hardly support a detailed surveying task due to their operation limitations. In the past thirty years, Synthetic Aperture Radar Interferometry (InSAR) has been rapidly developed with successful applications in various areas. The space-to-earth monitoring technique brings us a new tool to remotely detect ground displacements, and offers point-wise measurements with high spatiotemporal resolutions. Usually, decorrelation phenomenon of phase signals over reclaimed lands can vary a lot according to their different stages of consolidation. For example, good coherence was obtained (regardless of some low-reflective regions) over Hong Kong International Airport (HKIA) due to its slow and near-linear subsiding behavior. On the contrast, fast subsidence rate of Disneyland in its early consolidation stage has caused large temporal decorrelation between SAR acquisitions, which often fails the single-master multi- temporal InSAR (MTInSAR) method. Based on the above, we exploited two different techniques for the two specific cases. First, a combined processing of persistent scatterers (PS) and distributed scatterers (DS) was applied to the HKIA. The introduce of DS can compensate the vulnerability of PS on low-coherence surfaces of the airport, which helps to generate much denser measurements with better spatial coverage. Second, the small baseline subsets (SBAS) was used to overcome phase decorrelation over Disneyland. By optimally grouping the SAR datasets in the spatiotemporal domain, SBAS is able to recover deformation history through a multi-master strategy for the time series analysis. Experiments were carried out using multi-platform data of C-band ASAR, X-band TerraSAR and CosmoSkyMed, with verifications from ground leveling. Subsiding zones were mainly detected in the middle of the newly reclaimed Disneyland and the north runway of the airport, respectively.

Keywords: InSAR, Reclaimed Lands, Subsidence, SBAS, DS

ASSESSMENT OF RADARSAT-2 POLARIMETRIC SAR FOR CROP DISCRIMINATION AND CLASSIFICATION

Bindi S. Dave (1), Shiv Mohan (2), Dipanwita Haldar (3), Anjana Vyas (1)

[1] Faculty of Technology, CEPT University, Ahmedabad-9, Gujarat
[2] PLANEX, Physical Research Laboratory, Ahmedabad-59, Gujarat
[3] Space Applications Centre, ISRO, Ahmedabad-15, Gujarat
Email: bindi.dave@cept.ac.in; shivmohan.isro@gmail.com; dipanwita@sac.isro.gov.in; anjanavyas@cept.ac.in

Abstract: Spatial and temporal monitoring of agricultural crop is one of the important aspects for the agricultural production estimation for India. Among the various remote sensing tools, role of polarimetric SAR is being evaluated for the assessment of its utility in providing improved information. In view of importance of polarimetric techniques, it is necessary to understand the role of polarimetric indices and decomposition techniques for improved identification and discrimination of different land cover classes. An attempt has been made to study temporal changes in polarimetric parameters and decomposition algorithm for monitoring landuse classes dominated by agricultural land using full polarimetric C-band radarsat-2 data set. Various polarimetric parameters like Radar Vegetation Index, polarimetric decomposition techniques like Freeman Durden, and Pauli Decomposition have been used to evaluate the capability of multi polarimetric and multi temporal SAR for landuse identification, discrimination and classification. Along with the above work, sub classification of RVI values and scattering behavior of the major Kharif crops and other land targets has been done. Temporal change in mean RVI value from 0.48 to 0.66 allowed to demarcate the aerial extent of agriculture/ vegetation cover. Based on the crop growth cycle during Kharif season, a very clear change in RVI value range from 0.4-0.6to 0.8-1.5 was noticed during crop growth. Cotton, Paddy and Gwar could be well discriminated based on change in RVI values with respect to their growth cycle. Freeman Durden Decomposition was found to have overall higher classification accuracy of 95%, followed by Pauli Decomposition (90%) and RVI parameter (49%). Temporally, in all cases, highest classification accuracy was obtained for three date data of July, August and September months.

Keywords: Backscattering, Radar Vegetation Index, Polarimetric parameters, Decomposition Techniques, Classification

COMPARISON OF HYBRID POLARIMETRIC DECOMPOSITION MODELS FOR SCATTERING ELEMENTS CHARACTERISATION

Pratyusha Gonnuru (1), Shashi Kumar (2)

[1] Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), United Nations, Photogrammetry and Remote Sensing Department, Dehradun 248001
[2] Indian Institute of Remote Sensing, Indian Space Research Organisation (ISRO), Dehradun 248001
Email: pratyusha963@gmail.com; shashi@iirs.gov.in

Abstract: Hybrid polarimetry is a sophisticated Synthetic Aperture Radar (SAR) technology that has opened new gateway to myriad applications in microwave remote sensing. Hybrid polarimetry has certain advantages over fully polarimetric SAR such as low signal to noise ratio, high incidence angle, self-calibration; it also covers a large area. With its circularly transmitting linear receiving feature, it becomes easier to interpret backscattered signal from a target, whose orientation is unknown with respect to the transmitted radar signal. The study focused on utilisation of RISAT-1 data obtained in FRS-1 mode for exploring the potential of different hybrid polarimetric decomposition models- m-δ, m-χ, m-α. Scattering information from different target features-river, forest and urban in Haridwar, Rishikesh and Barkot Forest in Uttarakhand, India was extracted using these decomposition models. A comparative analysis was made to provide insights into the efficiency of each decomposition model in distinguishing between the scattering elements and to determine their dominant scattering pattern. 50 points were chosen from each feature in all the three decompositions. Observations showed that urban area is sensitive to double-bounce scattering and is shown in pink/red. Surface scattering in blue was prominent in river. Dominant volume scattering was observed in Barkot forest. m-δ is more sensitive to volume scattering and was useful for retrieving scattering from forest. However, it shows slight overestimation of volume scattering when compared to m-χ and m-α. m-χ shows dominant surface scattering. Overall, enhanced scattering response from each feature can be observed in m-α when compared to m-δ, m-χ decompositions.

Keywords: RISAT-1, Hybrid polarimetry, m-δ, m-χ, m-α decomposition models

SPATIO-TEMPORAL MONITORING OF LAND SUBSIDENCE IN THE WORLD CUP LANDFILL PARK USING RADAR INTERFEROMETRY

Seong-Jae Hong (1), Won-Kyung Baek (1), Hyung-Sup Jung (1)

[1] University of Seoul 163 Seoulsiripdaero, Dongdaemun-gu, Seoul 02504 KOREA
Email: sjhong310@gmail.com; bekwkz@uos.ac.kr; hsjung@uos.ac.kr

Abstract: World Cup park was developed on landfill. Because landfill subsides over the long term, subsidence has to be estimated periodically. Recently, some study group observed its subsidence using TerraSAR-X and ALOS PALSAR-1 data. They suggested that the coherence of landfill park is largely dependent on the temporal baseline rather than a wavelength of a radar signal. These results are meaningful since they provided the effective approach to measure time-series deformation on the landfill parks. However, additional quantitative study for the various perpendicular and temporal baselines should be performed. In this study, we performed the study about "The feasibility of measuring land subsidence on landfill park using multi-temporal SAR Interferometry". For this, we added C-band Sentinel-1 data to the previous study. We acquired 3 years of images for each band and conducted quantitative analysis about temporal baseline and perpendicular baseline using coherence maps. Besides, we analyzed about seasonal factors for all bands. Based on the coherence analysis results, we selected proper interferometric pairs to apply multi-temporal SAR interferometry. Small baseline subset was employed in consideration of the area where mostly covered by vegetation. This study would contribute to enhance efficiency of the long-term subsidence monitoring on the landfill.

Keywords: SAR, SAR Interferometry, Small Baseline Subset, Landfill, Surface subsidence

RAINFALL CHARACTERIZATION IN KLANG VALLEY USING IMAGING AND NON-IMAGING DATA

Arnis Asmat (1)(2), Nurainshafika Sahak (1), Nur Atiqah Hazali (2)

[1] School of Chemistry and Environmental Studies. Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam Selangor
[2] Climate Change & Carbon Footprint Research Group Universiti Teknologi MARA (UiTM), 40450, Shah Alam, Selangor, Malaysia
Email: arnisasmat@gmail.com; nurainshafikasahak06@gmail.com; atiqahazali92@gmail.com

Abstract: Precipitation during a year of period in April 2007–March 2018 over the Klang Valley, Malaysia was studied for rainfall characterization of rainfall regime. Rainfall properties from ground with five-minutes interval and radar image were analyzed. The study investigates the pattern of rainfall properties; temporal and cumulative distribution of rain rates, and their contribution to the total rainfall. The separation of rainfall event to convective and stratiform type based on 35 mm/hr thresholds for the 5-minute interval. The spatial distribution of rainfall intensity from ground data (rain gauge) and radar image are compared. Results show in a year observation of the rainfall pattern in Klang Valley can be categorized as mainly stratiform with none of the data available has indicated as a convective rain. The result further shows about 68% rainfall event mostly occurred in the afternoon. There are 1862 short rainfall events, which classifies as stratiform and June has recorded as the highest mean values (26.1 mm). Meanwhile, comparison analysis from ground and radar has produced the marked difference in the reading of intensity. This indicated that rainfall intensity in radar image underestimates intensity from rain gauge. The study concludes that rainfall characterization is important to clearly demarcate both rainfall types and pattern which leads to extreme precipitation in study area. This also can be achieved by optimizing combined remote sensing data and ground measurement data.

Keywords: Rainfall characterization, rainfall type, radar rainfall, remote sensing, Klang Valley

INSAR ISBAS AND GPS MONITORING OF PROGRESSIVE LAND SUBSIDENCE IN PEKALONGAN, INDONESIA

Arif Aditiya (1), Andrew Sowter (2), Fifik Syaifudin (1), Joni Efendi (1), Akhmad Yulianto (1), Munawar Kholil (1), Marsono Julianto (1)

[1] Geospatial Information Authority of Indonesia, Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Bogor Indonesia
[2] Geomatic Ventures, Ltd Nottingham Geospatial Building, Triumph Road, Nottingham, NG7 2TU, United Kingdom
Email: arif.aditiya@big.go.id

Abstract: The area of Pekalongan, a small city located in Northern part of Java island, is subject to land subsidence. In term of monitor the temporal evolution of the subsidence, the intermittent small baseline subset (ISBAS) technique is used for interferometric synthetic aperture radar (InSAR) time-series analysis. To limit the spatial and temporal decorrelation phenomena, the interferograms produced from the raw Sentinel-1 SAR data from October 2014 to March 2018 are characterized by small spatial and temporal baselines. The average line of sight (LOS) of deformation velocity map computed from the time-series analysis demonstrates a considerable subsidence rate of up to 8-10 cm yr^{-1}. Meanwhile continuous GPS measurement shows the average subsidence up to 10 cm yr^{-1}. Through the comparison of the results of InSAR technique and the GPS result, it is shown that InSAR result deal with GPS technique that can be used to effectively monitor the land subsidence caused by nor human made or natural factors. Moreover, further investigation such validated by groundwater extraction in many wells, density of temporay GPS sites are needed to more accurately obtain subsidence rate at specific area. This result can be used to enhance urban policy in term of law enforcement of groundwater use. A continuation of high rates of subsidence is likely to put much of the densely populated coastal areas will subject to flood and environmental damage within near few years.

Keywords: Pekalongan, Subsidence, InSAR, ISBAS, GPS

SPACE-BORNE SYNTHETIC APERTURE RADAR (SAR) SENSORS IN LOW EARTH ORBIT FOR REAL-TIME DETECTION, MONITORING OF FLOODS AND DISASTER MANAGEMENT

Dr. Arun Kumar Verma (1), Dr. Ranbir Nandan (2), Ms Aditi Verma (3)

[1] Director, Vidyadaan Institute of Technology and Management, Aryabhatta Knowledge University, Dumraon-802119, Bihar, India
[2] Associate Professor and Member (Bihar Legislative Council), Geology Department, B.N. College, Patna University, Patna-800020, Bihar, India
[3] Engineer, Qualcomm India Pvt. LTD, Raheja Mindspace IT Park, Madhapur, Hyderabad500081, Telangana, India, Hyderabad - 800020, Andhra Pradesh, India
Email: arun@vidyadaan.org; nandanrranbir@gmail.com; aditiverma004@gmail.com

Abstract: Earth Observation System (EOS) consists of optical or microwave sensors on spaceborne system in the Lower Earth Orbit (LEO) and provides crucial information for effective flood disaster management by supporting decision makers or emergency response organization in their activities during time critical crisis response phase of natural disaster. It is well known that the applications of satellite images of multi-spectral sensors in optical spectrum is not suitable for detection and monitoring of flood during rainy season and clouds in the sky due to non-penetrating capability of signals restricting its applications during clear sky condition. The other limitation of multi-spectral sensors in optical spectrum is its acquisition of satellite imageries during day time only. Synthetic Aperture Radar (SAR) Sensor is the preferred tool for flood detection and mapping from space due to continuous observation of earth surface from the polar orbit, where SAR sensors provides its own source of illumination and characterized by near all-weather / day- night imaging capability independent of atmospheric conditions in the microwave spectrum. Open water surface areas during flooding period in rivers behave like flat water surface for radar bands in microwave spectrum and acts as specular reflector responsible for scattering of radar signals incident from space borne SAR sensors resulting into dark pixels in the radar image in contrast to non-flooding area of earth surface. One of the major advantages of SAR images is its characteristic to generate high contrast between surfaces such as soil and water due to very low backscattering coefficient of radar signals from water bodies acting as a mirror reflecting surface. Further, earth surface gives higher backscattering coefficient due to surface roughness, soil characteristics and vegetation pattern, which results into enhanced brightness in the SAR image due to increased radar reflectivity of the surface. Therefore, the study of multi-temporal SAR images before and during the different phases of flooding provides the mapping of flooded areas with high degree of precision. The change detection techniques using multi-temporal SAR images based on the behaviour of backscattered signals for threshold value for detecting the flood based on variation of backscatter signals between non-flooding and flooding period, and provide information related the status of water surface of river system, an overflow stream and the flooding of the surrounding area. The flood areas appear darker in SAR images and therefore, the comparison of multi-temporal and multi-frequency time series analysis of SAR images before and during the flooding period provides the mapping of flooded areas with high degree of precision. The development in the space borne synthetic aperture radar (SAR) technology and imaging techniques to reduce the repeat pass period from 35 days during first generation SAR system to few days in third generation using multi- SAR sensor in Low Earth Orbit (LEO) makes its suitable for real time monitoring and mapping of earth surface for river basins and flood management. Recently, radar sensor has received interest in the development

of space-borne bi-static and multi-static SAR due its potential to reduce the revisit (repeat orbit) time for monitoring the changes on the earth surface and different radar missions depending upon the repeat orbit and SAR payloads on satellite. Space-borne SAR payloads can be placed in the orbit into fully active or semi-active configuration based on both transmits and receives capability of signals. In this paper, the concept of the bi-static and multi- static spaceborne SAR sensors has been described for development of real time space-borne SAR surveillance system for monitoring of various characteristics of river basins and detection of flood using threshold / change detection techniques. Further, the concept for the development of constellation of multi-static micro SAR satellite imaging receiver in low earth orbit and geostationary radar illuminating system have been described for real time surveillance of flood detection and management of flood management. The concept of geostationary radar illuminator and constellation of multi-static SAR receiver on micro or nano-satellites in LEO has been described for real time system for flood detection, monitoring and disaster management.

Keywords: Space-borne Synthetic Aperture Radar (SAR); Radar Backscattering Coefficient; Detection and Monitoring of Flood; Disaster Management; Bi-Static and Multi-Static SAR Sensors

MAPPING MAJOR CROP TYPES AT FIELD LEVEL IN SOUTHERN AND NORTHEASTERN CHINA BY FUSING SAR AND OPTICAL DATA

Xiaoman Huang (1)

[1] Twenty First Century Aerospace Technology (Asia) Pte. Ltd., 61 Science Park Road, #05-17, The Galen, Singapore Science Park II, Singapore 117525
Email: huangxm@21at.sg

Abstract: Timely and accurate identification of crop type at field level is crucial to state and local governments, as well as agricultural, food, and insurance industries. High temporal frequency observations are often required to distinguish between various crop types. This type of data is often available from coarse spatial resolution instruments such as the Moderate Resolution Imaging Spectroradiometer (MODIS) (250-500m) and medium spatial resolution instruments such as the Landsat series (30m), but with many applications finer spatial details are desired. With the launch of European Space Agency (ESA)'s Sentinel series, higher spatial resolution data (10m) at high temporal frequency provide new opportunities for agricultural applications. To improve available regional information and methods, we fuse high temporal resolution radar and optical observations from the Sentinel-1 C-band Synthetic Aperture Radar (SAR) instrument and Sentinel-2 Multispectral Instrument (MSI) for mapping major crop types (corn, soybean, and rice) in Southern and North eastern China. To accomplish this, we construct Sentinel-1 and Sentinel-2 growing season time series data sets, and compare state-of-the-art supervised classification algorithms including Random Forest (RF) and Support Vector Machine (SVM) for crop type classification. Separate models will be built for Southern and North eastern China to account for difference in crop phenology. Different set of inputs including SAR only, optical only, and SAR and optical combined will be assessed to determine the most suitable for each region. Additionally, the crop type information generated using the Sentinel fusion approach will be migrated to field/patch level, which in turn will be obtained from higher spatial resolution (1-4m) optical data from the TripleSat Constellation.

Keywords: Crop type, Data fusion, Multi-temporal, Classification, Sentinel

SPATIO-TEMPORAL VARIATION OF SURFACE MELTING OVER GREENLAND ICE SHEET USING BRIGHTNESS TEMPERATURE, SCATSAT-1 DATA-2017

Pooja Mishra (1), Naveen Tripathi (2), Sandeep R. Oza (2), R.D Shah (1), I.M. Bahuguna (2)

[1] M.G Science Institute, Ahmedabad
[2] Space Applications Centre (ISRO), Ahmedabad
Email: Pooja.6401@gamial.com; sandipoza@sac.isro.gov.in; rdshahmg@yahoo.com; imbahuguna@sac.isro.gov.in

Abstract: Surface melting over Greenland Ice sheet is very important indicator for Arctic climate changes and also responsible for sea level rise. The brightness temperature data collected from Ku band scatterometer (SCATSAT-1) product is used to illustrate spatial and temporal variability of surface melting over Greenland Ice sheet (2017). The highly sensitive data received from the Ku band sensor helps to find daily accumulated snow and ice by volume scattering. The simple algorithm is developed for deriving daily surface melt using mean of winter months and daily data of summer 2017. The melt pattern found from this algorithm shows major melt areas at south eastern and south western parts. This area lie in percolation zone and hence increased in the intensity of scattering is also observed here. We validated the same melt patterns with melt derived from multiple data on NSIDC site (2017).

Keywords: Ku band, brightness temperature, SCATSAT-1, Scatterometer

MAPPING OF OIL PALM PLANTATION BASED ON THEIR AGE BY USING SENTINEL -1

Ita Carolita (1), Dede Dirgahayu (1), Soni Darmawan (2), Dhimas Wiratmoko (3), Tatik Kartika (1)

[1] Remote Sensing Application Centre, LAPAN
[2] Faculty of Civil Engineering, ITENAS
[3] Indonesian Oil Palm Research Institute
E-mail: ita.carolita@yahoo.com

Abstract: The results of the PPKS study showed that productivity of oil palm increase from 4 years to the age of about 13 years, and then decrease. Therefore, mapping of oil palm based on age will be useful to know the national production of palm oil. Remote Sensing is one of powerful technique to do this mapping. The presence of cloud problems that are often encountered in optical satellite data in tropical areas, causing the need for SAR (Synthetic Apterture Radar) satellite data in oil palm mapping. This study aims to develop a method for mapping oil palm plantations based on their age using SENTINEL satellite data 1. The study area is Labuhan Batu district, North Sumatra. The analysis was done by converting SAR data into back scatter, then texture analysis, land use classification and palm oil plantation were used. Furthermore, by using field data in the form of data of the age of oil palm plants, conducted regression analysis to determine the relationship between age and value back scatter. The results show that the oil palm growth model forms a logarithmic curve, with the best equation obtained with a R2 value of 0.75 in HV polarization. This equation then was used to create the map of oil palm plantation based on their age.

Keywords: SENTINEL 1, Texture Analysis, SAR

RADAR IMAGER FOR MARS' SUBSURFACE EXPERIMENT: A HIGH RESOLUTION GROUND PENETRATING RADAR FOR MARS

Md. Shahid Iqbal Ansari (1) and Anul Haq (2)

[1] Junior Research Fellow, NIIT University, Neemrana, Rajasthan, India 301705
[2] Associate Professor, NIIT University, Neemrana, Rajasthan, India 301705
Email: shahid.iqbal@st.nituniversity.in; Anul.haq@niituniversity.in

Abstract: Sending rovers on Mars has always been prolific for the future mission planning. Also, space based remote sensing lead to the selection of suitable landing sites and Mars Reconnaissance Orbiter (MRO) mission's results came out clean on it. Hydrated minerals detection by Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) and mid-latitude subsurface ice detection by SHAllow RADar (SHARAD) reveals the mystery of fluvial flow structures. SHARAD has been able to detect subsurface ice and it helps geophysicists to understand polar ice cap stratigraphy somehow in low vertical resolution of 15m in free space as compared to Ground Penetrating Radar (GPR) but with greater penetration power up to 2 km in ice. On the other hand, Recurring Slope Linea (RSL) detection near hydrated minerals bearing area brought up the scenario of liquid brine/water flow on the steep slopes in the warm Martian season and fades up seasonally that has always been a hypothetical topic which demanded the sensor 'Radar Imager for Mars' subsurFAce eXperiment (RIMFAX)' onboard Mars 2020 Rover that has the potential to detect buried layers, ice regolith and possible RSL feeding aquifers at 14.2 cm vertical resolution in free space and 10 cm along the rover track.

Keywords: RIMFAX, SHARAD, spectrometer, regolith.

DAMAGE ANALYSIS OF LANDSLIDES AND BRIDGES IN MINAMI-ASO VILLAGE DUE TO 2016 KUMAMOTO EARTHQUAKE USING FULL-POLARIMETRIC AIRBORNE SAR IMAGES

Ryoto Tanabe (1), Fumio Yamazaki (1), Wen Liu (1)

[1] Department of Urban Environment Systems, Graduate School of Engineering, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba, 263-8522, Japan
Email: acxa2152@chiba-u.jp; fumio.yamazaki@faculty.chiba-u.jp; wen.liu@chiba-u.jp

Abstract: To grasp damage situation soon after an earthquake occurrence is an important issue for recovery and relief activities. Synthetic Aperture Radar (SAR) sensors are suitable for collecting information in emergency response since they are not affected by weather and sunlight conditions. Comparing to satellite sensors, airborne sensors can obtain more high-resolution SAR imagery. After the Mw 6.2 and Mw 7.0 Kumamoto earthquakes on April 14 and 16, 2016, 83 of 478 bridges were damaged and around 200 landslides were occurred by the earthquakes. In this study, we set the target area in Minami-Aso village, which was suffered from huge damage of landslides. Landslide areas, damaged bridges were investigated using the pre- and post-event Pi-SAR-X2 airborne SAR images. The pre-event image was taken on December 5, 2015, and the post-event one was taken on April 17, 2016. Although two images were taken in the different paths, the differences of the heading angle are only 1 degree. Thus, the two images could be compared directly. First, the full-polarimatic images were decomposed to four scattering components. The differences on backscattering intensity of each polarization and each scattering component were calculated from the pre- and post-event images. Comparing with the result of visual interpretation, most of the landslides were extracted accurately and the surface scattering component was most suitable for the extraction. To detect the damaged bridges, the bridge regions were created manually according to the pre-event GIS data and aerial optical images. The percentage of each scattering component to the total power were calculated within the bridge region. Although it was difficult to estimate the damage levels of bridges, collapsed bridges could be extracted using the pre- and post-event airborne SAR images.

Keywords: Pi-SAR-X2, Airborne SAR, Landslide, Bridge Damage, Full-Polarimetry

SYNERGY OF L AND C BAND RADAR DATA FOR ESTIMATING ABOVEGROUND BIOMASS OF OIL PALM IN PENINSULAR MALAYSIA

Nazarin Ezzaty Mohd Najib (1), Kasturi Devi Kanniah (1)(2), Arthur Philip Cracknell (3), Le Yu (4), Nordiana Abd Aziz (5)

[1] Faculty of Geoinformation and Real Estate Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor
[2] Centre for Environmental Sustainability and Water Security (IPASA), Research Institute for Sustainable Environment (RISE),Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor
[3] School of Science and Engineering, University of Dundee, Dundee, UK
[4] Ministry of Education Key Laboratory for Earth System Modelling, Centre for Earth System Science, Tsinghua University, Beijing,China
[5] Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
Email: nazarinnajib@gmail.com; kasturi@utm.my; apcracknell774787@yahoo.co.uk; leyu@tsinghua.edu.cn; diana2share@gmail.com

Abstract: Oil palm above ground biomass (AGB) plays an important role in assessing the carbon footprint of oil palm industry and impact on climate change. Nevertheless, only limited studies have reported the potential carbon storage of oil palm. Although remote sensing is now used for AGB mapping, however previous techniques found difficulties in estimating oil palm AGB due to saturation of satellite signal at high AGB. Therefore, this study has been carried out to estimate oil palm AGB in Peninsular Malaysia using ALOS PALSAR and SENTINEL 1A radar data. The L-band HH and HV polarization (ALOS PALSAR) and C-band VH and VV polarizations (SENTINEL 1A) were used to estimate the oil palm AGB. The L-band data is important to obtain oil palm trunk biomass while, C-band data used for canopy biomass. Both radar images were preprocessed before different combinations i.e sum, difference, ratio and multiplication of polarizations were attempted on images for Gray Level Co-Occurrence Matrix (GLCM) texture measures to find the best data for the AGB estimation. Biometric data such as diameter at breast height, age and coordinate of oil palm trees were collected in Johor (Genting plantation in Kulai). These data were used to estimate AGB using the allometric equations proposed by Syahrinudin (2005), Henson (2003) and Corley and Tinker (2003). The AGB was correlated with backscatter of the radar data. Preliminary results showed AGB estimated by Syahrinudin allometric equation correlated well with HH polarization backscatter ($r2 = 0.6$). The AGB increased rapidly between 3 and 10 years old, but showed not much increase after 10 years old. After the age of 20 years, the AGB was started to decrease. Future study will upscale the AGB to a plantation scale to obtain total AGB.

Keywords: Oil Palm, Biomass, Remote Sensing, Peninsular Malaysia and ALOS PALSAR 2

ANALYSIS OF BACKSCATTERING CHARACTERISTICS OF BUILDINGS FROMAIRBORNE FULL-POLARIMETRIC SAR IMAGES

Bellanie Lapian (1), Fumio Yamazaki (1), WenLiu (1)

[1]Department of Urban EnvironmentSystem, Chiba University,
1-33 Yayoi-cho, Inage-ku, Chiba,Japan263-8522
Email: b.lapian@chiba-u.jp; fumio.yamazaki@faculty.chiba-u.jp; wen.liu@chiba-u.jp

Abstract: Synthetic Aperture Radar (SAR) sensors transmit radio waves by itself and observe the backscattering from the ground surface. Thus, they are hardly affected by weather conditions. Recentlythe Polarimetric and Interferometric Synthetic Aperture Radar 2 (Pi-SAR2),one of airborne SAR systems,has beenactively developed to capture high resolution images with full polarizations. Owing to its adjustable observation route, it is suitable for grasping the damage situationdue to natural disasters. As a preliminary study of damage detection, this study attempts to grasp the backscattering characteristics of buildings from Pi-SAR-X2 images. Three image sets of central Tokyo, Japan, taken on 11th November 2017 (data A), 22nd December 2009 (data B) and 5th December 2011 (data C) were used in this study to estimate the relationship of the backscattering conditions and the illuminate angle. The target building outlines were downloaded from the fundamental geospatial data by the Geospatial Information Authority, Japan(GSI). Then the layover regions were created according to the building outlines and the heights.The backscattering intensity of the original polarizations (HH/HV/VH/VV), and the scattering components after the decompositionwere calculated. In addition, the ratio of each scatterings to the total power and each polarizations were obtained to compare with the illumination angles.As the results, the scattering of HH and VV polarizations increase when the illuminationangle closeto 90°, whereas HV polarization increase as the illuminationangle close to 45°. Similarly, the ratio of double-bounce scattering tends to increase as the illuminationangle close to 90°, whereas the ratio of volume scattering is higher as the illuminationangle close to 45°.

Keywords: PI-SAR-X2, backscattering characteristic, full-polarimetry, airborne SAR

EXTRACTION METHODS FOR SAR IMAGERY: A REVIEW FOR ROAD FEATURES

Pooja Shah (1), Parul R. Patel (2), Hemang Dalwadi (3)

[1] Junior Research Fellow, Civil Engineering Dept, School of Engineering, Institute of Technology, Nirma University, Ahmedabad, Gujarat, India – 382 481
[2] Professor, Civil Engineering Dept, School of Engineering, Institute of Technology, Nirma University, Ahmedabad, Gujarat, India – 382 481
[3] Assistant Professor, Civil Engineering Dept, School of Engineering, Institute of Technology, Nirma University, Ahmedabad, Gujarat, India – 382 481
Email: poojabshah2512@gmail.com

Abstract: SAR datasets provides an abundance of information as it has high penetration capacity. Various techniques for feature extraction has been developed rapidly in the recent times. Linear Features such as roads, canal, pipeline etc. plays a major role in city planning and development. The incessant development of roads in recent times has raised the amount of labour and finance required for maintenance of roads. Information from SAR imagery such as intensity, phase, backscattering, polarization, etc. is used to identify features depending upon its incidence angle and dielectric constant. SAR has a requirement of pre-processing of data before extraction of any useful information. This paper summarizes multiple methods for Road Feature Extraction such as Markov random field (MRF), Bayesian Tracking Framework using particle filter method, Multiple Views of imagery with different flight direction, Deeply Convolution Neural Network using Binary Segmentation and Regression, Various Transformation and Segmentation techniques etc. Various datasets required to process above extraction techniques and its application has also been reviewed. Comparison of various models with its advantages and disadvantages has also been performed. As, a single feature extraction technique will not give satisfactory result so clubbing of different methods can be done based on its characteristic and need. This can be beneficiary to users who are interested in road network and its analysis.

Keywords: SAR, Feature extraction, Polarization, Road

ESTIMATION OF MICROWAVE LAND SURFACE EMISSIVITY OVER EAST ASIA

Nozomu HIrose (1), Kenji Taniguchi (2), Ichiro Kaihotsu (3)

[1] National Institute of Technology, Matsue College,14-4, Nishi-Ikuma-cho, Matsue, 6908518 Shimane, Japan
[2] Faculty of Environmental design, Kanazawa University Kakuma-cho, Kanazawa, 9201192 Ishikawa, Japan
[3] Graduate School of Integrated Arts and Sciences, Hiroshima University 1-7-1 Kagamiyama, Higashi-Hiroshima City Hiroshima, Japan 739-8521
Email: nhirose@matsu-ct.jp; taniguti@se.kanazawa-u.ac.jp

Abstract: T Estimation of the land surface emissivity is crucial to evaluate the boundary conditions of atmospheric modeling data assimilation. We investigate the characteristics of land surface emissivity derived from SSM/I, AMSR-E and AMSR2 over Asia and the relationship between land surface emissivity and land hydrological variables based on satellite data sets and numerical models.

Keywords: Microwave Land Surface Emissivity, CRTM, CMEM, Japan, Mongolia

MULTICHANNEL MAP HEIGHT ESTIMATOR ALGORITHM FOR SEA SURFACE CURRENT SIMULATION FROM ALONG TRACK INTERFEROMETRY

Maged Marghany (1)

[1] School of Humanities, Geography Section, Universiti Sains Malaysia,
11800 USM Penang, Malaysia
Email: magedupm@hotmail.com

Abstract: This work has revealed a method for regaining sea surface flow using such high-resolution satellite data of TanDEM SAR-X. Along track interferometry (ATI) technique is implemented to retrieve sea surface current movement. To this end, multichannel MAP height estimator algorithm is used to model sea level variation. Then the inverse algorithm is used which based on the Doppler Frequency model to retrieve sea surface current. The results reveal that the sea surface flow pattern is dominated by low velocity of less than 0.3 m/s which corresponding to lower sea level variation of 0.4 m. The study confirms that multichannel MAP height estimator algorithm is proficient to regain the sea surface flow rate from ATI TanDEM-X with an extraordinary precision of ±0.09 m/s. In conclusion, the approximation algorithm of multichannel MAP height conceivably can be a tremendous practice for repossessing sea surface flow pattern and sea level fluctuations from ATI TanDEM-X satellite data.

Keywords: TanDEM SAR-X, Along track interferometry, Doppler Frequency, multichannel MAP height, current movements

LANDSLIDE DETECTION USING SENTINEL-1 SAR IMAGERY IN PACITAN, EAST JAVA INDONESIA

Mohammad Daman Huri (1), Gilbert Chiang (1),

[1] Center for Space and Remote Sensing Research, National Central University, Taiwan
Email: m.damanhuri@g.ncu.edu.tw; gilbert@csrsr.ncu.edu.tw

Abstract: The National Disaster Management Agency of Indonesia (2016) recorded 2,425 incidents of land movement disaster during 2011 to 2015, with locations occurring in various parts of Indonesia. Most land movement events are found in the Provinces of Central Java, West Java, East Java, West Sumatra and East Kalimantan. In the South Coast of Java Island, Pacitan where located in East Java is one of the most heavily damaged area during the tropical cyclones called Cempaka from 27 to 30 November 2017. Besides, a large number of landslide events were also reported in the hilly areas and damaged houses and people. For landslide detection, satellite data is effective to be applied for larger area with economic cost. Among many kinds of satellite resources, synthetic aperture radar (SAR) has less limitation operating in cloudy conditions, which is considered a very useful characteristic for landslide rapid mapping during or right after a cyclone event. In this study, freely available Sentinel-1 SAR data was applied to detect landslide induces by Cempaka in Pacitan, East Java, Indonesia. The Sentinel-1 SAR data before and after Cempaka event were processed for radiometric correction, geometric correction, and noise removal. Then, intensity images before and after the landslide event were used to calculate Normalized Sigma-naught Index (NDSI) for detecting land surface change. Landslides were identified with analyzing the texture of NDSI images using gray level cooccurrence matrices (GLCM). The result will be worthwhile for risk assessment and mitigation planning in Pacitan while in emergency cycle of natural disasters.

Keywords: Landslide Detection, Sentinel-1, NDSI, GLCM, Cempaka

INSAR ANALYSIS FOR MONITORING LAND SUBSIDENCE IN SOUTHERN SUMATERA BASED ON 32 YEARS OF EARTHQUAKE CYCLE AT RING OF FIRE

Arliandy Pratama (1), Mutiara Jamilah (2), Virgus Ari S. (3), Achmad Ardy (4), W. Takeuchi (5)

[1] Department of Geomatics Engineering, Sumatera Institute of Technology, No. 13, Jalan Terusan Ryacudu, 35365 Lampung Selatan, Indonesia
[2] Department of Geodesy, Diponegoro University, Jalan Prof. H. Soedarto, S.H, 50275 Tembalang, Semarang, Indonesia
[3] Dept. of Surveying and Mapping, Indo Global Mandiri University, Jl. Jendral Sudirman No.629 Km.4 30129, Palembang, Indonesia
[4] Dept. Agroechotchnology, Lampung University, Jl. Prof. Dr. Ir. Sumantri Brojonegoro No.1, Bandar Lampung, Indonesia
[5] Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba Meguro-Ku, Tokyo 153-8505, Japan
Email: arliandy.pratama@gt.itera.ac.id

Abstract: In the early 2018, a series of major earthquakes occurred in the Pacific ring of fire, where on Wednesday (7/2), the Mw 6.4 earthquake hits north-east of Hualien. Taiwan, Mw 7.9 for the Alaska earthquake, and several other major earthquakes have also occurred in Indonesia with strength Mw 6.2. In the last August [Bendick, R. and Bilham, R., 2017] made predictions about a major earthquake in 2018, regarding the world statistic record, since 1900 that there has been a connection of major earthquakes with the slowing of Earth's rotation. This cycle occurs every 32 years, where the year 2018 is the beginning of the cycle. We expected by this research, will be able to answer the phenomenon of new fault-line in Southern Sumatera particularly in Lampung with InSAR and GPS techniques for monitoring the changes (deformation) of an interest area until mm order accuracy. We inspected the surface changes induced by the modelled of deformation over the Sumatran fault zones and provide insights about the relationships between recent earthquake and changes in eruption behaviour based on, low coherence among the 2 images could give information about deformation path. This study also included SuGAr (Sumatran GPS Array) analysis to get deformation over the Lampung region by the time through RTK, SuGAr thus provides a great opportunity to understand pre- and post-seismic behaviour of the megathrust by monitoring tectonic deformation above it. TJKG GPS station shows the movement about 3cm to north and 2cm to east. Furthermore, we estimated the earthquake probability based on probabilistic seismic hazard analysis and deterministic seismic hazard analysis.

Keywords: InSAR, Subsidence, Earthquake Cycle, Sumatran Fault, Ring of Fire

DETERMINATION OF LANDSLIDES IN LAO CAI PROVINCE BY SENTINEL -1 TIME SERIES RADAR IMAGES

Tran Van Anh (1), Tran Quoc Cuong (2), Nguyen An Binh (3)

[1] Faculty of Geomatics and Land Administration, Hanoi University of Mining and Geology, Hanoi University of Mining and Geology, No.18 Vien Street, Bac Tu Liem, Hanoi- Vietnam
[2] Institute of Geological science, Vietnam Academy of Science and Technology, No. 84 Chua Lang, Dong Da, Hanoi – Vietnam
[3] Institute of resources geography, Vietnam Academy of Science and Technology, No. 01 Mac Dinh Chi Street, District 1, Ho Chi Minh City-Vietnam
Email: tranvananh@humg.edu.vn

Abstract: Vietnam is one of the countries is frequently affected by landslides due to tropical monsoon climate and three-fourths of Vietnam's land area is hilly. In the context of global climate change is going on quite severe, landslide is becoming more dangerous. Radar technology has been known for more than 20 years with some interferometric synthetic aperture radar (InSAR) methods can be used to determine landslides such as DInSAR, PSInSAR, SqueerSAR... Each method has different characteristics and advantages, but for mountainous areas of Vietnam with high humidity and cloud cover, DInSAR method is limited due to atmospheric influences. The PSInSAR method solves this disadvantage of DInSAR by using a series of images and only extracting permanent scattering points. However one drawback of traditional PSInSAR is that it only determines linear land displacements and that nonlinear land displacements will be less accurate. In this paper we use an advantage PSInSAR method that using traditional PSInSAR associated with nonlinear weighting for determination of topographic variation at permanent scattering points. The research area are Phin Ngan, Ta Phin, Trung Chai, Ban Khoang and some places on 4D roads belonging to Lao Cai province. The image used is a series of 18 Sentinel 1A from January 2017 to July 2018. The results of landslide determination have been compared with the field survey sites provided by Geological and Mineral Resources and the accuracy is quite reasonable.

Keywords: Landslide, A-PSInSAR, Sentinel- 1A

OIL SPILLS IN THE PERSIAN GULF: MAIN RESULTS FROM SATELLITE MONITORING WITH SAR

Andrei Yu. Ivanov (1), Natalia Evtushenko (1), Vyacheslav M. Evtushenko (1)

[1] Shirshov Institute of Oceanology, Russian Academy of Sciences, No. 36, Nakhimovsky prospect, 117997 Moscow, Russia
Email: ivanoff@ocean.ru; slav133@yandex.ru; slav133@yandex.ru

Abstract: In order to understand oil spill distribution in the Persian Gulf of more than 200 synthetic aperture radar (SAR) images acquired in 2017-2018 by the European Sentinel-1A and Sentinel-1B satellites covering the entire marine basin were collected and analyzed with respect to marine oil pollution. To effectively analyze the SAR images and variety of detected dark patches, a geoinformation approach, specifically, a web-based GeoMixer application platform, was used. This involves the creation of a dedicated geo-portal with physical-geographical and industrial information about the water basin, including the detailed offshore oil and gas infrastructure and nautical charts. As the result of monitoring, actual oil spill distribution maps for the Persian Gulf have been generated and analyzed. For example, in 2017 number of detected oil spills (4905) and total polluted area (13800 km2) were very large that indicates very high that level of oil pollution. Sources of oil spills in the gulf generally are of the same origin: oil production industry is the main source and highest pollution rate. The largest oil patches (up to 600 km2) were detected near the oil production sites. On the other hand, according to data of the automatic ship identification systems (AIS) ship traffic (tanker traffic) appears to cause significant degree of oil pollution in the Persian Gulf as well. The largest spill numbers in the Persian Gulf were found during the summer time, especially at low wind conditions, thereby making oil pollution detection with SAR easier. Finally, it is shown that routine oil spill monitoring with SAR, together with the GIS approach and AIS data, makes it possible to observe and easily understanding the distribution of oil spills of a marine area everywhere, including their number, sources and calculate statistics. Also these results indicate that the Persian Gulf can be considered as one of heavily polluted inland basins in the world on a local and international scale due to oil production and man-made oil pollution.

Keywords: oil spills, Persian Gulf, satellite monitoring, SAR images, GIS approach

SAR ANALYSIS OF 2018-0206 HUALIEN EARTHQUAKE

Sheng-Wei Wu (1), Peter Tian-Yain Shih (1)

[1] Department of Civil Engineering, National Chiao Tung University,
1001 University Road, Hsinchu 300, Taiwan
Email: willie321.cv06g@nctu.edu.tw

Abstract: Taiwan is on Circum-Pacific Seismic Belt, the frequency of earthquake is very high. A destructive earthquake occurred on Feb. 6, 2018, at Hualien, a city located in the east of Taiwan. In this study, DInSAR technology is applied for observing topographic changes after this earthquake. The objective is to learn the magnitude and direction of surface deformation. The images used in this study are acquired with Sentinel-1A and 1B. There were 11 ascending images and 10 descending images, time spanning from 2018.01.01 to 2018.03.31. The wave range of these images are C band. Acquisition mode is Interferometric Wide. Polarization selected is VH. The swath in ascending images were iw3, and iw1 for descending. From the DInSAR result, significant deformation is observed. The physical interpretation and relation with the faults where the earthquake occurred are explored.

Keyword: DInSAR, Sentinel-1, earthquake

BACKSCATTERING SIGNAL (σ^0) RETRIEVAL FROM MICROWAVE SYNTHETIC APERTURE RADAR (SAR) DATASET USING INTEGRAL EQUATION MODEL

S. C. Karle (2), S. B. Sayyad (1), M. A. Shaikh (2), S. B. Kolhe (3), P. W. Khirade (4)

[1]Department of Physics, Milliya Arts, Science & Management Science College, Beed, (M.S.), India
[2] Department of Electronic Science, New Arts, Commerce & Science College, Ahmadnagar, (M.S.), India
[3] Department of Physics, Shivaji College, Kannad, (M.S.), India
[4] Department of Physics, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, (M.S.), India
Email: syedsb@rediffmail.com; mudassarshaikh333@gmail.com; sambhaji.karle@gmail.com
kolhe_sb71@yahoo.com; pwkhirade59@gmail.com

Abstract: The microwave remote sensing is highly useful, as it provides synoptic observation of the Earth's surface or planetary bodies. It retrieved the data regardless of day or night and the atmospheric conditions, propagation through ionosphere with minimum loss.The Earth's surface data can be retrieved by using both active and passive microwave instruments. One of the best active microwave technology for imaging system is the Synthetic Aperture Radar (SAR) remote sensing. The microwave SAR currently represents the best approach for obtaining spatially distributed geophysical parameter present on the Earth'ssurface or planetary bodies. In the present work, Backscattering Coefficients (σ0) geophysical parameterwill be retrieved. The modelling makes the process of estimating information beyond the real observation range for data interpretation. There are various modelling used to classify and analyze the geophysical parameters on the Earth'ssurface or planetary bodies. In the present paper most widely used modelling techniques fromthe microwave SAR dataset is an Integral Equation Model (IEM) is implemented. This modelling technology has demonstrated the potential to map and monitor relative geophysical parameter changes over large areas at regular intervals in time and also the opportunity of measuring, through inverse modelling, absolute parameter values. The aim of the present work is to estimate accurate, reliable and skillful measurements of σ0from the microwave SAR dataset. In the present study microwave SAR dataset is used. The overall processing was done by using PolSARPro Ver. 5.0 software. PolSARpro is a European Space Agency (ESA) open source toolbox for polarimetric SAR data processing and education. In the present work, σ0is measured with the help IEM modelling, the statistical parameter and the occurrence plane, estimated from the microwave SAR image, which was very helpful for retrieving geophysical parameters. From the overall paper work, it was concluded that the IEM modelling is a one of the realistic modelling methods for retrieving σ0forthe microwave SAR dataset.

Keywords: Backscattering Coefficients (σ0), Microwave, SAR, IEM Modelling.

MODELLING MAGMA SOURCE IN MT. BAEKDU VOLCANO USING SENTINEL-1 INTERFEROMETRY

Won-Kyung Baek (1), Hyung-Sup Jung (1)

[1] Department of Geoinformatics, University of Seoul, Korea
Email: bekwkz@uos.ac.kr; hsjung@uos.ac.kr

Abstract: Mt. Baekdu is known as a still active volcano and is located on the border between Korea and China. Although some gentle volcanic movements were only observed recently, Mt. Baekdu were notably erupted around 1000 years ago whose volcanic ash was found on Hokkaido, Japan. So necessity of the periodic observation was always existed. Especially after the fact that a significant magma storage is under the Mt. Baekdu was suggested, the importance of magma source movements were gradually larger. As SAR could observe wide area with centimetre precision, SAR-derived deformation based magma source modelling approach was widely applied. In this study, we estimated the location of magma source under the Mt. Baekdu by adapting point source (Mogi) model to a deformation rate map. For that we collected multi-temporal Sentinel-1 interferometric wide mode acquisitions from descending orbits. In succession we generated interferometric pairs whose longest temporal baseline is 48 days because the study area tend to be temporally decorrelated. After that deformation rate map was generated by stacking qualified multi-temporal interferograms. As a result, the volume change and source depth were about 0.0066 km^3 and 7.4 km respectively. This results was very similar to previously published parameters. The final result would validate with the same result from the independent data, which is multi-temporal Sentinel-1 interferometric wide mode acquisitions from ascending orbits.

Keywords: SAR, SAR Interferometry, Sentinel-1, Mt. Baekdu, Magma Source

THE CONVECTIVE CLOUD PROPERTIES EXTRACTION FROM WEATHER RADAR REFLECTIVITY DURING SONCA TROPICAL STORM OVER THE LOWER NORTHERN THAILAND

Nattapon Mahavik (1), Sarintip Tantanee (2)

[1]Department of Natural Resources and Environment, Naresuan University, Phitsanulok, 65000, Thailand
[2]Department of Civil Engineering, Naresuan University, Phitsanulok, 65000, Thailand
Email: nattaponm@nu.ac.th

Abstract: Disaster Management is one of the most important responsibilities of the governments all over the world. The systems of disaster prevention, preparedness and mitigation have been well established only in developed countries. For the developing countries including Thailand, people still have suffered from disaster since they are lacking of adequate information to cope with disaster. The weather radar is one of the tools that can provide spatio-temporal information for Nowcast which is useful for hydrological disaster warning and mitigation system. The extremes of precipitation are usually detested by convective cloud where the updrafts and downdrafts have been strengthened in vertical wind motions. In this study, we have developed algorithm to extract convective cloud information that is necessary for prediction of precipitation extremes. These extremes are the vital threat to people during wet season over Thailand. The algorithm is constructed in python script using Opencv library to extract the radar reflectivity of the 1st ppi radar image. The reflectivity data with the measurement frequency of once per hour has been obtained from the website of Thaiwater.net of which original data provided by Thai Meteorological Department (TMD). This study has been done by using reflectivity data from Phitsanulok radar station which locates in Lower Northern Thailand. Radar flares over radar images has been removed by the developed algorithm. In addition, the fitting ellipses have been applied to obtain the properties of convective clouds during Sonca tropical storm in July of 2017. The spatio-temporal analysis of the extracted storm information will be provided with the appropriate discussion.

Keywords: Convective Cloud Properties, Indochina Peninsula, Phitsanulok, Weather Radar, Sonca Tropical Storm

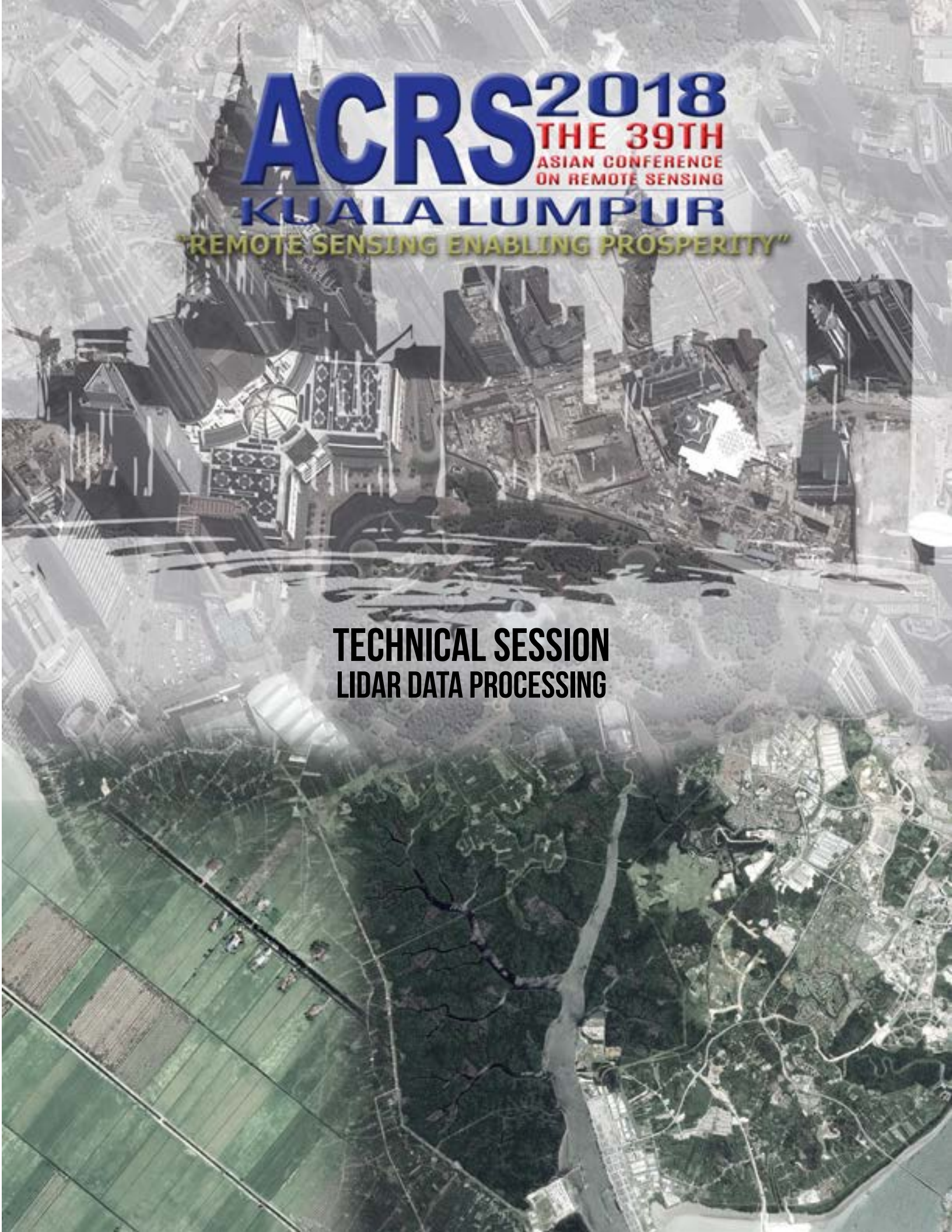
MAPPING STAND AGE OF INDONESIAN RUBBER PLANTATION USING FULLY POLARIMETRIC L-BAND SYNTHETIC APERTURE RADAR

Bambang H. Trisasongko (1)(2)

[1]School of Physical, Environmental and Mathematical Sciences, UNSW Canberra at Australian Defence Force Academy, Northcott Drive, Campbell 2600, ACT, Australia
[2]Department of Soil Science and Land Resource, Bogor Agricultural University, Jalan Meranti, Bogor 16680, Indonesia
Email: trisasongko@apps.ipb.ac.id

Abstract: Rapid expansion of plantations has recently been one of emerging subjects in remote sensing applications. In the case of tropical regions, Synthetic Aperture Radar (SAR) sensor has gained its popularity due to its ability to overcome atmospheric disturbance. The sensor has demonstrated its capability in the detection of plantations, especially oil palm and rubber, although the use in discriminating varying growth phase remains understudied. In this research, full polarimetry L-band SAR data were employed to investigate their potential in the separation of rubber plantation's age situated in East Java, Indonesia. Fully polarimetric data were shown useful as they provide opportunity to derive polarimetric decomposition features. This article demonstrates that model-based decomposition features were more favourable to conventional backscatter coefficients. With the aid of C5.0 algorithm, accuracy of the separation was above 90% using several polarimetric variables. The outcome did not significantly differs to the one yielded by random forest algorithm. Taking the benefit of faster computation, a combination of model-based features, especially the one derived from Bhattacharya approach, and C5.0 technique would serve as the benchmark for further investigation.

Keywords: Bhattacharya decomposition; C5.0; polarimetry; random forests; rubber plantation



TECHNICAL SESSION
LIDAR DATA PROCESSING

FOREST ATTRIBUTES ESTIMATION USING DISCRETE RETURN AIRBORNE LIDAR: AN INDIVIDUAL TREE BASED APPROACH

Wan Shafrina Wan Mohd Jaafar (1)(4), Iain Hector Woodhouse (1), Carlos Alberto Silva (2), Hamdan Omar (3), Khairul Nizam Abdul Maulud (4)(5)

[1] School of Geosciences, University of Edinburgh, Edinburgh EH8 9XL, UK
[2] Department of Natural Resources and Society, College of Natural Resources, University of Idaho (UI), 875 Perimeter Drive, Moscow, ID 83843
[3] Forest Research Institute Malaysia, 52109 FRIM, Kepong, Selangor, Malaysia
[4] Earth Observation Centre, Institute of Climate Change (IPI), Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia
[5] Smart & Sustainable Township Research Center, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia
Email: wanshafrina@gmail.com; wanshafrina@ukm.edu.my; i.h.woodhouse@ed.ac.uk; carlos_engflorestal@outlook.com; hamdanomar@frim.gov.my; knam@ukm.edu.my

Abstract: Light Detection and Ranging (LiDAR) has become a common tool for predicting forest attributes. Forest attributes estimation such as aboveground biomass (AGB), crown width and tree height for forest inventories using area-based approach have reached the operational status, while methods using the individual tree-based approach still remain a great challenge. In this study, we present a step by step approach in developing predictive LiDAR-AGB model derived at tree level and how this model can be used to validate the results on automatic delineation of individual trees at the landscape level. The methodology in this study arranged according to the following order: (1) Pre-processing: LiDAR normalization, LiDAR metrics extraction and LiDAR-field individual tree extraction, (2) Regression Model development, (3) Predictive model assessment and validation, (4) Individual tree crown delineation and crown assessment and, (5) Cross-validation and uncertainty analysis. The predictive model was found to best fit the data as evidenced by an Adj-R2 value of 0.63, root mean square error (RMSE) of the model of 14.8%, and analysis of the residuals. The automated method correctly delineated about 84% and 88% of the tree crowns in two forest site of tropical rainforest in Peninsular Malaysia. The correct extraction of individual tree helps to derive accurate forest parameters that are important for natural resource managers to improve management decisions.

Keywords: ITC, Forest attributes, LiDAR

WATER SEEPAGE DETECTION OF SUBWAY TUNNEL BASED ON LASER SCANNING INTENSITY DATA

Xiaolong Cheng (1), Xiaojun Cheng (2), Lingwen Wang (3)

[1] College of Architecture and Surveying&Mapping engineering, Jiangxi University of Science and Technology, Ganzhou 341000, Jiangxi Province, China
[2] College of Surveying and Geo-Informatics, Tongji University, Shanghai 200092, China
[3] Shanghai Geotechnical Investigations & Design Institute Co. Ltd, Shanghai 200092, China
Email: 494322312@qq.com; cxj@tongji.edu.cn; 854771297@qq.com

Abstract: The water seepage detection is an important work to ensure the subway tunnel operational safety. The traditional method of water seepage detection based on artificial investigation and image recognition has some disadvantages, such as low automation and high illumination condition, so there is great technical demand for the water seepage detection of subway tunnel. As a new method of data acquisition, LiDAR (Light detection and ranging) can not only obtain the three-dimensional information of the target, but also record the laser intensity of the target through the photoelectric receiving system, and the laser intensity information can be used to extract and retrieve the geometrical shape and attributes of the target, so it can be used as a target-identified data source. In this paper, a mobile laser scanning system is used to obtain the point cloud data and intensity information of the subway tunnel, and the intensity values of water seepage regions are theoretically lower than other regions of the subway tunnel, because of the water absorption coefficient is higher, so the water seepage regions of the subway tunnel can be detected. First, the centerline of the tunnel point cloud is extracted, and the noise of the tunnel point cloud is carried out according to the centerline; Secondly, the laser intensity of the tunnel point cloud is corrected uniformly by analyzing the influence factors of the laser intensity of the tunnel point cloud, then the intensity image is generated. Finally, the water seepage regions are detected based on the corrected intensity image. The experiment results of Shield tunnel in a certain section of Shanghai Metro line 1 show that the location and area of water seepage regions of subway tunnel can be detected effectively based on the corrected laser intensity value.

Keywords: LiDAR, laser intensity, intensity correction, subway tunnel, water seepage detection

DATA ACCURACY EVALUATION OF A MOBILE LASER SCANNING SYSTEM IN RURAL RESIDENTIAL AREAS

Qi Zhang (1)(2), Xiaojun Cheng (1), Changdi Huang (3), Weimin Wu (3), Feng Wang (3)

[1] Tongji University, College of Surveying and Geo-Information, No. 1239 Siping Road, Shanghai, 200092, China
[2] Zhejiang Gongshang University, Department of Land Resource Management, School of Public Administration, No. 18 Xuezheng Str., Xiasha University Town, Hangzhou, Zhejiang, 310018, China.
[3] Quality Inspection and Testing Station for Suverying and Mapping of Zhejiang Province, No. 83, Baochubei Road, Xihu District, Hangzhou, Zhejiang, 310012, China
Email: zhangqiGG@zjgsu.edu.cn; cxj@tongji.edu.cn; changdihuang@qq.com; china.engineer@163.com; fengWang@qq.com

Abstract: This paper evaluated the accuracy of LiDAR (Light Detection and Ranging) point data collected by Leica Pegasus: Two mobile scanning system for the quality inspection of large scale map under rural residential environments. We selected two typical rural residential test sites: (1) the first test site with regularly arranged residential buildings, and (2) the second test site with disorderly distributed residential buildings severely shaded by dense vegetation. After the data acquisition, we downloaded all the sensor data to the NovAtel workstation to calculate positions and attitudes. A CORS (Continuously Operating Reference Stations) station was set up in the near of 20 kilometres as a base station. The CORS data were integrated with the collected GNSS (Global Navigation Satellite System) and IMU (Inertial measurement unit) data during data acquisition, to obtain trajectory data. By integrating trajectory data, point clouds and panoramic images can be automatically generated via Leica AutoP (Automatic Processing) software. To increase the number of check points and meet the current quality inspection methods of surveying and mapping products, the existing 1: 500 digital topographic map were used to assess data accuracy. Firstly, sixty-four corner points of buildings and twenty-four ground points were manually extracted from point clouds. Secondly, the check points were extracted from the 1:500 digital topographic map. Thirdly, the errors between them were counted. By comparing with the 1:500 topographic map, the planimetric and elevation errors for the first test site are ±10.3 cm and ±3 cm, respectively, and the planimetric and elevation errors for the second test site are ±50.6 cm and ±24.1 cm, respectively. This experimental results showed that: (1) the situations of poor or obstructed GNSS satellite signals commonly occur in the rural residential environments, (2) for the point data collected by Leica Pegasus: Two mobile scanning system, the elevation accuracy are higher than the planimetric accuracy, and (3) the accuracy of the collected Leica Pegasus: Two LiDAR data, at the speed of 20 km/h and CORS station available in the range of 20 kilometres, can satisfy the quality inspection requirements of 1: 2000 and smaller scale maps.

Keywords: Mobile laser scanning system, Leica Pegasus Two, Point-cloud accuracy, Accuracy evaluation

MULTIPLE ALTIMETER BEAM EXPERIMENTAL LiDAR (MABEL) DATA PROCESSING USING STATISTICAL AND ITERATIVE APPROACH

Sourish Chatterjee (1), Aditya Himanshu (1), S. Raghavendra (2), Hina Pande (2), Poonam S. Tiwari (2)

[1] Indian Institute of Technology (Indian School of Mines), Dhanbad-826004, Jharkhand, India
[2] Indian Institute of Remote Sensing, Indian Space Research Organisation, Department of Space, Government of India, Dehradun-248001, India
Email: sourishthirteen@gmail.com; himanshuaditya95@gmail.com; raghav@iirs.gov.in; hina@iirs.gov.in; poonam@iirs.gov.in

Abstract: The Earth is changing incessantly with alterations in the global climate. Hence, it is imperative to study these changes. NASA's Ice Cloud and Elevation Satellite-2 (ICESat-2) mission is a space-borne LiDAR system which uses photon-time data to obtain elevations above the Earth's surface. This study uses the Multiple Altimeter Beam Experimental Lidar (MABEL) data which is an archetype of the Advanced Topographic Laser Altimeter System (ATLAS) instrument to be incorporated in the ICESat-2, to provide the end user, an efficacious interactive tool to de-noise the noisy airborne photon data; visualize it graphically along with ground extraction and also on the geospatial platform. A three-level de-noising methodology was adapted. In the first, statistical level, 3σ-elimination was performed. For the second level, line de-noising, all photons having more than one elevation for the same distance were removed. Finally, iterative de-noising, in which co-ordinate geometry was utilized to compute respective photon densities within an ellipse, was implemented. Elimination was then carried out according to a density threshold. This step was reprised four times with the ellipse dimensions varying automatically while keeping the threshold constant and the best data was chosen from the lot for further use. A Keyhole Markup Language (KML) file was created out of the refined data. The ground profile was plotted by choosing ground photons and then applying Piecewise Cubic Hermite Interpolating Polynomial (PCHIP) to join them. The statistical de-noising removed a few noisy photons but were inconsequential in some cases. The iterative refinement was observed to clear noisy data step by step while leaving the actual feature intact. This graphical representation of the ground profile resembled the geospatial visual i.e., the KML file which showed the trajectory along with the landform on the geospatial platform. Other features were also evident above the ground. The interface created will provide an efficacious way for the end user to perform the aforementioned tasks with a single tool. The de-noised data can be further used to obtain landform features and when done periodically, can be instrumental in studying changes in the area of interest.

Keywords: MABEL, ICESat-2, Statistical De-noising, Iterative De-noising, Geospatial Platform

AN ENSEMBLE GAUSSIAN MIXTURE MODEL – LOGISTIC REGRESSION APPROACH FOR IDENTIFICATION OF POTENTIAL ROCKFALL SOURCE AREAS USING AIRBORNE LIDAR AND GIS

Ali Mutar Fanos (1), Biswajeet Pradhan (2), Shattri Mansor (1)

[1] Department of Civil Engineering, Faculty of Engineering, Universiti Putra Malaysia, Malaysia
[2] School of Systems, Management and Leadership, Faculty of Engineering and IT, University of Technology Sydney, New South Wales, Australia
Email: biswajeet24@gmail.comor; Biswajeet.Pradhan@uts.edu.au

Abstract: Rockfall incidents are widely in Ipoh, Malaysia that threat people and their properties in addition to the infrastructure in this area. The current research design and evaluate an ensemble approach based on Gaussian Mixture Model (GMM) and Logistic Regression (LR) for identifying rockfall source regions utilizing high-resolution airborne laser scanning data. GMM model was used to compute automatically slope angle thresholds for different type of landslides such as shallow, debris flow, and rockfalls. Homogenous Morphometric Land Use Area (HMLA) was constructed to reduce the noise and sensitivity of the model to the variations in different conditioning factors improving the performance of the model computations. Random forest (RF) was employed to rank and select the conditioning factors taking into account the landslides type. After that, various LR models were trained with the previously prepared inventory datasets and the selected best factors. The LR models were then utilized to produce the probability maps and then the source areas were identified by combining the probability maps and the reclassified slope raster based on the thresholds obtained by the GMM model. The result of the accuracy assessment indicates that the proposed ensemble model can identify the potential rockfall source areas with an accuracy of 0.916 based on training data and 0.958 on validation data. Generally, the proposed model is an effective model for rockfall source identification in presence of other types of landslides with an accepted generalization performance.

Keywords: Rockfall, Debris Flow, Ensemble Model, Lidar, Gaussian Mixture Model

FOREST CLASSIFICATION AND DERIVING FORESTRY RESOURCES PARAMETERS FROM LiDAR DATA

Ballado, Alejandro H. (1), Garcia, Ramon G. (1), Campos, Christian Razel P. (1), Chicano, Ara Philippa P. (1), Eugenio, Adrian O. (1), Flores, June Michel Romwell M. (1)

1School of Electrical, Electronics, and Computer Engineering,
Mapúa University, Intramuros, Manila, Philippines
Email: ahballado@mapua.edu.ph, rggarcia@mapua.edu.ph, crpcampos@mymail.mapua.edu.ph, appchicano@mymail.mapua.edu.ph, aoeugenio@mymail.mapua.edu.ph, jmrmflores@mymail.mapua.edu.ph

Abstract: With the introduction of Light Detection and Ranging (LiDAR) Survey Technology into government and commercial sectors, this study aims to create precise and accurate extraction of LiDAR data aided by various software tools and incorporating several data mining techniques as a reference point for generating comprehensive and high-quality forest resource maps. Utilizing a proposed Laser Range Finder (LRF) for Canopy Height Model (CHM) Tree Inventory within a plot of 15 x 15 meter of a chosen classified forest type for field validation. The results indicate that for a certain height, the actual stature is demographically the same with the height measured by the projected LRF which makes it viable as an alternative solution for retrieving CHM data. The Accuracy of height measurement was calculated as 97.29%. The Precision of the prototype has standard deviation of ± 0.092037.

Keywords: LiDAR, Canopy Height Model, Diameter at Breast Height, Decision tree, Laser Ranger Finder

OPTIMISATION OF TOTAL NUMBER OF SCANNING STATIONS FOR TERRESTRIAL LASER SCANNING (TLS) SURVEY

Yogender (1), S.K.P. Kushwaha (2), S Raghavendra (3)

[1] Student, Department of Civil Engineering, National Institute of Technology, Kurukshetra
[2] M. Tech Researcher, Photogrammetry and Remote Sensing Division, Indian Institute of Remote Sensing, ISRO, Dehradun
[3] Scientist, Photogrammetry and Remote Sensing Division, Indian Institute of Remote Sensing, ISRO, Dehradun

Abstract: Surveying techniques have always played a primary role in engineering surveying, recent advances and development in new instruments and methods of data capturing and processing have introduced the chance to increase the accuracy and the amount of information obtained. This research is focused to optimise the number of scanning positions for Terrestrial Laser Scanning (TLS) data acquisition. More scanning positions in Laser Scanning increases the size of the data collected by the instrument and cover all the portions of the target with increasing the point density. In this work, the no of TLS stations were optimised by shifting the Vertical and Horizontal inclination angle to the optimised position .TLS scanning stations were minimised depending on the Shape file of the target, terrain features and the scanning parameters of the instrument. This work reduces the bulkiness of the TLS data by reducing the scans and repetition of the overlapping regions between the scans are reduced.

Keywords: Terrestrial laser Scanner, TLS parameters, 3D shapefile, optimum TLS scanning parameters and positions

DETECTION OF LANDSLIDES IN THE 2016 KUMAMOTOEARTHQUAKE USING AIRBORNELIDAR DATA

Yuki Sagawa (1), Luis Moya (2), Fumio Yamazaki (3), Wen Liu (4)

[1] Graduate Student, Graduate School of Science and Engineering, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba 263-8522, Japan
[2] International Research Institute for Disaster Science, Tohoku University, 468-1 Aoba, Aramaki, Aoba-ku, Sendai-shi, Miyagi 980-8572, Japan
[3]Professor, Department of Urban Environment Systems, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba 263-8522, Japan
[4]Assistant professor, Department of Urban Environment Systems, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba 263-8522, Japan
E-mail: yuki_sagawa@chiba-u.jp2011; lmoyah@irides.tohoku.ac.jp; fumio.yamazaki@faculty.chiba-u.jp; wen.liu@chiba-u.jp

Abstract: An earthquake of Mw 6.2occurred in the Kumamoto district of Kumamoto Prefecture, Japan at 21:26 on April 14, 2016. An earthquake of Mw 7.0occurred at 1:25 on April 16, about 28 hours after the first event. Surface ruptures with lateral displacement of up to about 2 m appeared along the Futagawa fault line. A large number of buildings and infrastructures were severely damaged. For a prompt emergency response, it is important to grasp damage distribution at an early stage after the occurrence of an earthquake. In such a case, the use of remote sensing technology is effective. The purpose of this research is to extract landslides caused by the Kumamoto earthquake using airborne Lidar data. We used the digital surface models (DSMs) acquired before and after the April 16 earthquake to grasp the slope failures in Mashiki town. We searched for a method to automatically extract by differentiating the DSMs at two times and searching characteristics of the area where landslides occurred. Furthermore, the result of automatic extraction was compared with the result of visual interpretation from aerial photographs. Through this comparison, small landslides difficult to locate from field survey or aerial photograph interpretation were extracted sufficiently from the DSM difference together with the large scale ones.

Keywords: 2016 Kumamoto Earthquake, Landslide, Airborne Lidar, Digital Surface Model

THREE KEY PROCESSING FUNCTIONALITIES OF THE EOS LIDAR TOOL

Sergiy Kostrikov (1)(2), Dmitry Bubnov (2), Ann Kostrikova (2), Rostyslav Pudlo (2)

[1] School of Geology, Geography, Recreation and Tourism, Kharkiv Karazin National University, No. 4, Svobodu Sq., 61077, Kharkiv, Ukraine
[2] EOS Data Analytics Ukraine, LLC, Alchevskyh st., bld. 31, 61002, Kharkiv, Ukraine
Email: sergiy.kostrikov@eosda.com; dmitry.bubnov@eosda.com; anna.kostrikova@eosda.com; rostyslav.pudlo@eosda.com

Abstract: The automated building and other man-made feature extraction from LiDAR point clouds together with the relevant topography generation is one of the most challenging research and development goals for urban studies and city monitoring procedures. Consequently, quite a few LIDAR-based approaches have been developed. Nevertheless, the majority of existing software examples is normally intended to demonstrate its main advantages predominantly in one only subject area: either *Building* (and *other man-made features*) *Extraction* (BE), or *Change Detection* (CD), or *DEM Generation* (DEM-G). Our presentation focuses on the ***EOS LiDAR Tool*** – the *ELiT multifunctional software*, developed by our team at the EOS Data Analytics company (https://eos.com). *ELiT* is both a separate web-based (network) generator (*ELiT Server* - it means a common Client-Server application, in other words), and an integrated component of other EOS Platform-as-a-Service software (*ELiT Cloud*). It is the sophisticated entity based on the complicated algorithms for urban environment modeling and analysis. *ELiT* performs within the Web browser installed on the user's workstation and provides the ability to extract urban features from raw LiDAR data. The software architectural structure consists of two key constituents: *ElitCore* and *ELiT Viewer*. The latter user obtains building models visualized in three levels of details (LODs) in the *Cesium3D* - an open-source JS library. Clicking any model from a panel of models list, a user obtains both geometric, and semantic information about a modelled building selected. *ElitCore* is the structured set of algorithmic procedures that accomplishes the whole and computing thread. Three key features of our software – BE, CD, and DEM-G – correspond to three sub-pages of the *ELIT* Homepage. Each of these functionalities has been already approbated and tested on both open-source (England, D.C. area of USA, Northern Europe) and commercial (Poland, Italy, Ukraine) datasets. With coming software update we will get a chance to provide urban modelling procedures not only in a block, and district scopes, but in a whole city scope as well. Any alterations in the city spatial infrastructure and in its social economic attributes will be able to be traced then, as well as the city changes will be steadily monitored.

Keywords: ELiT, Software Functionalities, Urban Modeling

URBAN LAND COVER MAPPING IN MONGOLIA USING OPTICAL AND LiDAR DATA

D.Amarsaikhan (1), E.Nyamjargal (1), D.Enkhjargal (1), A.Munkh-Erdene (1), B.Byamdolgor (1), E.Jargaldalai (1), S.Naranbat (1), G.Tsogzol (1)

[1] Institute of Geography and Geoecology, Mongolian Academy of Sciences av.Enkhtaivan-54B, Ulaanbaatar-51, Mongolia
Email: igg.mas1@gmail.com

Abstract: Traditionally, satellite remote sensing (RS) has been efficiently used for land cover mapping at a large spatial extent. However, because of the recent rapid urbanization process, the demand on land cover maps at a more fine resolution has been raised with evidence by numerous biophysical and socio-economic studies, specifically in city areas. Although most research studies mainly focus on the analysis of geometric components of three dimensional LiDAR data point clouds, there has been an increasing interest in investigating the intensity data, integrate it with other multispectral images and use the integrated data sets for land cover classification. The aim of this study is to conduct an urban land cover mapping in central part of Ulaanbaatar, the capital city of Mongolia using airborne LiDAR intensity data and multispectral Quickbird image of 2016. To extract the urban land cover information, initially, the data sets from two different sources were fused. Then, an object-based classification technique has been applied to extract reliable thematic information. The result of the object-based method was compared with result of a standard supervised classification technique, and it demonstrated a higher accuracy.

Keywords: Urban, Land cover mapping, Object-based classification

AUTOMATIC BUILDING MODEL EXTRACTION USING LIDAR DATA

Danang Budi Susetyo (1), Fahrul Hidayat (1), Mochamad Irwan Hariyono (1)

[1] Geospatial Information Agency of Indonesia Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Jawa Barat 16911, Indonesia
Email: danang.budi@big.go.id; fahrul.hidayat@big.go.id; mochamad.irwan@big.go.id

Abstract: One of topographic mapping step is feature extraction, where the building becomes one of the displayed layers. The extraction method used for topographic map production in Indonesia today is digitization or stereocompilation which takes a lot of time, so the automation of topographic feature extraction becomes a topic that needs to be developed. The use of LiDAR data has been widely used in Indonesia to be one of the breakthroughs in the acceleration of large-scale mapping. But for topographic mapping, the use of LiDAR data in Indonesia is still limited only to the generation of DTM (Digital Terrain Model). Whereas, LiDAR data can also be used for extraction of other features, one of them building, and automation for building extraction using LiDAR data is expected to accelerate the production of topographic map in Indonesia. The purpose of this research is to examine the ability of LiDAR data as input to building extraction process which represented in 3D model using Terrasolid software. The data used is the area of Surabaya city (East Java, Indonesia) with a density of 12 ppm (points per meter square). First step is point cloud classification becomes ground and non-ground, with parameter maximal building size = 100.0 m, terrain angle = 88.00 degrees, iteration angle = 5.00 degrees to plane, and iteration distance = 1.40 m to plane. Furthermore, non-ground data is classified into buildings, low vegetation, medium vegetation, and high vegetation. The building parameters are minimum size = 40 m^2 and Z tolerance = 0.12 m. For vegetation classification, low vegetation height = 0-0.3 m, medium vegetation = 0.3-2.5 m, and high vegetation = 2.5-999.0 m. After that, point cloud that classified into buildings is generated into 3D models. Validation of 3D model extraction results is by comparing the model with orthophoto. As a result, most building models are compatible with orthophoto, although in some segments there is still a need for manual editing. This research proves the automation of building feature extraction from LiDAR data enables to accelerate the topographic map production in Indonesia.

Keywords: LiDAR, building model, automatic, Terrasolid

CLASSIFICATION LIDAR DATA TO GENERATE THE DIGITAL TERRAIN MODEL

Mochamad Irwan Hariyono (1), Rizka Windiastuti (1)

[1] Geospatial Information Agency, Jalan Raya Jakarta – Bogor KM.46 Cibinong 16911 Bogor, Indonesia
Email: mochamad.irwan@big.go.id; rizka.windiastuti@big.go.id

Abstract: The use of LiDar data is the solutions for improving the quality of large-scale mapping. Topographic mapping using conventional measurement methods such as terrestrial measurements requires relatively large costs and takes a long time. LiDar technology is able to provide altitude accurate data and requires faster time to process the data. One of the information on topographic mapping is the contour or ground surface shape. The purpose of this research was to know the ability of LiDar data to generated the Digital Terrain Model (DTM). The data used was Mataram area, acquisition in 2015 with 4ppm density and the processing data used Terrasolid software. The main process in this research was to classify point cloud data of acquisition into ground and non-ground points. Classification was done by the TIN method to separated the ground point that forms the Digital Elevation Model (DEM). The result of this research showed that Lidar data could be used to generate digital terrain model.

Keywords: LiDar, Topographic, Digital Terrain Model, Density, Classification

ANALYSIS OF FLOODPLAIN ENCROACHMENT USING HEC-RAS 2D UNSTEADY FLOOD FLOW MODELING OVER AN ENTIRE RIVER BASIN

Alan E. Milano (1), Daniel S. Mostrales (1), Stephanie Mae B. Salcedo (1), Rejen L. Albores (1), Dave Charity C. Gambuta (1)

[1] College of Engineering, MSU-Iligan Institute of Technology, Iligan City, Philippines
Email: alan.milano@g.msuiit.edu.ph; daniel.mostrales@g.msuiit.edu.ph; stephsalcedo@gmail.com; albores.rejen@gmail.com; davinchi_2015@yahoo.com.ph

Abstract: The study attempts to provide a methodology for a rapid assessment of flood dynamics over an area using HEC-RAS 5.0.5. HEC-RAS has been improved and includes new abilities of performing 2D flood routing over a large area at variable time steps. Its computational engine also has been parallelized in a 64-bit environment resulting to reduced run times. It would be sufficient to provide an initial assessment of flow extent and depth using generalized workflow especially for areas where there are no available extensive data of rainfall, land use and soil types. The study was performed on a 210-km2 river basin particularly to assess the effect of major infrastructures that were built on its floodplain. Major infrastructures include raised approach road to a newly built bridge along the national highway and a 6-m perimeter fence of a 6-hectare coal power generating plant. LiDAR-derived DEM was used which covers over 60% of the river basin including its floodplain. LiDAR datasets were acquired before the presence of the above-mentioned infrastructures. A second terrain was processed with the HEC-RAS Mapper by lifting areas representing the raised approach road and the perimeter fence. The LiDAR DEM was resampled and fused with a 5-m resolution IFSAR DEM which covers the remaining area of the watershed. The whole watershed was considered as a 2D flow area at 30 m x 30 m flow grid with a breakline over the highway centerline. HEC-HMS was used to estimate excess precipitation over the watershed area. Several HEC-RAS simulations before and after the presence of major infrastructures are performed at rainfall probabilities of 20%, 4%, 2% and 1%. Results show that full 2D unsteady flood modeling over the entire river basin could be used for a rapid assessment of the effects of encroachment on a floodplain. Major effects include increased flood depths and flood retention time in the study area. Any major infrastructure that is being planned could be assessed rapidly using HEC-RAS 5.0.5 on the changes of flood dynamics caused by this infrastructure especially if it is located on the floodplain.

Keywords: floodplain encroachment, 2D flood modeling, HEC-RAS, LiDAR DEM

FOREST CLASSIFICATION AND DERIVING FORESTRY RESOURCE PARAMETERS IN INFANTA QUEZON USING LiDAR DATA AND VALIDATION WITH LASER RANGE FINDER

Alejandro H. Ballado, Jr. (1), Ramon G. Garcia (1), Christian Razel P. Campos (1), Ara Philippa P. Chicano (1), Adrian O. Eugenio (1), June Michel Romwell M. Flores (1)

[1] School of Electrical, Electronics, and Computer Engineering Mapúa University, 658 Muralla St., Intramuros Manila 1002, Philippines
Email: ahballado@mapua.edu.ph; rggarcia@mapua.edu.ph; crpcampos@mymail.mapua.edu.ph; appchicano@mymail.mapua.edu.ph; aoeugenio@mymail.mapua.edu.ph; jmrmflores@mymail.mapua.edu.ph

Abstract: With the availability of Light Detection and Ranging (LIDAR) survey technology into government and commercial sectors, the study aimed to produce an accurate extraction of forest classification and resource parameters through LIDAR data aided by various software tools and incorporating other data mining techniques as a reference point for generating comprehensive and high quality forest resource maps. The developed Laser Range Finder (LRF), for Canopy Height Model (CHM) Tree Inventory, was used within a plot of 15x15 meter in a chosen classified forest type for field validation. Seven LIDAR parameter have been successfully extracted and processed to generate four classified forest types in Infanta Quezon. Natural Mangroves makes up 82% of the forest cover class covering an area of 16.88 sq. km, while Broadleaf Plantation is at 22% with an area of 0.78 sq. km, Closed Broadleaf is at 19% with an area of 1 sq. km, and Open Broadleaf is at 7% with an area of 0.02 sq. km. The results indicate that for a certain height, the actual stature is demographically the same with the height measured by the projected LRF which makes it viable as an alternative solution for retrieving CHM data. CHM was successfully validated with an accuracy of 98.61% coming from LiDAR data and 97.29% for the developed Laser Range Finder.

Keywords: Lidar, Canopy Height Model, Laser Range Finder, Open Broadleaf, Closed Broadleaf

FOREST LEAF AREA INDEX ESTIMATION USING AIRBORNE LIDAR DATA IN TROPICAL RAINFOREST IN SABAH, MALAYSIA

Shazrul Azwan Johari (1), Keiko Ioki (1), David Alloysius (2), Phua Mui-How (1), Gregory Asner (3), Ulrik Ilstedt (4)

[1] Forestry Complex, Faculty of Science and Natural Resources, University Malaysia Sabah, 88400 Kota Kinabalu, Sabah, Malaysia
[2] Conservation and Environmental Management Division, Yayasan Sabah Group, P.O. Box 11623, 88817 Kota Kinabalu, Sabah, Malaysia
[3] Department of Global Ecology, Carnegie Instituion for Science, 260 Panama Street, Stanford, California, United States
[4] Department of Forest Ecology and Management, Swedish University of Agricultural Sciences (SLU), 901 83, Umeå, Sweden
Email: shazrul.aj@gmail.com; keiko_ioki@ums.edu.my; dalloysius@gmail.com; pmh@ums.edu.my; gpa@ciw.edu; ulrik.ilstedt@slu.se

Abstract: Leaf area index (LAI) serves as important input variable for forest structural modelling that can be linked to vegetation productivity. Recently, remote sensing applications were used to enhance the potential of estimating forest LAI. Light detection and ranging (LiDAR) have emerged as a promising technology for LAI estimation in different forest types. This research focused on estimating forest LAI using the metrics derived from airborne LiDAR data. The forest LAI were derived from digital hemispherical photograph (DHP) on 20 square plots across the study area. DHP was taken at every 10 m interval in a cardinal direction to achieve a total of 25 points for each plot. For the remote sensing variables, the airborne LiDAR data collected in April 2016 were used to extract the laser penetration, canopy height and foliage density metrics. Regression analysis of LiDAR metrics against field-measured LAIs was performed to develop LAI estimation model. Our results showed that the LiDAR height and density metrics was the significant predictor for LAI. It suggests that LiDAR metrics alone could reliably estimate LAI in closed-canopy structure tropical forest area. Therefore, this airborne LiDAR technology can act as a superior tool for forest structure modelling and mapping LAI in tropical forest.

Keywords: Leaf Area Index, Airborne LiDAR, Hemispherical Photograph, Tropical Forest

RELATIVE ACCURACY OF FLOOD MODELING USING LIDAR DATA AND COARSER RESOLUTION ELEVATION DATASETS

Alan E. Milano (1), Stephanie Mae B. Salcedo (1), Rejen L. Albores (1), Dave Charity C. Gambuta (1), Daniel S. Mostrales (1)

[1]College of Engineering & Technology, MSU-Iligan Institute of Technology, Iligan City, Philippines
Email: alan.milano@g.msuiit.edu.ph; stephsalcedo@gmail.com; albores.rejen@gmail.com
davinchi_2015@yahoo.com.ph; daniel.mostrales@g.msuiit.edu.ph

Abstract: The representation of topography plays an important role in determining the accuracy of flood inundation maps. One would expect high accuracy of flood modeling results if one uses a more detailed elevation datasets such as LiDAR-derived 1-m resolution elevation datasets. Although Light Detection and Ranging (LiDAR) data is accurate, it is not available in several areas across the country. It would be helpful to know the relative accuracy that one is able to accomplish when flood modeling is done using coarser resolution elevation datasets. The study proposes to quantify the errors arising from DEM properties such as resolution and accuracy on flood inundation maps. Detailed comparison of flood hazard maps generated using LiDAR datasets to that when using a coarser 5-m resolution elevation data. It is expected that a map produced using LiDAR data is more accurate but knowing their difference would give us some idea of accuracy when a coarser datasets is the only data that is available for a given area of interest. Initial work would start with comparison of datasets, for example, maximum land surface elevation difference, the mean elevation difference and range of values based on randomly selected sample points over the area. Flood inundation comparison is done using LiDAR-derived elevation datasets and a 5-m resolution datasets over two study areas of different river basin characteristics. Flood inundation comparison will be completed using Hydrologic Engineering Center- River Analysis System (HEC-RAS) which is capable of generating flood depth grids in a 30 by 30 mesh. Quantitative comparison of the water surface profiles and depth grids will indicate difference of flooding extent, volume, and maximum flood height.

Keywords: Flood Modeling, LiDAR Data, Flood Inundation

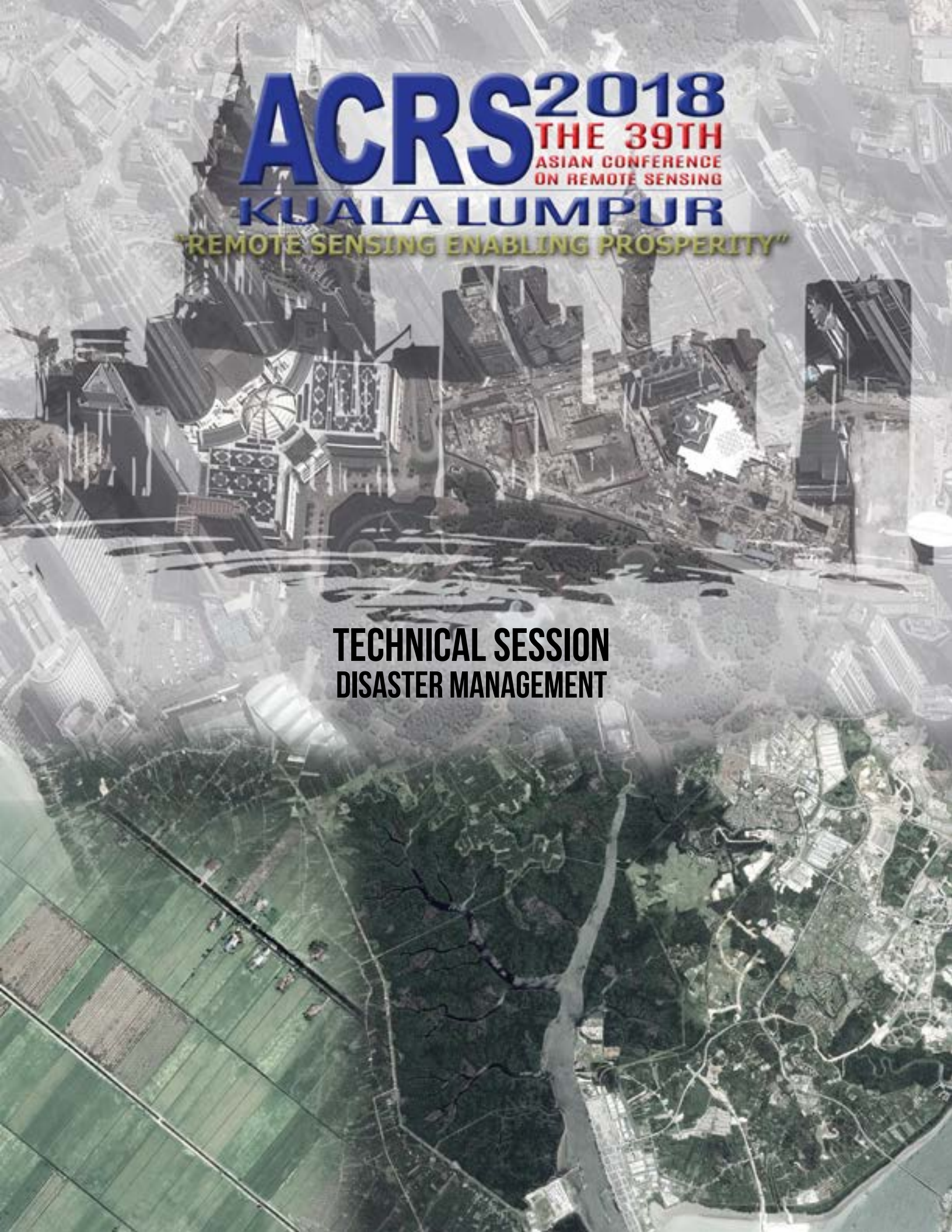
ESTIMATING ABOVEGROUND CARBON STOCK CHANGES FROM MULTI-TEMPORAL AIRBORNE LIDAR DATA IN A TROPICAL MONTANE FOREST OF SABAH

Daniel James (1), Mui-How Phua (1), Keiko Ioki (1), Wilson Vun Chiong Wong (1), Jim Jun Fei Liew (1)

[1] Forestry Complex, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, 88400 Kota Kinabalu, Sabah, Malaysia
Email: danieljames.ums@gmail.com; pmh@ums.edu.my; keiko_ioki@ums.edu.my; w.wilson@ums.edu.my; jimliewjunfei@gmail.com

Abstract: The tropical forest of Borneo is the richest terrestrial ecosystem in the world with the ability to store huge amount of carbon. However, the carbon sink function of the forest was undermined due to deforestation and forest degradation. Accurate estimation of carbon stock dynamics is crucial in order to understand the implications of forest disturbances on terrestrial carbon cycle. In this study, we assessed the ability of multi-temporal airborne Light Detection and Ranging (LiDAR) data to estimate the aboveground carbon stock (AGC) changes in a tropical montane forest of Sabah over a period of seven years. Approximately, more than 4000 ha of the study area were surveyed with airborne LiDAR in both 2011 and 2017. A total of 30 (30 m × 30 m) plots were established and measurements was taken at two phases of field inventory campaigns (Phase I: 2011-2014; Phase II: 2017-2018). The aboveground biomass (AGB) were derived from the field measured DBH and height using allometric equation and converted into AGC stock using a conversion factor of 0.50. The AGC estimation models were developed using stepwise multiple regressions based on the field estimated AGC and LiDAR height metrics for 2011 and 2017. The changes in AGC stock were calculated over the seven years time period by subtracting the 2011 AGC map from the one of 2017. Through spatial extrapolation of the AGC changes, the increases in AGC (positive values) are mainly caused by natural regeneration while the decreases in AGC (negative values) are greatly affected by anthropogenic activities. The results of this study shows that repetitive airborne LiDAR surveys have the capability to characterize the historical AGC stock changes in remote tropical forest at great accuracy. We believe that this study can contribute to reporting the current state of AGC stock in the tropical forest of Sabah which serves as vital information for policy and decision makers in the country for forest monitoring and management purposes.

Keywords: Aboveground Carbon Stock, Multi-Temporal Airborne Lidar, Tropical Montane Forest



TECHNICAL SESSION
DISASTER MANAGEMENT

BUILDING AN EARLY WARNING SYSTEM FOR MOUNTAINS AREA, CASE STUDY IN THUAN CHAU DISTRICT - SON LA PROVINCE

Ngoc Thach Nguyen (1), Thi Hong Nguyen (1), Xuan Canh Pham (1), Quoc Huy Nguyen (1)

[1] University of Science, Viet Nam National University, Hanoi

Abstract: Thuan Chau is a district of Son La province in the north mountainous region of Viet Nam. In the rainy season, it is one of the places where is mostly occurred flash flood hazard, causing significant damage to the localities. The early flash flood warning system includes 3 components online connection: automatic weather stations, WebGIS software and Web site. The system is based on hydrological and hydrological access to the catchment basin, which is based on the principle that hazards will only occur where there is a high potential risk and when heavy rainfall exceeds threshold. In the model build map risk of flash floods, eight parameters of the main basin and sub basins had been analyzed and evaluated the weight is determined by the pair-wise comparison methos of the Thomas Saaty-Analytics Hierarchy Process (AHP). Early flash flood warning software is built based on open source programming tools. With the spatial module and online processing in the internet, predicted precipitation of 1- 6 days early from the IMETOS automatic weather station will be interpolated and online integrated with the potential risk maps. The results will exactly determine the locations of flash flood at the risk level corresponding to the predicted rainfall values at the meteorological stations. The system was constructed and applied for early warning flash floods disaster in Thuan Chau district, Son La province by multimedia methods such as e-bulletin boards, SMS messages, Web pages or via traditional warning signals such as speakers or gag. Base on this informations, the manager and the end-users can make appropriate decisions in implementing the prevention before the catastrophe occurs. This technology is being expand applied in Viet Nam to avoid, minimize damage caused by the flash flood damage.

Keywords: flash flood, model, early warning, rainfall threshold, open source software

ENVIRONMENTAL STRESSORS ASSESSMENT FOR TROPICAL URBAN FLOOD USING EARTH OBSERVATION TECHNOLOGIES: A CONCEPTUAL FRAMEWORK

Mohd. Rizaludin Mahmud (1)(2), Mohd. Nadzri Mohd. Reba (1)(2), Jaw Siow Wei (1)(2), Noordyana Hassan (1)(2), Mazlan Hashim (1)(2), Nurul Nadiah Yahya (2), Mohd Taufik Razali (2)

[1] Department of Geoinformation, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
[2] Geoscience & Digital Earth Centre (INSteG), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
Email: rizaludin@utm.my; nadzri@utm.my; swjaw@utm.my; noordyana@utm.my; mazlanhashim@utm.my; nurulnadiahy@utm.my; mohdtaufik@utm.my

Abstract: The risk of the environmental stressors at the atmospheric, landscape and street-scale of drainage are vital in determining the resiliency level of urban ecosystems and adaptation initiatives to the high dynamics of tropical flood. However, depending on ground or field scale approach possesses limitation in terms of cost, coverage area, time-consuming and laborious tasks. The significant advancement of earth observation technology and related geo-solution is interpreted as effective measures to support the drawbacks. Therefore, the operational methodology ranging from the space to street-scale is the next technological gap towards the sustainable flood management in tropical city. In accordance to that, we had designed the conceptual framework in assessing the environmental stressors of tropical urban flood using earth observation technologies. There are three major phases in this framework, where each one emphasis environmental stressor assessment at atmospheric, landscape and drainage preferences. In phase 1, the assessment on hydro-climate hotspots is conducted. The thunderstorm will be classified based on their intensity and spatial scale; which suits the urban application. In phase 2, the landscape heterogeneity and its subsequent susceptibility to run-off will be determined. With the input from the hydro-climate condition, the landscape susceptibility to run-off of the prone areas to heavy thunderstorm will be examined by using the remote sensing images, elevation and related land use information from the satellite. In phase 3, the stressor of drainage will be assessed. With the input from phase 1 and phase 2, a groundwork will be done to examine the one of the important stressor to urban flood; the physical drainage condition. One of the main concerns in assessing the physical drainage is the constraint to check the implicit or closed drainage network. This framework make significant contribution in preparedness, prevention and relief phases of urban flood disaster management.

Keywords: Atmospheric, Landscape metrics, Drainage assessment, Remote Sensing

MEASURING BUILDING VULNERABILITY FOR SEISMIC HAZARD

Pooja B. Shah (1), Dr.J. M. Nongkynrih (2), Dr. Dipak Samal (1)

[1] CEPT University, Ahmedabad -380009, India
[2] North Eastern Space Application Center, Department of Space, Umiam-793103, Meghalaya, India
Email: poojabshah2512@gmail.com; jnongkynrih@gmail.com; dipak.samal@cept.ac.in

Abstract: Measuring vulnerability has always been an intriguing question for researchers and planners in the field of disaster management. With the advancing technologies, very high remote sensing data and geographical information system, offers a means to use ingeniously as a tool for management and planning of different scenarios of any hazard. The present study focuses on measuring building vulnerability due to earthquake. The study area is a case Shillong Planning area, which falls under seismic zone V. The study was screened off into three major stages. In the initial stage it focuses on building footprint extraction using high resolution imagery of CARTOSAT-2S (6m in Panchromatic and 1.6m in Multispectral). The various challenges were faced while extracting building footprints using automatic, semi-automatic and manual extraction method are addressed, because of the complex terrain of the study area. While, in the second stage it focuses on preparation of questionnaires to be collected from the field for the building characteristics. The Rapid Visual Screening method was adopted for studying the different types of buildings found in the area. Data are collected from the field using global positioning system. Integration of satellite derived data- building footprints and the field data in GIS platform was done. Factors affecting the Vulnerability of building to Earthquake like structure, wall material, number of floors, floor material, roof material were identified. Weighted overlay analysis was performed, to identify the vulnerable buildings, in case a seismic hazard.

Keywords: Database Generation, Earthquake, Building Vulnerability, Shillong

ASSESSING DEBRIS FLOW HAZARD WITH A MACHINE-LEARNING METHOD IN EL SALVADOR

Po-Cheng Yao (1), Shou-hao Chiang (1)

[1] Center for Space and Remote Sensing Research, National Central University No. 300, Zhongda Rd., Zhongli District, Taoyuan City 32001, Taiwan (R.O.C.)
Email: bcyao@csrsr.ncu.edu.tw; gilbert@csrsr.ncu.edu.tw

Abstract: Both catastrophic earthquake and heavy rainfall events are major triggering factors of land sliding. Sediments from failure materials of landslides may lead to serious debris flows in the subsequent rainfall event. Considering the above processes of debris flow, this study combines two landslide models, earthquake- and rainfall model, and a debris flow simulation to assess areas susceptible debris flow hazard in El Salvador. This study collected landslide data from two rainfall events (Nov. 2009 and Oct. 2011) and two earthquake events (Jan. 2001 and Feb.2001) to develop an earthquake model and a rainfall-model. The machine-learning Maximum Entropy (MaxEnt) method is applied to develop the two landslide models. With assuming 24-h rainfall of 350 mm and ground peak acceleration of 500 gals in the landslide modelling, the predicted landslide points (landslide probability>0.5) from the two models are treated as proxy of debris flow intonation points. Specifically, we performed 5 debris flow simulations, divided into different susceptibility levels. They are: debris flow initiation points greater than or equal to 0.5 (Medium Low), 0.6 (Medium), 0.7 (Medium High), 0.8 (High) and 0.9 (Very High), respectively. The generated debris flow hazard map fits the historical data well, indicating the applicability of the proposed method. We expect the outcomes can be used to improve to management of debris flow hazard in El Salvador.

Keywords: debris flow hazard, rainfall, earthquake, machine-learning, El Salvador

TROPICAL CYCLONES WIND RADII COMPOSITE FROM THE REMOTELY SENSED SATELLITE WINDS

Seubson Soisuvarn (1)(2), Zorana Jelenak (1, 2) and Paul Chang (1)

[1] NOAA/NESDIS/Center for Satellite Applications and Research,5830 University Research Ct., College Park, MD 20740, USA
[2] University Corporation for Atmospheric Research,P.O. Box 3000, Boulder, CO 80307, USA
Email: seubson.soisuvarn@noaa.gov; zorana.jelenak@noaa.gov; paul.s.chang@noaa.gov

Abstract: We evaluate the tropical cyclone ocean surface wind observations from the remotely sensed satellites. The satellite instruments that are capable of measuring the winds near the ocean surface are the scatterometers and the microwave radiometers. The scatterometer is an active radar instrument designed to measure both wind speeds and wind directions by indirectly derive the winds from the measured radar backscatter at the ocean surface. The scatterometers currently are in orbits include two ASCAT on board the Metop-A and Metop-B satellites and the Scatsat-1. The microwave radiometer is a radiometric instrument that are passively collect the brightness temperatures over the ocean surface and the atmosphere. The microwave radiometers currently are in orbits include AMSR2, GMI, SMAP, SSMI and Windsat. Unlike the scatterometers, the radiometers are capable of measuring only the wind speeds but not wind directions except for the Windsat which are a polarimetric radiometer. In this paper, we use the wind observations from the scatterometers and the radiometers over the tropical cyclone to create the wind radii composite.Each of the satellite orbits will be spatially and temporally collocated within 500-km radius and 30-minute time window, respectively, with the tropical cyclone best track data to create the matchup scenes For each scene, the standard wind radii of 34-knot, 50-knot and 64-knot will be computed and compared against the wind radii reported in the best track and then the normalized wind radii will be determined. Before the wind radii composite will be made, additional step is needed to normalize the different storm heading direction from each scene. The quality flags from each sensor will be applied appropriately. Finally, the wind radii composite will be constructed for each tropical cyclone track for each sensor. Finally, the statistical analysis of the wind radii composite derived from the different satellite sensors will be presented.

Keywords: Scatterometer, Radiometer, Wind, Tropical Cyclone

REMOTE SENSING ANALYSIS OF SPATIAL AND TEMPORAL DISTRIBUTION OF OIL CONTENT IN DALIAN PORT WATER AREA OF CHINA

Huang Miaofen (1), Liu Yang (2), Xing Xufeng (1), Wang Zhonglin (1), Sun Zhongyong (1)

[1] Faculty of Mathematics and Computer Science, Guangdong Ocean University, 524088 Guangdong Zhanjiang China
[2] PetroChina Exploration & Development Research Institute, 100083 Beijing, China
Email: hmf808@163.com; liuyang_rs@petrochina.com.cn; 4918585@qq.com; wzlin19@qq.com; 1027126966@qq.com

Abstract: Dalian Port is located in Liaodong Peninsula, as one of the 15 key construction port cities of the Belt and Road Initiatives, has a construction history of more than one hundred years. Most of the crude and refined oil in Northeast China has long been transported from here, which results in economic growth to some degree and at the same time, has an impact on the environment of the port water area. Due to crude oil spill, large ship transport and some other factors during loading and unloading, the waters in terminal area will be subjected to serious oil pollution. Analysing spatial and temporal distribution of oil content in Dalian Port water area can provide important reference for marine environmental regulation, pollution prevention, marine ecological protection and restoration. 20 remote sensing images shot by USA Landsat satellites (10 by Landsat-5 and 10 by Landsat-8) were used, 20 oil-bearing and 20 oil-free seawater test points were selected on each remote sensing image by means of profile method. The spectral characteristics of these test points were analysed and compared to find out the differences between the characteristics of oil-bearing seawater and oil-free seawater. The threshold of NDPRI (Normalized Difference Petroleum Remote Sensing Reflectance Index) derived from above steps was used to determine whether the waters is polluted by oil, and further the parameters of the remote sensing model for retrieving oil content in water were corrected. Finally, based on the Landsat-5 and Landsat-8 image data, the temporal and spatial variation characteristics of oil content in Dalian Port water area from June 1996 to June 2016 were analysed, and the causes of temporal and spatial variation were analysed combined with specific oil pollution diffusion characteristics.

Keywords: Remote sensing, spatial and temporal distribution, oil content, Dalian port

AN ASSESSMENT OF LANDUSE EFFECTS ON THE IMPLEMENTATION OF THE PROPOSED DAMS IN KUALA KRAI, KELANTAN

Syaza Faiqah Maruti (1), Shahabuddin Amerudin (1), Wan Hazli Wan Kadir (1), Zainab Mohamed Yusof (2)

[1] Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
[2] Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia
Email: syazafaiqah92@gmail.com; shahabuddin@utm.my; wanhazli@utm.my; zainabyusof@utm.my

Abstract: Flood catastrophe that has been hits Kelantan in 2014 cause damages and loss of life, particularly in Kuala Krai area (2,329 km^2). Topographically, Kuala Krai situated near to Kelantan river after the confluence of Galas and Lebir rivers. Consequently, the high flood magnitude from these two rivers when meanders to Kelantan river have resulting in Kuala Krai area to be greatly affected by flood. Therefore, Kemubu and Lebir dams were proposed to be built at the upstream area along these two rivers, which intended to reduce the flood hazard at the downstream area. However, there are several areas with various landuse types at the upstream before the dams and Kuala Krai area that will be affected by the implementation of the proposed dams. This paper is aimed to assess the impact on the implementation of the proposed Kemubu and Lebir dams to the landuse by using a hydrodynamic model. The hydrodynamic modelling of the 2014 flood event; with and without the occurrence of the proposed dams has been modelled using a 1D2D SOBEK hydrodynamic model. The Digital Terrain Model (DTM) of 15 m spatial resolution from Airborne Light Detection and Ranging (LiDAR) and Shuttle Radar Topography Mission (SRTM) data sources is used in the model. The flow hydrograph and water level are used as the input for initial and boundary conditions. From the flood simulation result, the flood extent areas are identified and then have been overlay with the landuse map of 2010, acquired from the Ministry of Agriculture. The area of the affected landuse by 2014 flood at the Kuala Krai area and the area at the upstream area before the dams was measured. The results revealed that the most affected landuse in Kuala Krai based on the landcover map of 2010 was oil palm with the area of 9.97 km^2. Meanwhile for the upstream area before the proposed Kemubu dam, the most affected landuse was rubber where the area affected was 10.07 km^2. As for the Lebir dam, forest was the greatly affected landuse with the area of 18.66 km^2.

Keywords: Flood Catastrophe, Kuala Krai, Hydrodynamic Modelling, Proposed Dams, Landuse Affected

STATISTICAL SPATIAL DOWNSCALING TECHNIQUE OF GLOBAL PRECIPITATION MEASUREMENT (GPM) PRECIPITATION USING SATELLITE DERIVED VEGETATION AND TOPOGRAPHIC DATA

Mohd Nadzri Md Reba (1)(2), Noor Emi Ramlan (1), Mohd Rizaludin Mahmud (1)(2), Mazlan Hashim (1)(2)

[1] Geoscience and Digital Earth Centre (INSTeG), Research Institute for Sustainability and Environment (RISE)
[2] Faculty of Built Environment and Survey (FBES), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
Email: nadzri@utm.my; nefadzilah@gmail.com

Abstract: Global Precipitation Measurements (GPM) is the latest satellite mission operated to map the atmospheric precipitation over the globe by virtue of 0.1º spatial resolution and 3-hour temporal resolution. The recent GPM precipitation data improves the hydrological modelling quality by giving reliable now casting hydrological parameters from its rasterbased precipitation pixels. Such advantages are best to be applied to map precipitation at regular period and higher diversity tropical rainfall particularly in Kelantan, Malaysia. Spatial resolution on pixels has greatly improved the modelling results by increasing the reliability and spatial accuracy of point measurement by gauge. Yet, the spatial variation propagates into GPM precipitation and has poorer correlation with gauges. This becomes more difficult if the gauge is sparsely located and having frequent void and unreliable readings. Therefore, localised precipitation map is needed and this may lead to spatial downscaling of the GPM precipitation image. Spatial downscaling approach determines the best scale at which the relationship between precipitation and other environmental parameters was established in the algorithm. Vegetation and local topography in the context of Normalised Difference Vegetation Index (NDVI) and Digital Elevation Model (DEM) respectively are common parameters being tested. Relationship of NDVI and DEM with GPM precipitation has never been tested in the Malaysia tropical rainfall and thus no intention was made for downscaling the GPM precipitation pixels. This study focuses to downscale the GPM precipitation by means of the statistical spatial downscaling method from the autocorrelation between the NDVI and DEM in Kelantan river basins. Online data repository of the GPM IMERG precipitation, Moderate Resolution Imaging Spectroradiometer (MODIS) derived NDVI and DEM from the Shuttle Radar Topography Mission (SRTM) are used for this study. Temporal integration used to derive monthly average of 3-hour GPM precipitation and 16-day MODIS NDVI products from Nov 2013 to Dec 2015. DEMs STRM at specific locations were selected and non-linear relationship between NDVI and DEM was used to predict the monthly precipitation. Monthly precipitation at 1km^2 was estimated from regression model and the residue between estimated and measured GPM precipitation was interpolated. Bias and average difference of GPM downscaled precipitation was evaluated by comparing with gauge data. NDVI shows good correlation with GPM precipitation particularly in pixels where the homogeneous vegetated area is available. Quasi flat area with consistent DEM improved the correlation coefficient. Exponential regression type gives more representation of relation between NDVI and DEM as the bias was reducing. Spatial downscaling on GPM using NDVI and DEM is straightforward and can be used to determine large-scale precipitation map in Kelantan river basin area.

Keywords: Global Precipitation Mission (GPM), Normalized Difference Vegetation Indexed (NDVI), Digital Elevation Model, Downscaling

SUPERVISED CLASSIFICATION FOR FLOOD EXTENT MAPPING USING SENTINEL-1 RADAR DATA

M.Gomathi (1), M.Geetha Priya (2), Krishnaveni.D (2)

[1] CIIRC-Jyothy Institute of Technology, Bengaluru, 560082 Karnataka, India
[2] CIIRC & Department of ECE, Jyothy Institute of Technology, Bengaluru, 560082 Karnataka, India
Email: goms.mano1992@gmail.com; geetha.sri82@gmail.com; mailkveni@gmail.com

Abstract: The flood inundated studies are important now days due to the uncontrolled human settlements and development in flood plains especially in countries like India. To regularize the development in flood plains it is needed to identify the flood prone zones by mapping the recurrently inundating areas. The objective of the paper is to map the flood inundation areas in parts of Godavari river basin using Sentinel-1A data during monsoon time. The Godavari basin is chosen as study area as it has witnessed severe flood impacts on its flood plains in recent years. Supervised classification techniques including random forest, KNN, KD-tree, maximum likelihood and minimum distance to mean are used as classifiers in this study for extraction of water pixels and to quantify the amount of area flooded. On an average it has been estimated that an area of 27.4412 Km^2 is flooded excluding existing water bodies before monsoon for the given subset of Sentinel-1A image covering a part of Godavari delta region using different classifiers. It has been observed that random forest classifier has performed in flood area extraction with nearly less than 1% variation with respect to the average value of extracted flood area obtained in comparison with other classifiers for a given set of data and training samples.

Keywords: Sentinel-1A, supervised classification, Flood extent, Godavari, classifiers

COMPARISON OF SPATIAL ERROR STRUCTURES BETWEEN TRMM PRODUCTS AND APHRODITE OVER THE INDOCHINA PENINSULA

Nattapon Mahavik (1), Sarintip Tantanee (2)

[1] Department of Natural Resources and Environment, Naresuan University, Phitsanulok, 65000, Thailand
[2] Department of Civil Engineering, Naresuan University, Phitsanulok, 65000, Thailand
Email: nattaponm@nu.ac.th

Abstract: Precipitation is essential factor to drive agricultural activities in the tropical region including Indochina peninsula (ICP). Natural hazards triggered by precipitation extremes such as drought, floods, and landslides have increased in the region over the past decade. Precipitation/rainfall estimates products from satellites occupying such high spatio-temporal resolution can be one of solutions for the disaster prevention and mitigation processes. However, the products need to be validated as well as understood in the spatial error structures prior to the application in the fields. In this study, we developed the method to validate the two products from TRMM Multi-satellite precipitation Analysis (TMPA) which are TRMM3B42 and TRMM342RT. The validating data as ground-based rainfall is derived from Asian Precipitation-Highly Resolved Observational Data Integration Towards Evaluation of Water Resources (Aphrodite). Python script and Base Map library have been used in this study to find spatial structure errors. We have found that both the spatial errors and detection of performance statistics such as POD, CSI and FAR have shown significant difference for both products in comparison between dry and wet seasons over the ICP for the selected year of 2004 as a case study. The discussion of the possible reasons in the difference will be provided in the full paper.

Keywords: Satellite Rainfall Estimates, Indochina Peninsula, Validation, Python, Base Map

APPLICATION OF GEOGRAPHICAL WEIGHT REGRESSION (GWR) METHOD FOR SPATIAL AND TEMPORAL DOWNSCALING OF SATELLITE DERIVED PRECIPITATION DATA IN KELANTAN BASIN

Mohd Nadzri Md Reba (1)(2), Noor Emi Ramlan (1), Mohd Rizaludin Mahmud(1)(2), Mazlan Hashim (1)(2)
[1] Geoscience and Digital Earth Centre (INSTeG), Research Institute for Sustainability and Environment (RISE),
[2] Faculty of Built Environment and Survey (FBES), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
Email: nadzri@utm.my; nefadzilah@gmail.com

Abstract: An improved spatial and temporal resolution of the new precipitation data derived by Global Precipitation Measurement (GPM) satellite provides great advantage for hydrological model and thus complementing the gauge limit. Though spatial variation generated by the raster-based GPM pixels within 0.1˚ has led to special intention for downscaling the precipitation estimate to reduce the spatial bias. Statistical approach that is commonly used in downscaling precipitation data requires higher correlation with the other objective environmental data at higher spatial resolution to determine the best scale. The relationship is always difficult to be established due to lower quality of objective data and significant environmental perturbations. This study is therefore designed to overcome the spatial variation and correlation issue and the geographically weighted regression (GWR) method was introduced. The GWR applies spatial and temporal differences as input to the correlation model. For this study, the relationship between GPM precipitation and the vegetation and local topography was hypothesised, and Kelantan basin was chosen because of the higher diversity of rainfall recorded. Normalized Difference Vegetation Index (NDVI) and Digital Elevation Model (DEM) derived from Moderate Resolution Imaging Spectroradiometer (MODIS) and Shuttle Radar Topography Mission (SRTM) respectively was considered. The 1-km MODIS NDVI products of 16 consecutive days taken from November to December 2014 was used along with SRTM DEM of 1km resolution. MODIS NDVI were monthly averaged and spatially integrated into 10 km resolution to match with GPM precipitation pixels. Similar spatial integration was applied on SRTM DEM. The central pixel coordinates of MODIS NDVI and SRTM DEM were selected and applied in GWR algorithm to produce the regression coefficient at finer scale. The estimated GPM precipitation was extracted based on the new regression outputs. Independent precipitation estimates from ground gauge were utilised in the final evaluation. This study found that the spatial bias was reduced up to 30% particularly for the pixels located in vegetated areas. Flat terrain with consistent DEM may help to reduce the spatial bias. The GWR approach has proved as the alternative downscaling method for raw GPM precipitation data.

Keywords: Downscaling, Geographical Weight Regression (GWR), Global Precipitation Measurement (GPM), Normalized Difference Vegetation Index (NDVI)

COMPARASION OF TSUNAMI MODELLING ON DISASTER RISK REDUCTION MANAGEMENT AT NUSA PENIDA ISLANDS

Yamuna Jiwaningrat M (1), Gerry Utama (1). Andi Abdul Manaf (2)

[1] Departement of Environmental Geography, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang , Sekip Utara, Bulaksumur, Sinduadi, Kabupaten Sleman, Daerah Istimewa Yogyakarta, Indonesia 55281
[2] Departement of Development Geography, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang , Sekip Utara, Bulaksumur, Sinduadi, Kabupaten Sleman, Daerah Istimewa Yogyakarta, Indonesia 55281
Email: yamunajiwaningrat@gmail.com; gerry.utama@mail.ugm.ac.id; manaf_sinjai@yahoo.com

Abstract: Bali Island is the most famous global tourism destination. Domestical and international visitor are always visited Bali when the holiday was come. Based on Beareu of statistics of Bali Province, at least 1 milion tourist visited bali every year in last decade. Popular destination in Bali is Nusa Penida's Islands. Nusa Penida islands are pack of islands that include: Nusa penida, Nusa Lembongan, Nusa Ceningan, and other little islands, that located at southern east Bali. Nusa Penida's island visitor mostly have done their activity in coastal area. Southern of Bali Island that directly facing to India Ocean is located close to most active tectonic plate in the world. The one most terrific disaster that may occured is Tsunami. Therefore, deep study about tsunami must be held to reduce possibility of risk that may be happened there, including modeling. Digital Elevation Model (DEM) data have an important rule in modeling process. Three different model could be used to asses risk in Nusa Penida's islands such as; simple elevation model, roughness index model, and also spreading model with iteration model. From those three model, different result would be conducted are inundation area with 10, 20, 50, and 100m tsunami run up scenario. Hopefully, these result may showing affected area of tsunami, and signification differrentiation between model to display the result. Moreover, these model could be used to plan risk reduction program in Nusa Penida islands.

Keywords: coastal, tsunami, modelling, DEM, risk reduction

SPATIAL MANAGEMENT PLANNING FOR RESTORATION OF SMALL TANK CASCADE SYSTEM IN SRI LANKA

K.D. Fernando, W.H.A. Shantha, G.M.W.L. Gunawardena

Email: kdftcp176@yahoo.com; w.lakpriya@gmail.com

Abstract: Long drought condition is a common weather phenomenon in Sri Lanka. This regime in the weather condition adversely affects the livelihood of the farmer population specifically and the rest in the dry and transitional climatic zones of the country. As many studies pertaining to small tank cascade system emphasized its importance in its hydrological system. This is formed and activated by the natural topographical formation which generates the gravity flows and storage of rain water. The indigenous settlements are evolved in a compatible manner with the ecology and the hydrology. This was an impetus to design their agro-culture based livelihood which leads into traditions and its embraced vivid cultural norms and standards. Accordingly natural forest and the soil catena have been well maintained in carrying out their activities. The village layout of this purana or indigenous village is a testimony to fame as a n indigenous knowledge which exists in the country. This has led to manage the natural assets which derived from the ecology and its biodiversity and the natural hydrology. This planned small tank eco- hydrology driven village settlement has its layout plan determined by the physical formation of the location. However, at present this cohesion was destroyed by the haphazard development plans throughout the country. Due to this destruction, hordes of environmental, social and economical issues emerged in Sri Lanka. This research focus on studying the spatial management of villages with the tank cascade systems which was once successful in ancient time periods. To analyze the possibility of rearranging the current villages to overcome the existing issues due to drawbacks of haphazard developments at present, K urunegala district of Sri Lanka was selected. The ancient spatial management was sketched out with the help of literature and the current condition was mapped out with the help of remote sensing. The drawbacks of current spatial management were identified with the help of secondary data and remote sensing techniques. New spatial management system was proposed to minimize the prevailing issues comparing ancient spatial management methods and the current condition while proposing practicable alterations to the current spatial management system.

Keywords: Eco-Hydrology, Restoration, indigenous, small village tanks, spatial management

PERMANENT AND TEMPORARY HAZARDS IN SYRIA AND ITS STUDY USING SPACE DATA

Mohamad Rukieh (1)

[1] Damascus University, Geographic Faculty, Syria –Damascus- Mazeh- P.O.Box 9916
Email: rukiehm@gmail.com

Abstract: The objective of this research aims to identifying the Hazards that are affected by the Syrian lands, which can lead to serious disasters. I have been classified it to permanent Hazards, as:- Earthquakes associated with faults of Arabian Rift Zone, - Desertification associated with Drought and Human activity , -water, air and soil Pollution , associated with industrial facilities, transportation, agricultural activity and oil pollution .- Land degradation. Temporary Hazards, as: -Dust and windstorms, -Forest Fires, -Snowstorms, -frost, -heavy rain, -extremes temperature, -Floods, -Landslides. The research also focuses on "studying and monitoring these risks using space data and field Studies, we used in our research, data of next Satellites ,Earth Observation Satellites - Navigations Satellites - Meteorological &weather satellites, for mitigation of these Hazards and disasters. As a result, we have prepared many maps of different scales, which illustrate the locations of these risks and determine their degree of seriousness, especially for Earthquakes, Desertification, pollution, Forest Fires and Land degradation. Conclusions: This research confirms the permanent and temporary risks on Syrian lands and shows that the integration of space data and field investigations is the best way to study these phenomena, evaluate and mitigate their effects.

Keywords: Hazards, space data, Syria, Maps

DISASTER SITUATION REPORT BASED ON GENERAL PUBLIC RESPONSE: A STANDARDIZATION PERSPECTIVE

Lin Hao Huang (1), Jung Hong Hong (1)

[1] No. 1, Da-xue Rd., East District, 70101 Tainan City, Taiwan
Email: cathy840101@gmail.com; junghong@mail.ncku.edu.tw

Abstract: Taiwan is located in an area often struck by natural disasters like typhoon or earthquake. To enable the general public aware of the coming threats of hazards, the disaster relief agencies are required to monitor the continuously changing situations and provide immediate help to the disaster sites. The source of hazard information may widely include individual agencies' own systems, sensor web, IoT devices, exchange with other agencies or even social media (e.g., Facebook) and citizens. The content may be as simple as a photo with a few words or as complex as integrated reports about the hazard information of a region. The past practices often require a tremendous volume of manual operations to overcome the heterogeneity barriers, and even extra edition to make the acquired information (e.g., geotagging the photo) good for response decision making. An effective mechanism is therefore desperately necessary for improving the efficiency for automatically handling the variety types of hazard information from different resources in a timely manner. Social media has become an increasingly important source for collecting and updating the real-time disaster situations. This paper examines the requirement and processing strategies of hazard information collected from the general public from the standardized framework in the EDXL Situation Report standard. By determining the essential requirements of reporting emergent situations in terms of location, time, descriptions and media, strategies using geocoding service, time management, real-time and historical hazard information are developed. Validated hazard information is then encoded in the standardized format for further analysis or exchange. As the EDXL SitRep standard can suffice the needs for further exchanging information between different agencies, we believe this paper can contribute to expand the capability of taking advantages of the extraordinary valuable information from the general public for better emergency response and recovery.

Keywords: social media, situation reports, EDXL

STUDY ON COUNTRY-BASED FLOOD RISK INDEX USING GLOBAL MONITORING DATA

Yoshiyuki Imamura (1)

[1] International Centre for Water Hazard and Risk Management under the auspices of UNESCO, Public Works Research Institute, 1-6 Minamihara, Tsukuba, Ibaraki, 305-8516, Japan
E-mail: imamura-y573bs@pwri.go.jp

Abstract: The frequency and severity of flood disasters has been increasing around the globe. Therefore, it is needed to evaluate and compare the risks among different countries and regions and to use the results of such analysis as a guide in formulating policy and countermeasures to prevent disasters and mitigate their impact. In this study, we categorized flood risk into four dimensions (exposure, basic vulnerability, soft countermeasures, and hard countermeasures) and used this categorization to calculate the flood risk for individual countries. We developed a methodology to compute Flood Risk Index by using global datasets combined with satellite remote sensing data, such as a Global Precipitation Measurement data and identified flood risk factors in different countries. The examples of the study's outcomes are as follows. Many of the countries with high flood risk are located near the equator in Southeast and South Asia. In these countries, the greatest contributing factor to high flood risk is increased hazard due to high precipitation. Although Japan has a high hazard score due to high precipitation, flood risk remains relatively low thanks to high coping capacity scores stemming from factors such as the country's high literacy rate. The significance of this study lies in the fact that we were able to collect, use, and analyze global monitoring data (from satellites and space-based radar) that contain flood-related data for developing countries, for which such information is scarce, as well as the fact that we were able to use these data to evaluate flood risk for different countries around the world by a consistent methodology. In addition, we demonstrated that the use of satellite data, which can be continuously collected, is an effective method for analyzing changes in flood risk over time. It is expected that the results of this study will be useful in the formulation of flood management policy and will promote expansion of the ways in which global monitoring data are used.

Keywords: country-based, flood risk index, global monitoring data, satellite data

APPLYING MODIS AND LANDSAT IMAGES FOR EVALUATING URBAN COOL ISLAND EFFECT

Yu Qi Lin (1), Tzu Heng Chou (2), Sendo Wang (3)

[1] Department of Geography, National Taiwan Normal University,
No. 162, Heping E. Rd. Sec. 1, Da'an Dist., Taipei City 10610, Taiwan (R.O.C.)
Email: kiki850729@gmail.com; tracymcgrady0124@gmail.com; sendo@ntnu.edu.tw

Abstract: Both MODIS and Landsat provide the land surface temperature (LST) images, but their images are slightly different both in the spatial resolution and in the calculation of LST. The MODIS retrieves LST from thermal infrared response at the spatial resolution of 1 kilometer, whereas the Landsat TM images retrieve LST from band 7 shortwave infrared response with the spatial resolution of 30 meters. These differences are the focus of this paper and are evaluated in the process of finding urban cool islands (UCI). Taipei City is selected as our research area. The heat generated from high-rise buildings and artificial impervious surfaces in Taipei results in the urban heat islands. Yet, there are also several urban parks with high-density vegetation coverage where can cool down the surface temperature of the city. Thus, we expect to acquire large-scale LST by multi-temporal MODIS and Landsat images, considering the relationship between the green area in downtown and the spatial resolution of images, and assessing how large the green area may result in the UCI. Finally, we also use the temperature actually measured by the ground weather station for validation, analyzing whether both of two images can be used to evaluate the UCI effect.

Keywords: MODIS, Landsat, Land Surface Temperature (LST), Urban Cool Island (UCI)

FLOOD HAZARD MAPPING IN THE FLOODPLAIN OF MALINGON RIVER, VALENCIA CITY, MINDANAO, PHILIPPINES

George R. Puno (1), Bryan Allan M. Talisay (2), Rose Angelica L. Amper (2)

[1] College of Forestry and Environmental Science, Central Mindanao University, Musuan, Maramag, Bukidnon, Philippines
[2] GeoSAFER: Northern Mindanao/Cotabato Project, Central Mindano University, Musuan, Maramag, Bukidnon, Philippines
Email: grpuno@cmu.edu.ph; bryanallan.talisay@gmail.com; roseangelica_amper@yahoo.com

Abstract: Flooding becomes one the most challenging natural calamities in the Philippines today risking the lives and properties of the affected communities. Loss of lives and livelihoods due to flood hazards made the government to consider the need of research aiming to mitigate flood impacts and to increase the level of awareness thereby creating more adaptive and resilient communities. This study involved the combined technologies of Geographic Information System (GIS), Light Detection and Ranging (LiDAR)-derived digital elevation model (DEM) and the families of hydrologic models like Hydrologic Engineering Center-Hydrologic Modelling System and -River Analysis System (HEC-HMS and HEC-RAS). The aim was to determine the amount and timing of precipitation-runoff relationships in the upstream watershed, and performing two-dimensional hydraulic calculation in the flood plain of Malingon River in Valencia City, Mindanao, Philippines. Models were calibrated and the generated flood hazard maps were validated using actual datasets gathered from the field. Maps for different scenarios like 5-year, 10-year, 25-year, 50-year and 100-year return periods were generated. Statistical analysis of features like buildings and other infrastructures exposed to different level of flood hazards was likewise conducted. Output of the study served as important basis to a more informed decision and a science-based recommendations in formulating policies and ordinances for more effective and cost-efficient management relative to flood hazards both at the local and national level.

Keywords: flood hazard, mapping, modelling, GIS, LiDAR

A FRAMEWORK OF CLIMATE DISASTER RESILIENCE INDEX (CDRI) FOR ENVIRONMENTAL COMPONENTS IN KUKUP-TANJUNG PIAI, JOHOR

M.Zainora Asmawi (1), Illyani Ibrahim (1), Megat Sahrir Zainal (2), Suriani Zainal Abidin (2), Khamarrul A.Razak (3) and Wan Nurul Mardiah Wan Mohd Rani (3)

[1] Department of Urban and Regional Planning, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur
[2] Environmental Planning Group Sdn Bhd, 53B, Jalan SG3/19, Pusat Bandar Sri Gombak, 68100 Batu Caves, Selangor
[3] Department of Science, Management and Design, Razak School of Engineering and Advanced Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, Kuala Lumpur
Email: zainora@iium.edu.my; i_ibrahim@iium.edu.my; epgplanning@gmail.com; wnurul.kl@utm.my

Abstract: Over the time, Malaysia has been experienced environmental related disasters in relation to the impact of climate change and its associated phenomena. Disasters such as monsoon flood, erosion and landslide are amongst the most common ones hit Malaysia. In this regards, Malaysia highly emphasises the need for having an appropriate management system for disaster risk strategies in its 11th Malaysia Plan (2016-2020), which is parallel with the aspiration of Sendai Framework for Disaster Risk Reduction (2015-2030). The issue of coastal erosion concerning sea level rise has merged significantly in Kukup-Tanjung Piai, Johor. Hence, this research was initiated to develop a framework of the Climate Disaster Resilience Index (CDRI) for environmental components, reflecting the importance of environmental dimensions within the context of land use planning. The analysis is based on a comprehensive review of the literature and used the international directive in developing the proposed framework. This paper presents the GIS-based process in developing a framework of CDRI for environmental components. There are five geographical settings namely built-up areas, forest reserve, erosion, coastal areas, and rivers applied as GIS database for generating the spatial risks areas of coastal erosion. Whereas, the result for CDRI was obtained via conducting a Focus Group Discussion (FGD) session with 23 participants of various government technical officials. The findings of DCRI indicate that the average score of resilience is relatively moderate with a score of 3.52. The frequency of hazard records the highest score at 3.87 and ecosystem has the lowest score of 3.20. These findings are of particular importance to Pontian District Council and other technical agencies to strengthen their ability and capacity as responding to the risk of coastal erosion in Kukup-Tanjong Piai.

Keywords: resilience, environmental components, disaster, coastal erosion, land use

PRACTICE AND EVALUATION OF SCIENCE, TECHNOLOGY AND DISASTER PREVENTION EDUCATION USING EARTH OBSERVATION RESULTS

Yosuke Ito (1), Ikuya Doi (1)

[1] Naruto University of Education 748 Takashima, Naruto-city, Tokushima Pref. 772-8502, Japan
Email: ito@naruto-u.ac.jp; 16827037@naruto-u.ac.jp

Abstract: From experiences of disaster due to crust activity such as volcanic activity and earthquake, excellent technology is necessary for disaster prevention and reduction. Learning about the disaster prevention based on the science and technology is important. Since the disasters caused by crustal activities generally occur in a wide area, the Earth observation results by artificial satellites are useful for the disaster prevention. Especially, it is possible to generate fine ground surface deformation as a ripple image by interfering SAR data before and after an event. The purpose of this research is to develop science, technology and disaster prevention education in a secondary school using Earth observation results and to evaluate its learning effect. The aim of this education is to use information technology to measure topographic change due to the volcanic activity or the earthquake and analyze the results from a scientific point of view to make it useful for the disaster prevention. In this learning, the topographic change due to the crustal activities is imaged by using the information technology and knowledge on disaster prevention is deepened by analyzing the produced image. Understanding the principle of interferometric SAR technology generally requires advanced knowledge of mathematics and physics. However, the change of the ground surface along Radar beam direction can be easily estimated from the shape and density of ripples appearing in the produced image. Therefore, SAR datasets that can generate clear interferometry are adopted in this education. The target learners are junior high school students. A learning guidance plan was drawn up as eight unit hours. The SAR data used as a teaching material was observed by Sentinel-1 SAR. SNAP (SeNtinel Application Platform) which is provided free of charge from the European Space Agency as interferometric SAR processing software is employed. As a result of teaching practice according to the developed teaching guidance plan, it was found that the students could perform the interferometric SAR processing using SNAP and the other application software. They also could read ripple images properly. The learning effects were clarified based on the analysis of pre- and post-learning surveys.

Keywords: Disaster prevention, Interferometric SAR, Earth observation, Secondary education

GRAPHICAL COMPARISON OF EROSION WITH MULTIPLE DEMS

Walter Chen (1), Yi-Hsin Liu (1)

[1] Department of Civil Engineering, National Taipei University of Technology,
1 Sec. 3 Chung-Hsiao E. Rd., Taipei 106, Taiwan
Email: waltchen@ntut.edu.tw; egyn55420@gmail.com

Abstract: Literature suggests that the topography factor of a watershed is the most important element in the computation of soil erosion at the watershed scale. In this study, we collected eight different DEMs and used them to compute soil erosion in the Shihmen reservoir watershed of Taiwan to examine the effect of DEM on soil erosion. The Rm, Km, C, and P factors of the Universal Soil Loss Equation (USLE) were kept constant and different DEMs were substituted into the model. Our results show that the amount of estimated soil erosion is heavily dependent upon the DEM used in the analysis, but the relationship between the two variables is still unclear.

Keywords: Shihmen reservoir watershed, DEM, erosion

MULTIPLE EVENT-BASED LANDSLIDE MODELING METHOD USING ARTIFICIAL NEURAL NETWORK

Chiang Shou-Hao (1), Emmanuel Léonard (1)

[1] Center for Space and Remote Sensing Research, National Central University, 300, Jhongda Rd., Jhongli District, Taoyuan City 32001, Taiwan
Email: gilbert@csrsr.ncu.edu.tw

Abstract: Landslide hazard assessment is able to be conducted by analyzing historical landslide events which can be caused by different triggers, including heavy rainfall, earthquake and human activities. For landslide modeling, many studies have focused on developing landslide models based on single landslide event (rainfall or earthquake). However, considering the variations of different events, regarding their magnitude and distribution of induced landslides, this study examines the difference of modeling results between two approaches: (1) single event-based modeling (SEB): developing a landslide model using data from one typhoon event, and validate the model with other two typhoon events, and (2) multiple event-based modeling (MEB): developing a landslide model using data from two events and validate the model with the other event. Yushan National Park (YNP), located in central Taiwan, was chosen as an ideal test site where has been continuously affected by typhoons with different magnitude, creating a complex landslide environment. In this research rainfall data of three typhoons that struck YNP in 1996, 2001 and 2009 were collected to develop the SEB and MEB landslide models using Artificial Neural Network (ANN). The model outcomes were validated by manually interpreted landslide inventories of each typhoon event, and the result shows multiple event-based models perform better than single ones. For SEB, the validation accuracies vary form 68% – 88%, and 87% – 91% for MEB. In average, the validation set accuracies are: 78% for SEB, and 89% for MEB. This study demonstrates the importance of considering multi-events in landslide modeling, and also reveals the applicability of ANN method in landslide hazard assessment.

Keywords: landslide, multiple landslide event, Artificial Neural Network, typhoon

DEVELOPMENT OF OFFLINE APPLICATION UTILIZING GEOSPATIAL INFORMATION FOR FIELD SURVEY AT LARGE-SCALE DISASTERS

Yuki Okajima (1), Yasuhiro Mitani (1), Hiro Ikemi (1), Takuto Hayashida (1), Satoru Kimura (1)

[1] Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan
Email: okajima@doc.kyushu-u.ac.jp;mitani@doc.kyushu-u.ac.jp; ikemi.hiro.017@m.kyushu-u.ac.jp; takuto@doc.kyushu-u.ac.jp; kimura.satoru.767@s.kyushu-u.ac.jp

Abstract: In the Great East Japan Earthquake that occurred on March 11, 2011, massive damage occurred due to a wide area tsunami. In response to this large-scale disaster, the country, prefectures, municipalities dispatched personnel to the site and carried out relief and field survey, but had to act without having sufficient local information such as the map and the damage situation. In addition, mobile phones were also discontinued (offline state) over a wide area, causing troubles in information collection and transmission at the site. Meanwhile, at the disaster headquarters, geospatial information including satellite data played a major role in grasping disaster situations. Therefore, we developed an offline application of Android which has the function to utilize the geospatial information in the field survey at the time of a large-scale disaster. We also developed a system that displays posted local information and tracking information so that it can be used for decision support at the disaster headquarters. We demonstrated the usefulness of the developed offline application in field survey of heavy rain disaster in northern Kyushu occurred on July 5, 2017. As a result, local information and tracking information can be collected even when offline, and geospatial information is useful as reference information for field survey. In addition, the local information and tracking information posted online were useful for grasping the overall picture of the disaster.

Keywords: Disaster Response, Field Survey, Offline Application, Geospatial Information

NEAR REAL-TIME FLOOD FORECASTING USING IFSAR AND LIDAR DERIVED HYDROLOGIC MODEL OF TUMAGA RIVER, ZAMBOANGA CITY

Glenn Leandri Brylle L. Lamparas (1) , Isnailah S. Ontong (1), Raymond T. Ong (1), Augustini Ave O. Paduganan (1), Emir V. Epino (1), Mario S. Rodriguez (1)

[1]ADZU Geo-SAFER Mindanao: ZAMBASULTA, Ateneo de Zamboanga University, Philippines
Email: lamparasglel@adzu.edu.ph

Abstract: The occurrence of flooding in the Philippines is common as it is geographically located along the Pacific region. Heavy rains brought by typhoons, low pressure areas and monsoons is a major problem in the country mainly in the urban communities and agricultural lands. With this, the Ateneo de Zamboanga University Geo-SAFER Mindanao developed a system that will help the communities prepare for flood brought by heavy rains in the Tumaga River basin. A hydrologic model is prepared by resampling an Interferometric Synthetic Aperture Radar (IFSAR) Digital Terrain Model (DTM) which is then mosaicked with Light Detection and Ranging (LiDAR) DTM. The mosaicked DTM provides accurate and detailed elevation data and geometry which produces precise subbasin and reach delineation. The model parameters are derived from vector data from government agencies that are concerned in land use, land cover and soil mapping. The model utilizes three (3) Automated Rain Gauges (ARG), three (3) Water Level Sensors and a Tandem Sensor from the Department of Science and Technology- Advanced Science and Technology Institute (DOST ASTI) that are located inside and near the river basin. The ARGs are integrated to the meteorological model which utilizes inverse distance method that is designed for application in real-time forecasting systems. The real-time precipitation data are automatically incorporated to the model using HEC Data Storage System. The HEC HMS Model simulates discharge data in four (4) water level monitoring stations along the twenty (20) kilometer reach of the river. The hydrologic model is calibrated and validated using observed data gathered in the field. The discharges simulated from the validated model are then converted to water levels which are verified using historical data in each monitoring stations. The system forecast flood water levels for the next eight (8) hours in a ten (10)–minute interval. The system is then finally integrated to an existing web platform for access. With this system, the urbanized community of Zamboanga City will be aware of the impending flood in the different sections of the river and will also enable the local government unit for any precautionary measures.

Keywords: Flood Forecasting, Hydrologic Modeling, HEC HMS

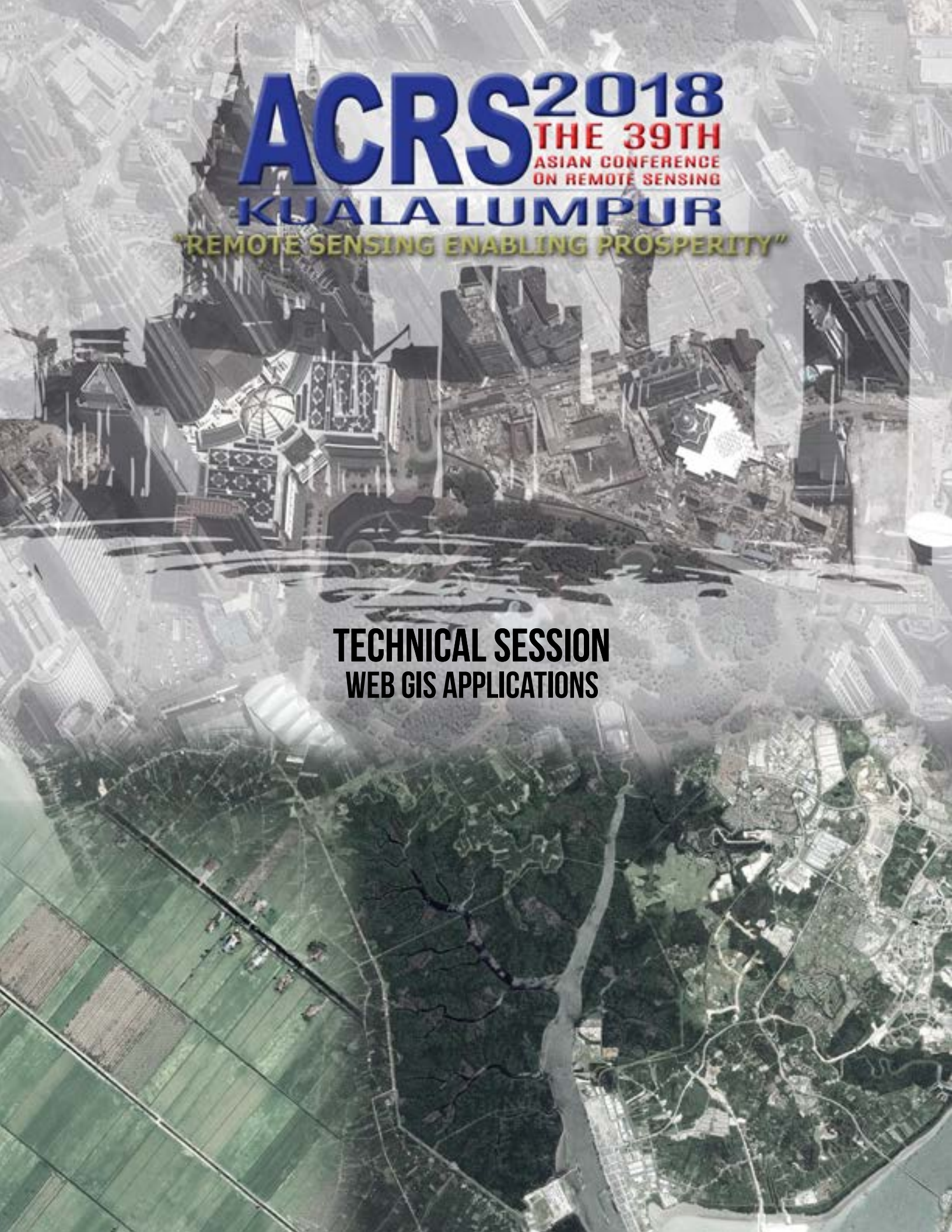
THE IMPACT OF USING THE AUTOMATED WATERLEVEL AND RAIN MONITORING USING NEAR REAL-TIME OBSERVATION SYSTEM (ALeRTO) TO LOCAL GOVERNMENT UNITS (LGU) AS AN EARLY WARNING SYSTEM FOR FLOOD PRONE AREAS IN ZAMBOANGA PENINSULA, PHILIPPINES

Raymond T. Ong (1), Mario S. Rodriguez (1), Emir V. Epino (1), Julemer Ann G. Aying (1), Glenn Leandri Brylle L. Lamparas (1), Rengie Bagares (1)

[1] ADZU Geo-SAFER Mindanao: ZAMBASULTA, Ateneo de Zamboanga University, Philippines
Email: ongrayt@adzu.edu.ph

Abstract: Philippines is one of the countries that appears to be part of the typhoon's favorite spot and the desolation brought by the typhoons to the people, structures and livelihood are undeniable. Ateneo de Zamboanga University GeoSAFER ZAMBASULTA with Department of Science and Technology Region IX, created ALeRTO or Automated Waterlevel and Rain Monitoring using near Real-time Observation as an early warning system to help the Local Government Units (LGU) by giving lead-time with their respective river basin from possible flooding. This system uses the existing sensors installed by the Advance Science and Technology Institute (ASTI) (i.e. ARGs – Automated Rain Gauges and WLMS – Waterlevel Monitoring System) located at different bridges and upstream areas. The system follows the color warning system (yellow – warning, orange – alert, red - critical) identified by the National Disaster Risk Reduction Management Council (NDRRMC). The LGUs can view their respective status of their rivers thru the website of ALeRTO and at the same time a text message will be sending to the point person per LGU. With their data, the LGU can act accordingly with their emergency plan. ALeRTO system is being used by the City Disaster and other parts of Zamboanga Peninsula in monitoring their river's status. The purpose of this project is to lessen to zero casualties by giving an early warning to each concerned units/agencies when natural disaster is present. This system is focused on localized thunderstorms and Low Pressure Areas which are not covered by the NDRRMC system. One of these days, no one is not informed and nobody gets behind.

Keywords: near real-time monitoring, localized, sensors, alert system, web application



TECHNICAL SESSION
WEB GIS APPLICATIONS

DEVELOPMENT OF SPATIAL ENABLED WEB-APPLICATION FOR GOVERNANCE: A CASE STUDY OF FDCA, GOVERNMENT OF GUJARAT

Shaily Raju Gandhi (1), Dr Anjana Vyas (2)

[1] Faculty of Technology, CEPT University, Kasturbhai Lalbhai Campus, University Road Ahmedabad-380009, Gujarat (India)
[2] Center of Applied Geomatics CEPT University, Ahmedabad - 380009, Gujarat (India)
Email: shaily.gandhi@gmail.com; anjanavyas@cept.ac.in

Abstract: Health is a critical issue for the human being. Good Health can bring good economy. Pharmaceuticals play an important role in the health so as the economy of the county, hence the regulatory system of the nation has to be very efficient in checking the quality of the pharmaceutical drugs. Food and Drugs Administration (FDCA), Gujarat has been pioneer developing E-governance platform which is now replicated in 16 other states. Adaptation of technology enhances the administrative efficiency of the governance. The objective of the study is to examine the possibilities (possible areas) for the use of geospatial technology in the governance of drugs. This study identifies the potential use of Geospatial Technology in the governance of FDCA. A prototype of web application is developed for one of the circles emphasizing the adaptation of geospatial technology for this organization. The study proves the use of spatially integrated analysis enriches the governance in decision making

Keywords: Health, Pharmaceutical Drugs, e-Governance, Geospatial Technology, Decision Making

THE PROBLEMATICS OF INDONESIAN GEOPORTAL AND ITS FUTURE STRATEGIES

Fahmi Amhar (1)

[1] Center for Research, Promotion and Cooperation Geospatial Information Agency, Jl. Raya Jakarta-Bogor Km. 46 Cibinong, Indonesia
Email: fahmi.amhar@big.go.id; famhar@yahoo.com

Abstract: Geoportal is one of the foremost components of the One Map Policy. Geoportal is also the spearhead of the Geospatial Information Infrastructure. Recently, Indonesia's geoportal (Ina-Geoportal) is still in minimal utilization. In this preliminary research, Ina-Geoportal problematics has been expolored using 10-C methods. The methods provided various possible for the causes of problematics and also offers some strategies for future geoportal optimization. Among the causes are the inefficient database design and the lack of user-friendly applications. Furthermore is the quality of the data itself.

Keywords: geoportal, 10C, user-friendly interface, database-design

DEVELOPMENT YEMEN DAMS INFORMATION SYSTEM USING WEB GIS

Ayoub Ahmed Almhab (1)

[1] Ministry of Agriculture and Irrigation, Researcher, Head MIS-GIS Unit, Sana'a, Republic of Yemen
Email: ayoub.almhab@gmail.com; almhab@live.nl

Abstract: This paper discusses the development of the Yemen Dams Management Information System (YDIS) and water barriers in Yemen based on the Internet, databases and geospatial data, as well as analysis characteristics through spatial structure and spatial data tables (attribute data) for dams and water barriers in Yemen. Modern information technology networks, databases and geographic information systems have been used and implemented in this system, which included 648 dams and a water barrier in the Republic of Yemen, which were surveyed by the Executive Unit to Prepare the Outline Plan for Dams (EUPOLD). Where the data for each dam were recorded and dropped on the map of the 1: 50,000 scale of the geographic information system (GIS). A national number has been given in addition to the code for the dams and hydrologic data created in the database, as well as the mapping layers that have been completed. The proposed (YDIS web) WebGIS site for Dams and the water barriers in Yemen started built the queries and data sharing service. The information level of dam data management in Yemen and its sharing will highlight the leading role of Yemen in this field.

Keywords: Yemen, Dams, Information System, WebGIS,

WEB-BASED DECISION SUPPORT SYSTEM TO EVALUATE LIVING CONDITIONS: A CASE STUDY OF COLOMBO CITY

E.M.R.D Ekanayaka (1), G.S.N Perera (1)

[1] Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, P.O Box 02, Belihuloya – 70140, Sri Lanka
Email: richierde@gmail.com; sanka.perera@gmail.com

Abstract: Colombo city hosts almost eight hundred thousand people from various parts of the world and is one of the fastest growing cities in Asian continent. The city subjects to heavy migration because of urbanization. Due to this reason, the living conditions also vary from place to place in the city. The immigrants often concern about their mobility and accessibility to different civic services. Hence, selection of a living area becomes an important factor for an inhabitant in physically, mentally and financially. However, systematic methodology has not been implemented to evaluate these living conditions. This study explicates utilizing of hotspot analysis and Network Analysis extension of ArcGIS to extrapolate crime and the accessibility to six fundamental civic services including education, healthcare, public parks, shopping centers and emergency response (firefighting and ambulance) from different neighbourhoods of the city. Weighted overlay approach is utilized to aggregate above criteria to find most inhabitable neighbourhoods in the city. The study indicates the best area as "neighbourhoods with least crime and easiest accessibility to all mentioned fundamental services". Accessibility to each civic service is calculated by service area and converted to a raster data which further aggregates them into a single raster using above mentioned weighted overlay approach. After exporting the graphical model as a python script, the system is further developed to handle and return dynamic influence rate based on the user inputs and ultimately the user obtains results for the best area. Then the generated map automatically gets uploaded into the geoserver and the users can view final liveability map on a dedicated web platform. Based on the approaches such as network analysis, multi criteria evaluation and decision support system, this study assists for selecting a neighbourhood on the basis of the selected criteria by a particular user and also help urban planners to identify design gaps in urban areas related to each criteria.

Keywords: Web-GIS, Decision Support System, Network analysis, Multi criteria analysis

INTEGRATING GEOSPATIAL WEB RESOURCES BASED ON SEMANTIC WEB TECHNOLOGY

I-Chen Yang(1), Chih-Yuan Huang (2)

[1]Masterstudentof Department of Civil Engineering,National Central University, No. 300 Jhongda Rd. Jhongli District, Taoyuan City 32001, Taiwan
[2]Assistant Professor, Center for Space and Remote Sensing Research, National Central University, No. 300 Jhongda Rd. Jhongli District, Taoyuan City 32001, Taiwan
Email: ally2586@gmail.com; cyhuang@csrsr.ncu.edu.tw

Abstract: With the advance of World-Wide Web (WWW) technology, Web resources can be efficiently transmitted across the widely-distributed Internet network. Among the vast number of Web resources, many of them include geographic attributes, where the collection of these resources forms the Geospatial Web (GeoWeb). The discovery and integration of GeoWeb resources are the important research directions in the WebGIS field. However, GeoWeb resources are distributed on the Internet and provided by different individuals or organizations, which cause serious heterogeneity issues. For users to find targeted GeoWeb resources efficiently, these heterogeneity issues need to be addressed. Among the heterogeneity issues, one of them is the semantic heterogeneity. An example of the semantic heterogeneity is using different words to represent the same concept or vice versa. Another problem of lacking semantic integration is that the relationships between resources will be hidden from users, where related resources cannot be discovered. Therefore, this study aims at addressing the semantic heterogeneity issue of the GeoWeb resources. To be specific, this research applies the semantic web technology to represent the metadata information of each resource. By describing resources in the Resource Description Framework (RDF) format based on a designed GeoWeb resource ontology, semantic relationships between resources can be inferred and queried. Consequently, the proposed solution can integrate GeoWeb resources and facilitate the GeoWeb resource discovery.

Keywords: GeoWeb, Semantic Web, Ontology

ENTERPRENURE CENTRIC WEB-SERVICE FOR INDUSTRIAL AND INFRASTRUCTURE DEVELOPMENT INITIATIVES IN ODISHA STATE, INDIA

Dr. Debajit Mishra (1), Sri Manoj Kumar Sanabada (1), Dr. Sandeep Tripathi (2)

[1] Scientist, Odisha Space Applications Centre (ORSAC)
[2] PCCF (Principal Chief Conservator of Forest) & CWLW, Odisha & CE, ORSAC
ORSAC, Plot no 45/48, Near GAA, Unit -16, Bhubaneswar-751023, Odisha, India
Email: djmishra@yahoo.com; m_sanabada@yahoo.co.in; sandeeptrip.ifs@gmail.com

Abstract: Introduction & Objective: - Geospatial Technologies are considered as one of the most powerful technologies that can effectively serve overall developmental needs. As India endeavours to achieve its developmental goals, the multifaceted and specialized capabilities offered by geospatial technologies plays a crucial role for information management. Mainstreaming geospatial technologies for effective decision making and better governance is one of the mandates of central and state administration. In a bid to attract investment and ensure hassle-free land acquisition for major projects, Government of Odisha, India decided to create land banks for industrial development using Remote sensing data, geospatial technology and Web-service applications. Image data, revenue cadastral data and industries department data are integrated to create land banks for 2.4 lakh acres out of which 119,000 Acres are webhosted for information of stakeholders as a key initiative for development of industrial infrastructure in Odisha. Methods: - The methods used to develop the Web-service are a) applications of Geo-ICT, GIS, Space applications and web-technology to provide centralized database service to decision makers, administrators, investors, planners and common public for industrial and infrastructure development (Web-Portal in public domain containing 45 data layers of all 314 blocks of the state including georeferenced revenue cadastral maps); b) query based digital database search (under three modules) for investors to obtain land bank information along with options of data supply about developed facilities, services, utilities, infrastructure and amenities around the identified land clusters; c) provision of information supply along with spatial and attribute data to potential investors for new ventures (interactive query modules); d) dissemination of industrial information in public domain in a spatial format for the access and appreciation of common citizen; e) provisions for establishing spatial relationship between industrial clusters and infrastructure and other amenities through an overlay of attributes that measures the suitability of industrial development and creating inventory and prioritise the industrial land utilization to provide strategic direction to industrial and economic development in Odisha state. Results: - GOPLUS (Govt. of Odisha's Portal for Land Use and Services) is developed (gis.investodisha.org) and is a web enabled platform to display real time information (45 data layers) with regards to land bank, developed infrastructure, utilities, services and land value around land banks besides information about existing industries in public domain. Conclusions: - The system is of great use to the state officials and is being regularly used by them. The various decision makers that are extensively using the portal are a) IDCO (Odisha Industrial Infrastructure Development Corporation, b) IPICOL (industrial Promotion & Investment Corporation of Odisha Limited, c) Regional / District Industries Centres, the District Level Nodal Agencies for industrial promotion and investment corporation, catering to Micro, Small and Medium Enterprises; d) Prospective Investors and common citizens.

Keywords: GOPLUS, Land Bank, Ortho image, Web-GIS, Geospatial data, Geocoded data

A SPATIAL MANAGEMENT SYSTEM DEVELOPMENT FOR MARINE AND COASTAL COMMUNITIES OF TRAT PROVINCE, THAILAND (TRAT PORTAL)

Nuttorn Kaewpoo (1), Siriluk Prukpitikul (1), Varatip Buakaew (1), Watchara Kesdech (1), Thanatrakorn Trachang and Natdanai Punsin (1)

[1]Geo-Informatics and Space Technology Development Agency (Public Organization)
120 Government Building Complex 6th and 7th Floor,
Chaeng Wattana Road, Lak Si, Bangkok 10210, Thailand
Email: nuttorn@gistda.or.th, siriluk@gistda.or.th; varatip@gistda.or.th;
watchara@gistda.or.th; thanatrakorn@gistda.or.th; natdanai@gistda.or.th

Abstract: This article aimed to develop a spatial management system as a simple tool for spatial data collecting for local people in marine and coastal communities of Trat province. They used this system within their communities to manage spatial information and its application. The main procedures were developed by GIS Portal namely Geo-Informatics and Space Technology Development Agency (GISTDA) Portal, which quickly and easily create and share its outcome to end users in various spatial data formats such as shapefile, CSV from Excel and Web Map Services. The system processing mainly consist of 2 parts: 1) Application Development for spatial management in the study area, and 2) volunteer encouragement and training in their communities at Trat. The result, also known as Trat Portal, is a basic tool and user friendly application about marine and coastal spatial management by local communities in Trat province. There are many functional prototype interfaces on a computer and a smartphone to collect spatial information, to pin reporting related events, to measure distance and calculate target area including to design map components and printing.

Keywords: GIS Portal, Trat Portal, Spatial Management, Marine And Coastal Communities

DEVELOPMENT OF WEB-BASED APPLICATION FOR SHAPEFILE COORDINATE SYSTEM CONVERSION FOR MALAYSIA

Elysonia Alim (1), Shahabuddin Amerudin (1)

[1] Department of Geoinformation, Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
Email: elysoniaalim@gmail.com; shahabuddin@utm.my

Abstract: It is difficult to process GIS vector data when they are not aligned with one another. The need for different coordinate systems rose from the fact that some coordinate systems are better fitted to describe the geographical phenomenon occurring in a specific area. However, even commercial software had been proven to have questionable accuracy in coordinate system conversions. The purpose of this study is to develop a web application capable of converting the coordinate system of a GIS data format such as a shapefile for Peninsular Malaysia. The web application named Coordinate Conversion Application (CCA v1.1) was developed using Django 2.0 with Python 3.6 and is capable of five coordinate transformations namely WGS84 to GDM2000 (forward and backward), WGS84 to MRSO (old) (forward only), MRSO (old) to Cassini (old) (forward and backward). Results obtained were compared with existing software such as GDTS v4.01 and ArcGIS 10.3, and analysis shows that CCA v1.1 has achieved satisfactory accuracy.

Keywords: Coordinate System, Conversion, Shapefile

ESDM ONE MAP INDONESIA: EXPLORING THE ENERGY AND MINERAL RESOURCES

Heratania Aprilia Setyowati (1), Sigit Heru Murti B.S. (2), M.P, Dwinugroho (3), Novelya Martha U. Napitupulu, Evita Wisnuwardhani

[1] Center for Data and Information Technology, Ministry of Energy and Mineral Resources, Jalan Medan Merdeka Selatan No.18 Jakarta Pusat 10110, Indonesia
[2] Departement of Cartography and Remote Sensing, Faculty of Geography, Universitas Gadjah Mada, Jalan Kaliurang, Sekip Utara, Sleman, Daerah Istimewa Yogyakarta 55281
[3] Center for Mineral and Coal Geology Human Resources Development, Ministry of Energy and Mineral Resources, Jalan Jendral Sudirman No.623, Warung Muncang, Bandung 40211
Email: heratania.a.s@mail.ugm.ac.id

Abstract: ESDM One Map Indonesia is a web-based information system capable of displaying various thematic geospatial information (maps) in the field of energy and mineral resource online (webGIS). Officially launched on May 31, 2017, this application presents a variety of thematic geospatial information obtained from different sectors of MEMR, namely Oil and Gas, Mineral and Coal, New Renewable Energy and Energy Conservation, Electricity, Geology, and Research Development Sectors. The information includes, for instance, the maps of Oil and Gas Working Area, Mining Business License Area, Geothermal Working Area, Electricity Infrastructure, Oil and Gas Infrastructure, and Potentials (Resources and Reserves) of New Renewable Energy and Geology. This system also provides thematic geospatial information from other sectors in different ministries or institutions. ESDM One Map Indonesia is expected to provide an overview of energy wealth and mineral resource potential in Indonesia to worldwide.

Keywords: ESDM One Map Indonesia, Web-GIS Application, Energy, Mineral, Resources

TITLE OPEN SOURCE AND FREEWARE WEB GIS AND AUGMENTED REALITY APPLICATION ON SOCIAL RENTED HOUSING

Jin-Tsong Hwang (1)

[1] Department of Real Estate and Built Environment, National Taipei University No. 151, University Rd., San Shia District, New Taipei City, 23741 Taiwan
Email: jthwang@mail.ntpu.edu.tw

Abstract: The price of real estate is expensive at urban area in Taiwan. Therefore, the government is striving to build a rental social housing providing people to live. This study uses open source software such as Geoserver, PostGIS, Leaflet, and Cesium for web GIS development. The 2D base map contains Google Map, Open Street Map, and high resolution ortho-photo images of UAV aerial photography. In addition, the web has the function of query and presentation the points of interested. The 3D map contains the base map and the building models. The building model provides properties of different types of house. Also check out the house where the homes available for rent by highlight the query results on the floor and position of the building model. In addition, this research will develop a function of markerless Augmented Reality (AR) and the operation of the interface, it not only load the building model and overlap on the screen of cell phone but also query the building information for each room near the base of social house. Providing people with the internet to conveniently query the relevant property information of social housing as a reference for whether to rent or not.

Keywords: Open Source, Web-GIS, Augmented Reality

TOWARDS A FLOOD-RESILIENT CARAGA: INTEGRATING NUMERICAL MODEL OUTPUTS, WEB APPLICATIONS AND SOCIAL MEDIA IN DEVELOPING A NEAR-REAL TIME HAZARD INFORMATION DISSEMINATION SYSTEM

Meriam Makinano-Santillan (1)(2), Jesiree L. Serviano (1), Charlemagne Kierra M. Rubillos (1), Jojene R. Santillan (1)(2), Arthur M. Amora (1)

[1] Geo-SAFER Mindanao: Agusan Project, Caraga Center for Geo-informatics, College of Engineering and Information Technology, Caraga State University, Ampayon, Butuan City, Agusan del Norte, Philippines, 8600
[2] Division of Geodetic Engineering, College of Engineering and Information Technology, Caraga State University, Ampayon, Butuan City, Agusan del Norte, Philippines, 8600
Email: mmsantillan@carsu.edu.ph; sjesiree@gmail.com; kyangrubillos@gmail.com; jrsantillan@carsu.edu.ph; arthuramora0809@gmail.com

Abstract: In mitigating and helping lessen the possible effects and damages of disaster to the communities, the transmission of information or end products derived from remote sensing and other multidisciplinary technologies into the community should be immediate, accessible and comprehensive to aid in better planning and decision-making procedures. The Philippine Government through the Department of Science and Technology (DOST) initiated and funded research programs to help the community prepare for flood disasters brought by extreme weather events. Among those programs funded is the Geo-SAFER Mindanao. The Geo-Informatics for the Systematic Assessment of Flood Effects and Risks (Geo-SAFER) in Mindanao, Philippines is implemented in whole Mindanao, one of the three major islands of the Philippine archipelago, for two years starting in 2017. Geo-SAFER Caraga is one of the five projects under the Geo-SAFER Mindanao Program which aims to cover detailed flood hazard maps for the entire Caraga Region. In this paper, we share a hazard information dissemination procedure used by the project, which integrates the use of outputs derived from two dimensional (2D) numerical models, web applications and systems as well as the use of social media and telecommunications to promote the utilization of advanced science and technology outputs that could represent and visualize a flooding scenario based on different rain return periods through social media and dynamic communication between stakeholders.

Keywords: Hazard Information Dissemination, LiDAR, Web Applications

A WEB GIS FOR SHORELINE CHANGES AND PROJECTION BASED ON HISTORICAL DATA: A CASE STUDY AT PENINSULAR MALAYSIA

Syaifulnizam Abd Manaf (1), Norwati Mustapha (1), Md Nasir Sulaiman (1), Nor Azura Husin (1), Mohd Radzi Abdul Hamid (2)

[1] Intelligent Computing Research Group, Faculty of Computer Science and Information Technology, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[2] National Hydraulic Research Institute of Malaysia, Seri Kembangan, Selangor, Malaysia
Email: nizamkpt2020@gmail.com; norwati@upm.edu.my; jieyou_1994@live.com; nasir@upm.edu.my; n_azura@upm.edu.my; radzi.nahrim@1govuc.gov.my

Abstract: A Web GIS was developed for displaying shoreline changes and shoreline projection based on historical data of extracted shorelines. Using online web based system connected to GIS server, system can display seamless data of shoreline vector GIS. Alternatif to NAHRIM mobile application that can display only projected value, this system could be able to display location and map visualize.

Keywords: Web GIS, historical data, shoreline changes, prediction, projection

INTEGRATION OF TWITTER-BASED DISASTER-INFORMATION SHARING SYSTEM AND SATELLITE IMAGERY

Osamu Uchida (1), Masafumi Kosugi (2), Keisuke Utsu (3), Kohei Cho (1)

[1] Dept. Human and Information Science, Tokai University, 4-1-1 Kitakaname, Hiratsuka, Kanagawa 259-1292, Japan
[2] Yahoo Japan Corporation, Kioi Tower, Tokyo Garden Terrace Kioicho, 1-3 Kioicho, Chiyoda, Tokyo 102-8282, Japan
[3] Dept. Communication and Network Engineering, Tokai University 4-1-1 Kitakaname, Minato, Tokyo 108-8619, Japan
Email: o-uchida@tokai.ac.jp; kosugimasafumi@gmail.com; utsu@utsuken.net; kohei.cho@tokai-u.jp

Abstract: To minimize damage during disasters, the rapid collection and delivery of accurate information are essential. The potentiality of social media, especially microblogging services such as Twitter, in the case of a disaster has, therefore, attracted worldwide attention. In recent large-scale natural disasters, Twitter has actively been used for a communication tool; during the Great East Japan Earthquake on March 11, 2011, for example, many people used Twitter to find information about the tsunami, shelters, the state of public transportation services, and so on. Over a quarter million tweets were posted in the first 72 h after Typhoon Haiyan destroyed large areas of the Philippine, and a crisis map was made using crowdsourcing. Based on this background, the authors have been developing a Twitter-based disaster-related information sharing system. The system is composed of the following two subsystems; (1) DITS (Disaster Information Tweeting System): a system that inserts both the user's current geo-location information (street address and MGRS Code) and the hashtag of the form "#disaster (city name)" to a tweet automatically, (2) DIMS (Disaster Information Mapping System): a system that plots tweets posted via DITS on a digital map. The system was launched in the middle of Feb. 2015 and generally has been operated well. The system was originally available only in Japan, but now it has been improved to be used also in countries other than Japan. The system was also utilized as a tool for disaster prevention drills and disaster prevention education. In this study, to make it easier to grasp the situation of a disaster, we are currently improving the system so that satellite imagery can be superimposed to the DIMS map. When a large-scale natural catastrophe such as tsunami and landslide disaster occurs, we can understand both the whole picture of the damaged area and detailed disaster-related local information at the same moment by using the proposed system.

Keywords: disaster, disaster-information, SNS, Twitter, satellite imagery

OPEN SOURCE-BASED AND PROPRIETARY WEB-GIS SYSTEMS

D.Amarsaikhan (1), Naranbat (1), D.Enkhjargal (1), Bayarbaatar (1)

[1] Institute of Geography and Geoecology, Mongolian Academy of Sciences av.Enkhtaivan-54B, Ulaanbaatar-51, Mongolia
Email: igg.mas1@gmail.com

Abstract: In recent years, open source platforms have become more reliable and capable tools for a wide range of applications. One of such open source platforms is GeoMoose Web Framework which has a number of strengths including modularity, configurability, and delivers a number of core functionalities in its packages. It can be fully controllable and programmed by Javascript, XML, PHP and Map script. As an open source project, GeoMoose is also built upon other open source projects such as MapServer and OpenLayers. Generally, ArcGIS is considered as one of the widely used proprietary GIS systems. It is used for creating and using maps; compiling geographic data; analyzing mapped information; sharing and discovering geographic information; using maps and geographic information in a range of applications; and managing geographic information in a database. The system provides an infrastructure for making maps and geographic information available throughout an organization as well as within a large community. The aim of this study is to compare open source-based and proprietary WEB-GIS systems considering the needs of the stakeholders, and sustainability in terms of operational requirements, functionality and software/hardware improvement, and also to propose how they could be updated by RS data. For this purpose, two operationally used WebGIS systems developed Mongolia have been compared.

Keywords: Open source, Proprietary, WebGIS system

GIS TOOL FOR AIRPORT OBSTACLE MANAGEMENT

Tanawat Chailungka (1), Kanapoom Bootchaicharoen(1), Supatcha Chaimatanan (1)

[1]Geo-Informatics and Space Technology Development Agency,
No. 88, Thung Sukala, 20230 Siracha, Chonburi
Email: tanawat.c@gistda.or.th; khanapoom.boo@gistda.or.th; supatcha@gistda.or.th

Abstract: Obstacle is one of the most important factor that impact safety of aircraft operation around the airport. According to the International Civil Aviation Organization (ICAO), the objects that extend above a defined surface around the airport, called Obstacle limitation Surface (OLS), are considered to be obstacle to flight operation. Appropriate authority must ensure that there are no obstacle in the obstacle-free zone, and control the number of obstacle around the airport to minimum. Moreover, the obstacle data shall be published and be updated at least every five years. However, obstacle management is still challenging for many countries, especially in urban expanding area, due to the lack of efficient tool and the cost involved in updating the data. In this work, we propose a web-based integrated GIS tool that allows the user and the authority to analyze appropriate height for construction according to ICAO safety requirements. The proposed tool models the OLS using grid-based method and relies on Hashmap data structure to ensure fast and efficient computation time. The analysis result can be presented in three dimensional and cross-section view. In addition, the tool also automatically detects change of the obstacle around the airport using remote sensing technology. Once the change is detected, the tool analyze the obstacle against the OLS so that the authority may take necessary actions to manage and control the obstacle. This also allows the authority to be able to update the obstacle data more frequently, more efficiently, and at lower cost.

Keywords: Aviation, Web-Based Integrated GIS, Hashmap, Obstacle Limitation Surface, Obstacle Management

WEB-BASED GIS DEVELOPMENT FOR LAND USE CHANGES

Aisyah Syazana Adeli (1), Shaparas Daliman (1), Jirapond Muangprathub (2),
Pattaraporn Warintarawej, Anirut Sriwichian

[1]Faculty of Earth Science, Universiti Malaysia Kelantan Jeli Campus, 17600 Jeli, Kelantan, Malaysia
[2] Faculty of Science and Industrial Technology, Prince of Songkla University, Suratthani Campus, Surattani 84000, Thailand
Email: a.syazana135@gmail.com; shaparas@umk.edu.my; jirapond.m@psu.ac.th

Abstract: Web-based geographic information system (GIS) is a GIS system which uses web technology to serve users. By utilizing the internet to access information over the web, the GIS user can fully utilize the geospatial information despite the distance between the server and client. Through presenting the land use changes via web-based GIS, it will estimate the percentages of land use change that helped the local authority to mitigate any conflict that might happen during the development. The study site chosen is Jeli, Kelantan as to see how the land use changes have occurred during the past years. To demonstrate the land use changes, the implementation based on web site is developed. This work designed in two parts such that data visualization on map and data presentation to users. The first part used the ArcMap, QGIS and Open Layer software to develop the land use changes to present on map whereas PHP language and MySQL is used in second part to manipulate data to show on web site. The results show that the proposed system can be used to assist any organization, public and individual to access the geospatial data by using web-based GIS for land use changes information.

Keywords: Web-Based GIS, Land Use Change, QGIS Geoserver

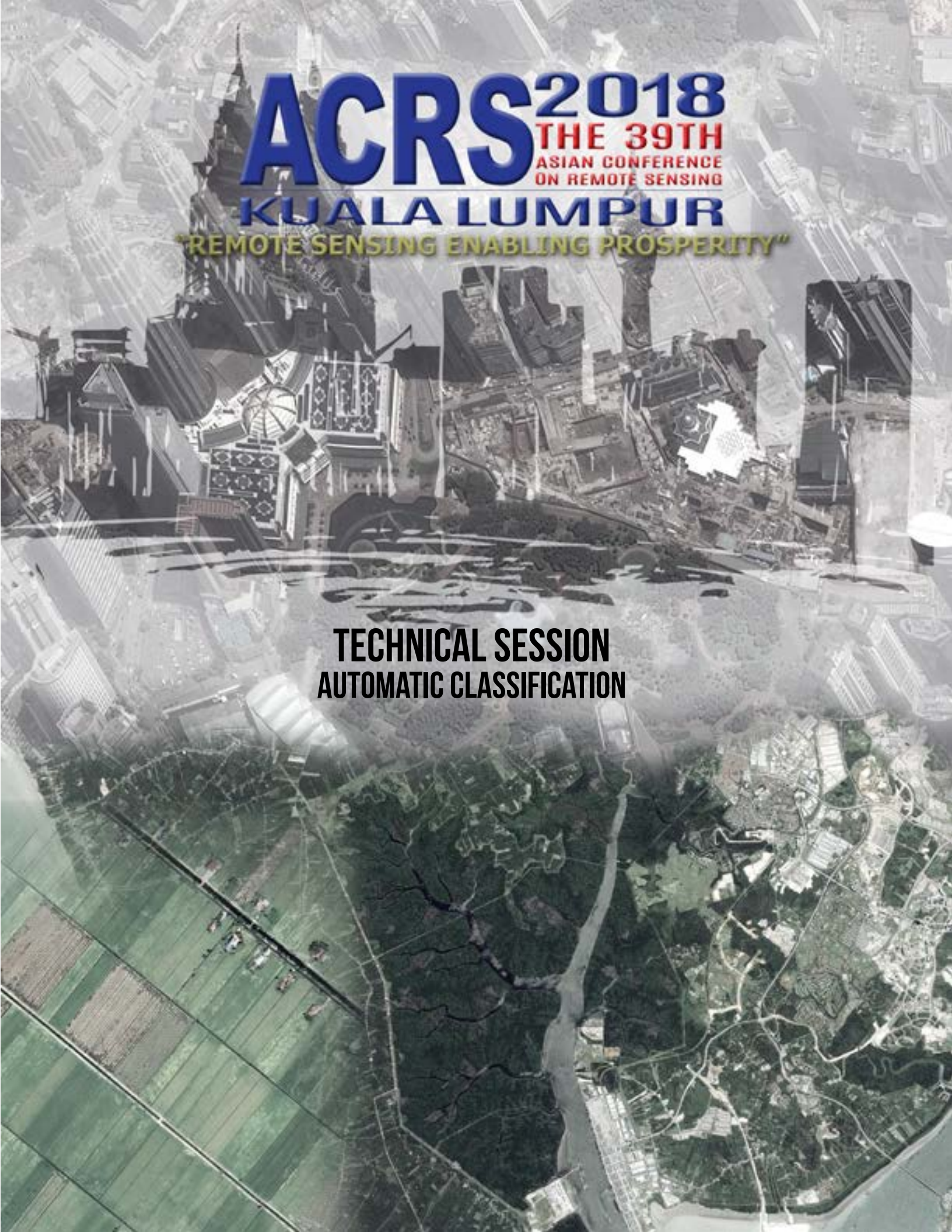
SMARTER DECISION MAKING DURING FLOOD DISASTER: UTILIZATION OF NEAR-REAL TIME FLOOD CHARACTERISTICS SIMULATION AND FORECASTING SYSTEMS

Meriam M. Makinano-Santillan (1)(2), Edsel Matt O. Morales (1), Jojene R. Santillan (1)(2), Arthur M. Amora (1)

[1] Geo-SAFER Mindanao: Agusan Project, Caraga Center for Geo-informatics, College of Engineering and Information Technology, Caraga State University, Ampayon, Butuan City, 8600, Philippines
[2] Division of Geodetic Engineering, College of Engineering and Information Technology, Caraga State University, Ampayon, Butuan City, 8600, Philippines
Email: mmsantillan@carsu.edu.ph; idsilmat@gmail.com; santillan.jr2@gmail.com; arthuramora0809@gmail.com

Abstract: In the event of flooding, an access to near-real time flood-related information such as the rainfall intensity and water level status of a certain area is vital to take an immediate action appropriate to the current situation. Providing this kind of information, including the possible extent of flooding in the next few hours and water level forecast will help the disaster managers to be aware of the impending event that may happen to prevent further casualties and loss of lives. One way of making this information available to the public is through an online web platform. The Geo-informatics for the Systematic Assessment of Flood Effects and Risk (Geo-SAFER) for a resilient Mindanao: Agusan Project developed a web-based system capable of portraying near-real time flood related map layers (arrival, duration, depth, velocity, and recession), including the conduct of spatial visualization and analysis of these layers with other geospatial datasets to estimate the current and forecasted impacts of flood to infrastructures. The development of the web platform consists of two major components, (1) generation of the near-real time flood-related map layers and (2) web application development. The first component automates the processes involved in hydraulic and hydrologic model simulation which utilizes Light Detection and Ranging (LiDAR) derived datasets as an input. The automation script for the simulation uses batch scripting for directory manipulation and performing series of commands, Python for accessing and downloading data, and also to write/overwrite files that need to be updated, and other several utilities. The outputs of this process are stored in database and map server. On the other hand, the web app is built using ReactJS and several JavaScript libraries; it will display the data from the servers in tabular and graphical manner. It also provides visualization of the current and forecasted flood extent and other flood-related map layers. By having this platform, the community and disaster managers will have an access to comprehensive flood-related information in which they can utilize to have a smarter decision making in the occurrence of a flood disaster.

Keywords: near-real time, flood disaster, web GIS, JavaScript, forecast



TECHNICAL SESSION
AUTOMATIC CLASSIFICATION

SEMI-AUTOMATED FEATURE EXTRACTION FOR ROOFTOP SOLAR POTENTIAL ASSESSMENT

Mudit Kapoor (1), Rahul D. Garg (1)

[1] Geomatics Engineering, CED, Indian Institute of Technology Roorkee, Roorkee-247667, Uttarakhand, India
Email: mkapoor@ce.iitr.ac.in; garg_fce@iitr.ac.in

Abstract: The problem of assessing the rooftop solar potential of large habitat is a big challenge for researchers. To address this problem, an approach has been devised to semi automate the process of extracting the features. The objective of this research is to assess the solar potential on the rooftop features extracted from the high resolution satellite image at the specific area. An approach using Matlab programming has been devised to extract the features from the high resolution satellite image using k-means clustering algorithm, shown in Fig 1. The high resolution multispectral satellite image of an area within the Haridwar district has been used in this study. The satellite image has been downloaded from the Google Earth.

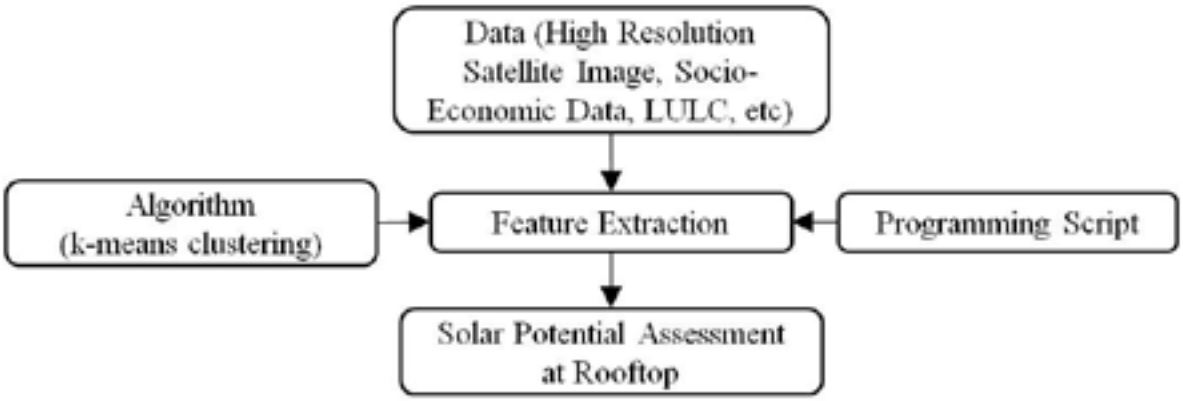


Figure 1. Methodology used to assess solar potential

The k-means clustering algorithm mentioned above has been implemented in Matlab to extract rooftops of the selected study area of Haridwar, India. Accuracy assessment has been performed using rooftop's area obtained by digitization in QGIS. This methodology helped in extracting almost all the rooftops available in the satellite image. The area estimation from the automated rooftops extracted and digitization is matching by 86%. This approach helped in lowering the time required in predicting solar potential of the densely populated large areas for installing solar photovoltaic modules. This approach will also help in predicting the solar potential of the large fields, barren land, water bodies, etc. in fast and accurate manner.

Keywords: Solar Potential, Matlab, k-means clustering, Remote Sensing, Geographic Information System

IDENTIFICATION OF LAND COVER USING SPOT 7 SATELLITE IMAGES USING OBIA METHOD (OBJECT BASED IMAGE ANALYSIS) CASE STUDY: GARUT

Remilla Sapta Nada (1), Rika Hernawati (1)

[1] Department of Geodetic Engineering, Faculty of Civil Engineering and Planning, National Institute of Technology, No. 23, Jalan Penghulu Kyai Haji Mustopha, Bandung, Indonesia
Email: reminada@gmail.com; riecchah@gmail.com

Abstract: Garut is the one of the eastern priangan cities in West Java Province with an area of 306,519 Ha (3,065.19 km²), there are 42 (Forty-Two) districts which are still dominated by agricultural activities, both wet and dry land agriculture and plantation and forestry activities. one technology that is considered quite effective in monitoring or analyzing and identifying land cover using remote sensing techniques that can be detect and monitor the physical characteristics of the earth's surface. One of them can be used to analyze this land cover using SPOT 7 imagery which has panchromatic spatial resolution can reach 1.5 m resolution and multispectral obtain 6 m resolution enough to analyze and identify the land cover. the purpose of this study is to identify the land cover of Garut. Using OBIA (Object Based Image Analysis) classification that is the image classification process not only considers the spectral value or color but also considers aspects of the spatial data or texture of the object and is carried out in 2 (two) stages, namely image segmentation and image classification with parameters corresponding to SPOT 7. the segmentation process in this OBIA to classify pixel values into a polygon based on the color of their spatial information. OBIA segmentation also has specific parameters that correspond desired segmentation results, parameters used include the value scale, the value of shape and compactness value. the classification process in OBIA processes the classification of an image into a category that is increasingly needed to carry out image analysis. after the process is done with the data OBIA SPOT 7, then obtained 15 (fifteen) from the results of the OBIA classification, that is clouds, sand dunes, forests, roads, roads railways, industrial estates, fields, empty land, beaches, plantations, settlements, rice fields, ponds, and mixed plants.

Keywords: Land Cover, Segmentation, SPOT 7, OBIA

URBAN SPRAWL MODELING OF LAHORE, PAKISTAN USING MACHINE LEARNING TECHNIQUES

Asna Ahmed (1), Yoshihida Sekimoto (2), Takehiro Kashiyama (2)

[1] Institute of Industrial Science, Department of Civil Engineering, The University of Tokyo, Ce507, 4-6-1, Komaba, Meguro-ku, Tokyo 153-8505, Japan
[2] Institute of Indestrial Science, The University of Tokyo, Ce507, 4-6-1, Komaba, Meguro-ku, Tokyo 153-8505, Japan
Email: asnasan@iis.u-tokyo.ac.jp; sekimoto@iis.u-tokyo.ac.jp; ksym@iis.u-tokyo.ac.jp

Abstract: Population is the fundamental concentration because population is related with all resources and urban sprawl, an effect of socioeconomic improvement in specific conditions, has progressively turned into a noteworthy issue confronting numerous metropolitan zones. This is very essential to understand the significant factors affecting the population. This research analyzed the spatial and temporal characteristics of metropolitan city Lahore, Pakistan. Supervised classification method is applied to examine the urban expansion and to evaluate signatures of Lahore city into four categories (urban, vegetation, bare land and water bodies). For the land cover change analysis and to predict the urban sprawl in future different techniques and methods can be used and out of numerous, geospatial techniques like (MOLUSCE) QGIS plug-in, GIS along with remote sensing is used. In this study, Landsat V and VIII satellite images of 1998, 2008 and 2017 were used to classify the urban expansion. The precision appraisal was completed for characterized maps. Distinctive images Transition probability matrix and region change were acquired by utilizing plug-in created in QGIS and future year 2036 urban expansion was obtained. In this study, an attempt was made to develop a relationship between urban sprawl and population of Lahore. In light of accessible informational index, from 2017 to 2036 the change in urban area is 40% while a 367.02 sq.km loss in vegetation is chronicled. The majority of the urban sprawl occurred along primary roadways. The outcome demonstrates that urban region is relied upon to develop substantially higher in the year 2036 when contrasted with 2017. This analysis gives awareness of urban development and supports in macro and micro level urban planning, policy making in metropolitan cities.

Keywords: GIS, Urban Sprawl, Population, Lahore, Landsat

REMOTE SENSING ROAD EXTRACTION TECHNIQUES FOR HERITAGE STREETS MORPHOLOGY IN SOUTHEAST ASIAN

Marina Mohd Noor (1), Norzailawati Mohd Noor (1), M.Zainora Asmawi (1)

[1] Department of Urban and Regional Planning, Kulliyah of Architecture and Environmental Design, International Islamic University Malaysia, Jalan Gombak, 53100, Kuala Lumpur
Email: marina.mn@gmx.com; norzailawati@iium.edu.my; zainora@iium.edu.my

Abstract: The morphology of city has changed dramatically and influenced by the expansion road network. The development of road needs to up-to-date in order to provide a good feasibility and reliable improvements in road design. The road analysis with remote sensing approach proven as a reliable method to provides a good result in road extraction. Its capabilities in strong spectral and spatial resolution have large users and widely acceptable in extracting a road. Due to different nature of development and climatology influences, we believe extracting road in Southeast Asian brings different issues and possibly lead to new improvement of road extraction techniques. Thus, this paper attempt to provide a critical review of road extraction techniques using remote sensing application in the countries in Southeast Asian. Bibliometric analysis technique is used to provide statistical analysis and evaluate the research trend-studies on road extraction. The quantitative distribution of road extraction literature using bibliometric analysis covering a period of thirteen years from the year 2005 until 2018 in order to identify changes in road extraction pattern analysis. To accomplish the objective, prominent source such as SCOPUS and Web of Science database is used as it is the largest database in science and technology. The finding shows that several method and approach such as semi-automatic, automatic, object-based image or pixel-based image in extracting road with different spatial, spectral, algorithm and operators that effects the result of road extraction. In a nutshell, the conservation of Heritage Street can be developed by using remotely sensed images in order to manage the heritage street either over-controlled or under controlled in steering the visions of technology application in the urban area.

Keywords: road extraction, remote sensing, bibliometric analysis, heritage streets, morphology

EXTRACTION OF FOREST PLANTATION USING MAJORITY VOTING CLASSIFICATION FUSION ALGORITHM

Maryam Adel Saharkhiz (1), Biswajeet Pradhan (1), Abdul Rashid Bin Mohamed Shariff (2)

[1]School of Systems, Management and Leadership, Faculty of Engineering and IT, University of Technology Sydney, New South Wales, Australia.
[2]Department of Biological and Agricultural Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 Selangor, Malaysia
Email: biswajeet24@gmail.com; Biswajeet.Pradhan@uts.edu.au

Abstract: This study aims to distinguish forest areas from other similar features in 2015 and 2016 using majority voting (MV) classification fusion method on high resolution ALOS-2 PALSAR-2 and Landsat 8 OLI in Peretak district of Selangor state, Malaysia. ALOS PALSAR-2 data have great advantage in extracting natural and industrial forest plantation but they generally suffer from presence of speckle that create problem to identify the forest body. Optimal fusion of Landsat 8 OLI bands with specific ALOS PALSAR data index can provide the best complementary information of both datasets for an accurate forest extraction while suppressing unwanted information. The ultimate goal of this study is to analyze the potential ability of Landsat 8 OLI and ALOS PALSAR-2 as complementary data resources in order to extract land cover types especially forest types. Comprehensive preprocessing tasks on SRTM, Landsat and PALSAR-2 datasets were conducted in order to make those imageries ready for processing. Principal Component Index (PCI) method as one of the most effective Pan-Sharpening fusion approaches was used to synthesize Landsat and PALSAR-2 images. Three different classifiers methods (SVM, KNN, and RF) were employed and then fused by MV algorithm to generate more robust and precise classification result. Next, ground truth points assessed the final fused dataset by using Confusion Matrices and Kappa Statistics. This study proves that the accurate and reliable MV fusion method can be used to extract large-scale land cover with emphasis on natural and industrial forest plantation from SAR and optical datasets.

Keywords: ALOS PALSAR-2, Landsat 8 OLI, Majority Voting, Remote Sensing, GIS

AUTOMATED RAT AND COCKROACH REPELLANT USING HAAR CASCADE ALGORITHM

Jennifer Dela Cruz (1), Gavriel Antoni A. Fernando (1), Marc Angelo S. Lagazo (1), Raymund R. Pasion (1), Jerome Paul B. Rectra (1)

[1] School of Electrical Electronics and Computer Engineering, Mapua University, Murall St. Intramuros Manila, Philippines
Email: jcdelacruz@mapua.edu.ph

Abstract: Electronic pest repellant has a variation of emitted frequency just to repel a certain kind of pest. According to studies each pest has its own unique range of frequency that has the ability to repel them. Cockroach and rat are one of the common pests that can be seen inside our home. These pests are carriers of different kinds of bacteria which could spread in our home and cause sickness. In this paper the researchers developed a device that uses image detection and emits a certain frequency that can eventually repel the pest. In determining the specific frequencies to be emitted, the study characterizes and verifies which frequency is the most effective. The device itself is a combination of a Raspberry Pi, Camera with night vision and speaker which emits ultrasonic frequency. The Raspberry Pi is programmed using Haar Cascade Algorithm for feature extraction, detection and classification of pests. The process of pest detection and device reaction is fast which effectively repels cockroaches and rats.

Keywords: Haar cascade, Haar features, ultrasonic frequency, pests repellant, image processing

AUTOMATIC BUILDING FOOTPRINTS EXTRACTION OF YANGON CITY FROM GEOEYE MONOCULAR OPTICAL SATELLITE IMAGE BY USING DEEP LEARNING

Hein Thura Aung (1), Sao Hone Pha (2), Wataru Takeuchi (3)

[1] Department of Electronic Engineering, Yangon Technological University Gyo Gone, Insein, 11011 Yangon, Myanmar
[2] Remote Sensing and GIS Research Center, Yangon Technological University Gyo Gone, Insein, 11011 Yangon, Myanmar
[3] Bw-602, Institute of Industrial Science, The University of Tokyo 4-6-1 Komaba Meguro-Ku, Tokyo 153-8505, Japan
Email: heinthuraung@gmail.com; heinthuraung@ieee.org; saohonepha76@gmail.com; wataru@iis.u-tokyo.ac.jp

Abstract: Building extraction is important in creation of urban maps and previous building extraction methods were based on LiDAR dataset and optical satellite images. Building footprints can also be manually extracted but it is very time-consuming and needs a lot of human resource. In this paper, building footprints in Yangon city are automatically extracted only from high resolution optical satellite image by using deep learning algorithm. Automatic extraction of buildings only from optical satellite images is a very challenging task because of spatial and spectral complexities of urban objects especially trees and buildings under trees, and shadow and water bodies. Moreover, very high spatial resolution of satellite image is necessary for building level extraction. Very high resolution satellite images are expensive which makes preparing enough training samples for deep learning algorithm more difficult. In this work, *pix2pix* is used for automatic building footprint extraction in Yangon City. *Pix2pix* is based on conditional generative adversarial network which is an unsupervised deep learning algorithm that only needs very few labelled samples, and can generate its own fake samples. Various models of pix2pix are trained and optimized using different training image datasets and training parameters before testing with images from the proposed area. The raster output images of *pix2pix* are transformed into vector images, compared with manually digitized reference image, and evaluated by using confusion matrix. According to the results, *pix2pix* shows promising results for delineation of building boundaries out of other urban objects.

Keywords: deep learning, high resolution optical satellite image, *pix2pix*

URBANIZATION AND POPULATION GROWTH IN COLOMBO MUNICIPAL COUNCIL: URBAN GROWTH ANALYSIS USING GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND REMOTE SENSING (RS)

J.A.D.M. Sadani (1), M.A.D. Samanmali (1)

[1] Department of Geography, University of Colombo, Sri Lanka
Email: sadanijayasooriya@gmeil.com; mataraarachchids@gmail.com

Abstract: Over the past century, world has been an increasing trend towards urbanization. In that case many people living close to town areas. Urbanization and environmental pollution connected with together. Man had so many needs. They tried to achieve their needs. In that case increase in environmental pollutions. In additionally the world had a largest history of urban growth. The term of urbanization originate from the Latin. It was created with interconnection of "Urbs" and "Action" (Manawadu.L, 2008). The Urbanization has had important consequences for many aspects of social, political, and economic life (Kleniewski & Thomas, 2011). Urbanization can be defined as the process by which rural communities grow to form cities, or urban centers, and, by extension, the growth and expansion of those cities (Mark.J, 2014). The world population less than 250,000 people and also cities population not exceeded over twenty thousand citizens were in around thousand years ago. But it was increased around sixteenth century with the population explosions. As an Island Sri Lanka include in Developing country category. With the increasing of total population of country several semi urban areas become a city. The Maharagama, Homagama, Kadawatha and Nugegoda areas are some example for this situation. Urbanization is major problem in several countries of developing world, especially Asian countries. Major issues are; high population density, traffic congestion, environment pollution etc. The Colombo city is major and economical center of the Sri Lanka. It has two Divisional Secretariats as Colombo and Thimbirigasyaya and also had forty seven (47) Grama Niladari Divisions. According to the 2012 population census total population is 561,314. According to this situation most important to the study about process of urbanization in Sri Lanka. The main objective of this study is to analyzed relationship between urbanization and population growth in Colombo Municipal Council (CMC) Area using Geographical Information System (GIS) and Remote Sensing (RS) techniques. The image was classified using both supervised and non-supervised calcification techniques on ERDAS IMAGINE 2014 software. The changes of land surface temperature (LST) also compute using ERDAS. According to the result of those classification were identified gradually increase Built-up area within the CMC Area. Furthermore LST also increased and cover of vegetation goes to decrease at the area. According to the regression analysis was identified positive correlation at the 0.05 confident level.

Keywords: Urbanization, GIS and Remote Sensing, Population, Colombo

USING CONVOLUTIONAL NEURAL NETWORK FOR SIGNBOARD DETECTION ON STREET VIEW IMAGES

Pin-Xu Chen (1), Jiann-Yeou Rau (1)

[1] Department of Geomatics, National Cheng Kung University, No. 1, University Road, East District, 70101 Tainan City, Taiwan
Email: kevin90045@gmail.com; jyrau@geomatics.ncku.edu.tw

Abstract: With the advancement of technology, digital maps and web searching tools for attractions and stores are usually used in modern times. Nowadays, the information of stores is usually updated from the people or recognized manually from street view images. If we can automatically detect and localize signboards from images, we can not only build and update maps in a short time, but also provide users useful POI (point of interest) information. However, most signboards are not in the same shapes or colors, and some problems, such as occlusion and uneven illumination, will occur when taking street view images. Sufficient accuracy of signboard detection cannot be obtained by using traditional methods based on image segmentation or line detection. In this study, a convolutional neural network (CNN) model called Faster R-CNN proposed in 2015 is used for signboard detection. Google's Inception-ResNet-v2 model is the feature extractor in our model and a series of fully-connected layers are used for classification and bounding box regression. In the beginning, labelled street view images are used for training model. Then, the bounding boxes and corresponding probabilities of signboard detection results can be obtained from our model by inputting original images. In the preliminary evaluation, the accuracy of our method based on CNN is about 94.15%. In additional evaluations, all the accuracies are above 90% after respectively adding Gaussian noise, Gaussian blur, horizontal flip, and change of brightness to images, which shows high potential of our model for other applications. In the future, change analysis or text recognition technique can also be applied for acquiring information of stores automatically.

Keywords: Signboard detection, Convolutional neural network, Object detection

OBJECT-BASED APPROACH FOR IMPERVIOUS AREA DETECTION ON VARIOUS SCENE OF PLEIADES SATELLITE IMAGES

Iva Nurwauziyah (1), Nurahida Laili (1), Chi-Kuei Wang (1)

[1] Department of Geomatics, National Cheng Kung University, No.1, University Road, 70101 Tainan, Taiwan
Email: ivanurwauziyah@gmail.com; nurahidalaili@gmail.com; chikuei@mail.ncku.edu.tw

Abstract: The impervious area construction inside the agriculture land is increasing every year which leads to the reduction of the farmland. As the farmland plays an important role in providing the food source for humans, its reduction is very detrimental. A regular monitoring is necessary to be conducted, and being one of government's concern to decision policy. Generally, the impervious area is manually detected by using digitation on satellite imagery, which is a time-consuming process. In order to solve that, an object-based approach is chosen to process the satellite image and then can save the processing time. Object-based approach is one of automatic classification method which consider on the spatial and spectral information. In the object-based approach, the homogeneous pixels are grouped to create segments and then a classification rule-set is applied to assign each of the segment into the particular class. The developed ruleset was based on a single scene image subset, while there are seven Pleiades satellite images to cover the entire area in the Kaohsiung City, Taiwan. Those satellite scene images were taken on a different acquisition time; hence they have various spectral characteristics. Therefore, this study aims to apply the ruleset on those images and establish the transferability test. An evaluation would be conducted so that the developed object-based ruleset could be applicable for various image scene.

Keywords: Impervious area, object-based approach, Pleiades satellite image, transferability test

A REMOTE SENSING MODEL TO EXTRACT THE OIL POLLUTION CONCENTRATION BASED ON THE ABSORPTION COEFFICIENT OF THE REFERENCE BAND

Xing Xufeng (1), Huang Miaofen (1), Liu Yang (2), Sun Zhongyong (1), Wang Zhonglin (1)

[1] Faculty of Mathematics and Computer Science, Guangdong Ocean University, 524088 Guangdong Zhanjiang China
[2] PetroChina Exploration & Development Research Institute, 100083 Beijing, China
Email: 4918585@qq.com; hmf808@163.com; liuyang_rs@petrochina.com.cn; 1027126966@qq.com; wzlin19@qq.com

Abstract: Oil absorption coefficients were measured according to NASA's ocean optical measurement criteria using field experimental data and data of six oily sewage proportioning experiments conducted in 2008, 2009, 2010, 2012, 2013 and 2015. N-Hexane and carbon tetrachloride were used as reference solution in oily sewage proportioning experiments. In-situ spectral data and reference band absorption coefficients of petroleum substances were analyzed, and characteristics of basic physical quantities (remote sensing reflectance or water-leaving radiance) that can be detected in petroleum-contaminated water by optical sensors were studied, to find sensitive wavelengths or parameters which have effects on petroleum polluted water absorption coefficients. Inversion model of petroleum-contaminated water absorption coefficient $a(\lambda_0)$ at reference wavelength (for example, 440nm) was built based on the relation between the remote sensing reflectance and the sensitive wavelength of water absorption coefficient. On this basis, according to remote sensing reflectance, the normalized unit absorption coefficient was obtained with measured oily sewage absorption coefficient data and $a_{oil}(440)$ was calculated, further combined with the known S value, figured out $a_{oil}(\lambda 0)$ for each band. Finally, the corresponding oil concentration was determined by least squares method with relation between oil content and unit absorption coefficient as the absorption coefficient formula. This study provided an inversion model based on absorption coefficient $a_{oil}(\lambda_0)$ of petroleum substances in water at reference wavelength by remote sensing reflectance, to ensure that the parametric model of petroleum-contaminated water absorption coefficient can be forward closed, and further provided a method of retrieving oil content in petroleum-contaminated water using inherent optical properties.

Keywords: remote sensing model, oil pollution concentration, oil absorption coefficient, reference band

APPLICATION OF TIME SERIES OF REMOTELY SENSING SATELLITE IMAGES FOR CHARACTERIZING VEGETATION - HYDROMORPHOLOGY INTERACTIONS IN THE ARID REGION FLOODPLAINS

Xarapat Ablat (1)(2), Gaohuan Liu (1), Qingsheng Liu (1), Chong Huang (1)

[1] State Key Laboratory of Resources and Environment Information System, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China
[2] University of Chinese Academy of Sciences, Beijing 100049, China
Email: xiarp.15b@igsnrr.ac.cn; liugh@lreis.ac.cn; liuqs@lreis.ac.cn; huangch@lreis.ac.cn

Abstract: Floodplains are a key ecological feature of arid and semi-arid regions and river hydro geomorphology is the most direct factor for changing vegetation productivity and spatial patterns. Therefore, our research tried to answer how riparian vegetation interacts with river hydro geomorphology in the arid region floodplains by using time series remotely sensing images. First of all, we quantified lateral variations of the floodplain fluvial disturbance intensity, sediment erosion and deposition process and vegetation growth vigor and biomass through analysed water, vegetation and newly formed floodplain multiple indices generated by Landsat (total 67 scenes) and daily Moderate Resolution Imaging Spectroradiometer (MODIS) data of the Upstream wandering reach of the Yellow River between 2010-2015. Then based on the spatial distribution characters of each index, the study area was divided into five river corridor functioning zones. Results indicates that flood inundation intensity, vegetation cover and biomass as well as newly formed floodplain dynamics, has a significant spatial variability from river to floodplains. The Normalized Difference Vegetation Index (NDVI) curve of regular inundated zone has a significant regularity and the peak NDVI value of this zone was also higher than other zones. Floodplain formation activity was highly dynamic in the multi and irregular water inundation area. Peak NDVI value of extremely rare flooding area increased after the large flooding. Using remote sensing data can illustrate the interaction between the floodplain vegetation and river hydro geomorphology patterns. This method can be used in characterizing the vegetation hydro geomorphology interactions of other arid and semi-arid river floodplains.

Keywords: Vegetation; River hydro geomorphology; Remote sensing; Arid and semi-arid regions; Yellow River

INVESTIGATION ON AGENT BASED MODELS FOR IMAGE CLASSIFICATION OF LAND USE AND LAND COVER MAPS

Saziye Ozge Donmez (1), Cengizhan Ipbuker (1)

[1] Istanbul Technical University, Department of Geomatic Engineering, Sarıyer, Istanbul, Turkey
Email: donmezsaz@itu.edu.tr; buker@itu.edu.tr

Abstract: Natural resources are limited on Earth. Rapid increasements in population and urbanization can cause crucial and expeditious changes on land cover and land use. For this reason, monitoring in frequent periods of changes in the environment and heterogeneous areas is needed for strategic planning of sustainable applications and optimized management issues. As known, various regional and global initiations cooperates on Earth Observation services for environmental monitoring. Some main topics for these services are land management projects, cadastre, forestry, agriculture, rural and urban planning, environmental monitoring and so on. The improving technology and studies enable to use and analyze many different data sources efficiently and develop new methods for image interpretation, geo-information extraction, and processing. Today, geospatial intelligence influences all spatial and geographical sciences, as well image analysis. Widespread usage of remote sensing images for concerning both Earth's physical features and increasements of man-madely environmental changes bring semiautomatic and automatic analysis classification methods by side. Especially, VHS resolution imagery is started to be used as object-based image analyses methods, rule-based classification methods. Developing countries are started to standardize the land use and land cover (LULC) classification systems and nomenclature managing information more effectively and rapidly at national or regional levels years ago. Interoperable spatial data models and image analyses, which also play an important role in politics, government and economy is a study area as others; adaptive agents and agent based models (ABM) are used effectively and becoming more common in recent years. In this study, it is searched of advantages and requirements of ABM and agent based image analysis as an additional method to other image analysis methods for regional monitoring programs. In additionally, ABM stages of the classification algorithm and several ABM approaches (based on probability, Bayesian, Neural Network, and Genetic Algorithms) are investigated and described with examples on remotely sensed data. In the result of the models; the different land cover and land use map products are compared and interpreted in a scientific explication.

Keywords: agent-based classification, remote sensing applications, semi-automatic classification, image analysis, land use land cover maps (LULC)

COMPARING SPECTRAL BASED AND OBJECT-BASED CLASSIFICATION USING ASTER DATA FOR AUTOMATIC MAPPING: A CASE STUDY, BASEMENT ROCK OF WADI EL ALAQUI, EASTERN DESERT, EGYPT

Safaa Hassan (1) and Mohamed Roshdy (1)

[1] National Authority for Remote Sensing and Space Sciences, 23 Joseph Tito Street, El-Nozha El-Gedida, P.O. Box: 1564 Alf -Maskan, Cairo, Egypt
Email: Safaa.hassan@narss.sci.eg

Abstract: This paper compares the results of several object-based classification algorithms to a supervised pixel-based classification for mapping basement lithological units in Wadi El Alaqui, Eastern Desert of Egypt. The object-based method involved the segmentation process of the image into objects at several scale levels. The proposed training objects and the support Vector Machine (SVM), Decision Tree (DT) , Random Trees(RT), Bayes and K Nearest Neighbor (KNN) supervised classification algorithm have been used to assign the classes of the objects. The pixel-based classification involved the selection of training sets and a classification using the Support Vector Machine (SVM) classifier algorithm. The accuracy assessment using cross validation and grid search of all classifications results were assumed. A comparison of the results shows a statistically significant higher overall accuracy of the object-based classification over the pixel-based classification. The integration of both ASTER MNF and PCA layer and associated class rules into the object-based classification produced higher accuracies overall. The results indicate object-based analysis has good achievement for extracting the basement lithological units information from ASTER object-based classified image captured over Arabian Nubian belt.

Keywords: Object based classification, spectral based classification, ASTER, SVM.

AUTOMATIC IDENTIFICATION OF PLANT SPECIES THROUGH A CONVOLUTIONAL NEURAL NETWORK MODEL FOR UAV MOUNTED DIGITAL CAMERAS

Soumya K Das (1), Prakash P S (2), Bharath H Aithal (2)

[1] Center for Land Resource Management, Central University of Jharkhand, Jharkhand, Brambe, 835205 Ranchi, India
[2] RCG School of Infrastructure Design and Management, Indian Institute of Technology Kharagpur, West Bengal, 721302 Kharagpur, India
Email: dassoumyakana96@gmail.com; prakash.ps@iitkgp.ac.in; bhaithal@iitkgp.ac.in

Abstract: Species Identification is a challenging and significant part of Biodiversity conservation and protection. Traditional techniques of plant species identification are slow, complicated and require expertise in the field of biosciences. Plant species identification is a challenging task for a novice, interested in obtaining knowledge for various applications such as Bio-diversity monitoring, remote-sensing. Hence, with the advent of cost-effective unmanned aerial vehicle (UAV) technologies, deep learning and computer-vision have given rise to an interest in their use for plant species identification, with minimum knowledge of the expert. In this study, a seven-layer convolutional neural network (CNN), which is a deep learning feedforward artificial neural networks is proposed for automatic identification of plant species from the images acquired by UAVs, using feature learning. Small UAVs are suited for this model implementation as they can capture data at a very low altitude with visible plant morphology for feature learning. Three types of plant species leaf's i.e. Eucalyptus, Corylus (Hazel), Maple (Acer) where used for training of the network (90% of acquired data) and for testing (10% of acquired data) or data for identification by the networks. Data augmentation is performed on the training dataset to prevent overfitting of the model on the data. Model performance and efficiency are studied using the accuracy, loss curves and confusion matrix generated during successive iterations. The model showed an outstanding performance of 92% recognition rate on the test data. Performance of model is notable because basic RGB images are only used by the model to recognize plant species. It is observed that the increase in training data increases the accuracy of identification with decreased loss rate. The model could be trained to recognize as many species with basic RGB images, without the need for developing a new system. Future work include increase in robustness of the model by training it with more number of species. Hence, this model can be a powerful tool for automated identification of plant species in very low altitude UAV imageries and could be used in many forest, agricultural research and management processes.

Keywords: Automatic-classification, Agriculture and plantation, Deep-learning, CNN, UAV

GEOSPATIAL OBJECT BASED IMAGE ANALYSIS SMALL FORMAT AERIAL PHOTOGRAPH FOR DETAILED SCALE LAND COVER CLASSIFICATION

Akbar Muammar Syarif (1), Projo Danoedoro (1)(2)

[1]Department of Geography Information Science, Faculty of Geography, Universitas Gadjah Mada, Sekip Utara, Jalan Kaliurang, Bulaksumur, Sleman, Daerah Istimewa Yogyakarta, Indonesia
[2]Centre for Remote Sensing and Geographical Information System, Faculty of Geography, Universitas Gadjah Mada, Sekip Utara, Jalan Kaliurang, Bulaksumur, Sleman, Daerah Istimewa Yogyakarta, Indonesia
Email: akbar.muammar.s@mail.ugm.ac.id; akbarmuammarsyarif@gmail.com

Abstract: Object-oriented classification or Geospatial Object Based Image Analysis (GEOBIA) has not been widely used for land cover classification especially its application to small format aerial photography data (SFAP). There are also many object-based classification studies that haven't tried to identify the accuracy of segmentation. This study aims to assess the accuracy of segmentation and classification for classification of detailed scale land cover. The mosaics of five small format aerial photographs with 8.58 cm spatial resolution used as the source of data in this study. Segmentation process executed using multiresolution segmentation method and classification process through rule based classification. Segmentation process uses multiresolution segmentation method and classification process through rule-based classification. The segmentation accuracy test performed by quantitative analysis of over segmentation and under-segmentation, area fit index, root mean square, and quality rate. Object-based classification accuracy test is done through a comparison process between classification data and reference data that have been made previously on the same area coverage. Segmentation accuracy test executed on 25 segmentation simulation results with best accuracy value reaching 0.803. Rule based classification executed on the best segmentation results, accuracy of classification in this study reached 74,64%.

Keywords: GEOBIA, SFAP, landcover, segmentation, classification

INFRARED CAMERA ASSISTED OPTICAL PATTERN RECOGNITION OPTIMIZATION ALGORITHM -- USING HUMAN DETECTION AS AN EXAMPLE

Guanyu Yan (1), Wataru Takeuchi (1)

[1] Bw-602, Takeuchi Lab, Institute of Industrial Science,University of Tokyo, Komaba,Meguro-ku, 153-8505 Tokyo, Japan
Email: yangy@iis.u-tokyo.ac.jp; wataru@iis.u-tokyo.ac.jp

Abstract: Pattern recognition and object tracking have been one of the major topics in computer vision and automated monitoring where detection and tracking for human body are of great importance in security management and disaster rescue and relief. Techniques based on background subtraction works poorly on often moving use cases. While pattern recognition algorithm that utilizes multi-level subsampling to cover both the “bigger picture” and “minor details”, such as sliding windows, to find certain sets of patterns can be computationally expensive. For objects with heat signatures, like human body or wild animals, we can use low cost uncooled thermal infrared (TIR) camera to help accelerate the windows searching process in image pattern recognition algorithms. Additional thermal information provided by the TIR camera can help the system to pinpoint the Region of Interest (ROI) at potential areas instead of generating multiple level of subsampling images and loop through all of them. This paper proposes such optimization algorithm with human body as detecting target using low-cost uncooled thermal infrared camera.

Keywords: Human Detection, TIR, Computer Vision, Disaster Management

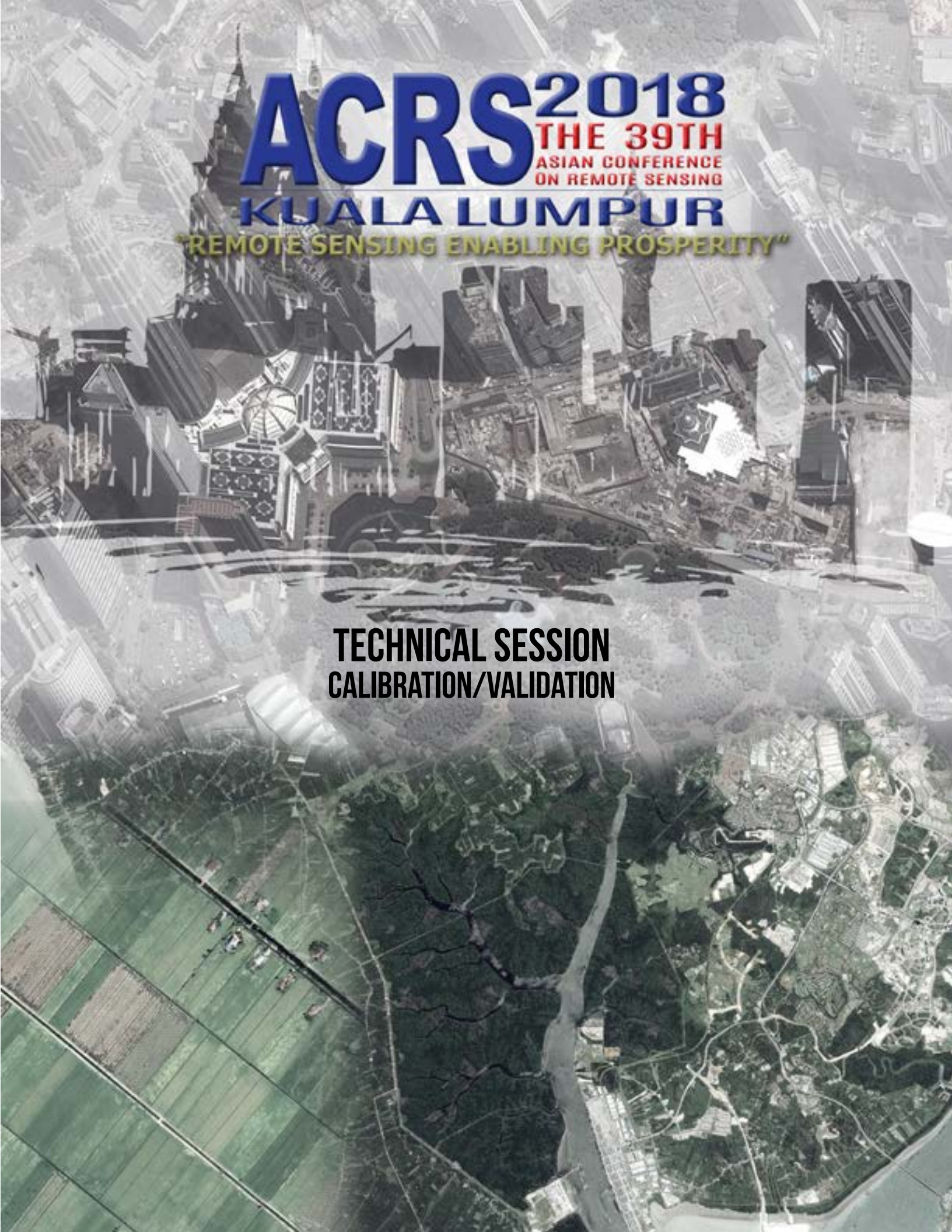
LAND USE AND LAND COVER CLASSIFICATION AND GEOMORPHOLOGICAL CHARACTERIZATION OF KUNDASANG, SABAH USING OBJECT-BASED IMAGE CLASSIFICATION

Nur Afiqah Mohd Kamal (1), Khamarrul Azahari Razak (2), Shuib Rambat (1)

[1] Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia Kuala Lumpur, 54100 Kuala Lumpur, Malaysia
[2] UTM RAZAK School of Engineering and Advanced Technology, Universiti Teknologi Malaysia Kuala Lumpur, 54100 Kuala Lumpur Malaysia
Email: afiqahhkamal@gmail.com; khamarrul.kl@utm.my; shuibrambat@utm.my

Abstract: Land use development in mountainous area should be monitored regularly as this region is extremely sensitive and vulnerable to various catastrophic threats caused by natural phenomena and climate change. Kundasang, Sabah, Malaysia is one of the famous mountainous area with highly potential in eco-tourism and active agriculture activity. The increase number of land use types such as infrastructure roads, buildings and even a cropland which in turn affects the topographic feature of mountainous area. Land use classification in this area is vital for understanding the interaction between human activity and landscape patterns and characteristics in order to support the planning and decision making through spatial analysis and appropriate image processing methodology. In this study, high resolution satellite imagery called Worldview-2 was used to classify land use and land cover (LULC) in mountainous area of Kundasang by applying object-based image analysis. Agriculture land and built-up area classes were overlaid with geomorphology character in order to determine the relationship between land use activities and physical features of the earth. LULC classes extracted in this area include dense vegetation, agriculture land, built-up area and road line. Slope map was categorised according to the Malaysia Department Mineral and Geosciences classification. Geomorphology unit were classified into hillslope, fluvial and tectonic geomorphology. The overlay analysis preliminarily reveals the land use activity especially built-up area was more focused on hillslope geomorphology with less than 15º slope angle. Agriculture activity occurred uniformly in all slope angle from gentle slope to steep denudational slope. Results shows that land use classes were distributed in all direction which become a matter of concern in this area. The integrated geomorphological features help to strengthen the land use decision making procedure.

Keywords: Land Use Land Cover, Object-based Image Analysis, Remote Sensing



TECHNICAL SESSION
CALIBRATION/VALIDATION

PROCEDURES AND LIMITATIONS IN QUALITY ASSESSMENT OF SPACEBORNE MULTISPECTRAL IMAGER (SMI) OUTPUTS FROM THE DIWATA-1 EARTH OBSERVATION MICROSATELLITE

Julius Noah H. Sempio (1), Jerine A. Amado-Dasallas (2), Romer Kristi D. Aranas (3), Ma. Divina Angela I. Bauzon (4), Benjamin Joseph D. Jiao (3), Benjamin Jonah P. Magallon (3), McGuillis Kim F. Ramos (5), Mark Edwin A. Tupas (6), Carl Earvin S. Yu (7)

[1]PHL-Microsat Program Data Processing, Archiving and Distribution (DPAD), National Engineering Center, University of the Philippines - Diliman, Quezon City, Philippines
[2]Training Center for Applied Geodesy and Photogrammetry (TCAGP), Melchor Hall, University of the Philippines - Diliman, Quezon City
[3]PHL-Microsat Program Data Processing, Archiving and Distribution (DPAD), National Engineering Center, University of the Philippines - Diliman, Quezon City, Philippines
[4]Department of Geodetic Engineering, Melchor Hall, University of the Philippines - Diliman, Quezon City
Email: jhsempio@up.edu.ph

Abstract: While microsatellites used for Earth observation are significantly cheaper than related large satellites such as Landsat 8 and WorldView-2, they are also limited in their equipment capacity, relying on miniaturized sensors that may not have the same quality characteristics as their larger counterparts. As such, it is imperative to have a robust satellite image quality assessment (IQA) scheme capable of noting possible issues present in miniaturized sensor data. This paper discusses the concepts and accepted procedures in the IQA of the outputs of the Spaceborne Multispectral Imager (SMI) installed in Diwata-1, the Philippines' first Earth observation microsatellite, including the preprocessing steps being undertaken before they are deemed ready for distribution, the statistics for assessing the performance of these steps, and the limitations in analyses due to the nature of the SMI images. The presence and effects of pixel dropout (PDO) are assessed by subjecting an image to a Laplacian filter, and analyses of individual and possible PDO clustering are used for initial characterization. Images that passed the above-mentioned test, but still possess transmission packet losses, then undergo an inpainting procedure via median filters to fill the "holes" with replacements referenced to the surrounding pixels. Signal-to-noise ratio is then computed via the homogeneous block method and fast cloud cover percentage determined by the Otsu process. Images are finally tagged using a qualitative scale made available on each image's metadata file, based on the tests they underwent. Limitations in the analysis are primarily driven by the coarse resolution of SMI images at 60 meters per pixel and the irregular orbit pattern of the microsatellite, manifested in the absence of a modulation transfer function (MTF) for the SMI sensor.

Keywords: Image Quality Assessment, Microsatellite, Earth Observation

PRELIMINARY TESTS OF CAMERA SELF-CALIBRATION BY WAVELET-BASED ADDITIONAL PARAMETERS

Jun-Fu Ye (1), Jaan-Rong Tsay (1)

[1] Dept. of Geomatics, National Cheng Kung University, Taiwan
Email: junfu.ye@gmail.com; tsayjr@mail.ncku.edu.tw

Abstract: Camera calibration is an important issue in photogrammetry. Self-calibration by additional parameters is the most famous method to calibrate various types of cameras. Traditional algebraic polynomial additional parameters were proposed for analogue single-head camera calibration, and they are later also applied to diverse digital cameras. However, many different types of metric and non-metric cameras are widely used in photogrammetry and computer vision. Traditional algebraic polynomial additional parameters might not be suitable for self-calibration of these diverse types of cameras. In addition, many additional parameters might be highly correlated with interior orientation parameters or other correction parameters. A new generation of additional parameters based on Fourier series overcomes these shortcomings, but they are not suitable for analyzing and representing nonstationary distortion signals. This study develops a new model of wavelets-based additional parameters as well as its computation program system for self-calibrated block adjustment. Preliminary tests are done by using aerial images in a calibration field. Their computation results demonstrate that wavelet additional parameters are helpful for correcting camera lens distortion. More details will be shown in this paper.

Keywords: Aerial triangulation, metric camera, self-calibration

STRATIFIED RANDOM SAMPLING FOR WATER AND NON-WATER REGION CLASSIFICATION USING PYTHON

Alejandro H. Ballado, Jr. (1), Sarah Alma P. Bentir (2), Ariel Kelly D. Balan (2), Jose B. Lazaro Jr. (1)

[1] School of Electrical, Electronics, and Computer Engineering Mapúa University, 658 Muralla St., Intramuros Manila 1002, Philippines
[2] School of Information Technology Mapúa University, 333 Sen. Gil Puyat Ave., Makati 1200, Philippines
Email: ahballado@mapua.edu.ph; sapbentir@gmail.com; akdbalan@mapua.edu.ph; jblazaro@mapua.edu.ph

Abstract: The main purpose of the stratification is to provide a higher degree of relative efficiency by giving better cross-section of the population where the reliability of the accuracy is determined through the sample units and sample schemes. To reduce the high sampling variance, the division of population into subpopulation may be used, this study performed stratified random sampling using Arcpy Package to be used as sampling array to classify water and non-water region. Samples were tested in Bayes, Function, and Decision Tree algorithms. Result shows that Naïvebayes has 98.4452 Overall Accuracy with 0.6047 kappa, J48 has 97.9752 Overall Accuracy with 0.7209 kappa, and Sequential Minimal Optimization (SMO) has 98.7659 Overall Accuracy with 0.626 kappa values.

Keywords: Python, Stratified Random Sampling, Decision Tree, Sampling Evaluation, RGB Color

EFFECTIVE IMPLEMENTATION OF FISHEYE LENS CALIBRATION BASED ON GEOMETRIC PROJECTION MODEL

Hsuan Yang (1), Jen-Jer Jaw (1)

[1] Department of Civil Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., 10617 Taipei, Taiwan.
Email: r06521801@ntu.edu.tw; jejaw@ntu.edu.tw

Abstract: Due to ultra wide-angle characteristics, fisheye lenses are widely used in artistic photography, surveillance application, forest science, self-driving obstacle avoidance, etc. Some applications that need to collect panoramic geo-information are especially suitable for using this kind of cameras. However, the imaging distortion of the fisheye image is significant, so the validity of fisheye lens calibration would largely depend on the correctness of geometric modelling between the image points and the object points. Since the fisheye lens has its own specific type of imaging formation, using collinearity equation attached by additional lens distortion parameters cannot set up a sufficient model. To achieve the relevant requirements of the metric measurement, this study adopts the rigorous object-image corresponding model to include geometric projection model for fisheye lens calibration. The discrepancy between the ideal image point and the actual image point is treated as the effect of lens distortion and modeled by additional parameters. This study verifies the validity of the employed fisheye lens calibration model by quantitatively assessing the calibration results. In addition, operational conditions and strategies that support effective and accurate fisheye lens calibration tasks are also analyzed and suggested.

Keywords: Fisheye lens calibration, Geometric projection model, Lens distortion

COMPARISON OF VIIRS AND MODIS ACTIVE FIRE PRODUCTS OVER SOUTH SUMATRA

Chenghua Shi (1), Jukka Miettinen, Xiaojing Huang (1), Soo Chin Liew (1)

[1]Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore, Blk S17 level 2, 10 Lower Kent Ridge Road, Singapore 119076
Email: crssc@nus.edu.sg; crsjukk@nus.edu.sg; crshxj@nus.edu.sg; scliew@nus.edu.sg

Abstract: This study aims to compare VIIRS and MODIS active fire data (hotspots) over a humid tropical region in Southeast Asia. Both VIIRS and MODIS employ similar algorithms for active fire detection but VIIRS hotspots have a nominal resolution of 375 m, in comparison to 1 km for MODIS. Thus, VIIRS is expected to have greater response for smaller fires as well as improved mapping of large fires. Daily VIIRS and MODIS active fire products from 2012 to 2017 were downloaded from NASA FIRMS web site. The study area is South Sumatra Province, Indonesia, where vegetation fires are routine occurrences. Aqua-MODIS and concurrent VIIRS afternoon hotspots were overlaid as rectangular objects, with consideration of their respective pixel sizes. Two hotspots are in agreement if their rectangles overlap. Otherwise, they are considered not in agreement. We also overlaid the hotspots on a VIIRS 500-m resolution visible-NIR image. Large fires can be detected visually from the smoke plumes. Thus, the detection performance of each sensor can be assessed for large fires.The study results show that, overall, 52.0% of MODIS hotspots were in agreement with VIIRS while only 22.7% of VIIRS hotspots agreed with MODIS. We also compared the detection performance for 10 days in the month of September 2015 when severe vegetation fires occurred. During this fire season, 73.2% of MODIS hotspots agreed with VIIRS while 47.1% of VIIRS hotspots agreed with MODIS. There were 78 visible fires in VIIR images. Among them, 70 (89.7%) were detected by VIIRS and 65 (83.3%) were detected by MODIS. Our results show that, on average, there were considerable disagreements between hotspots detected by VIIRS and MODIS, probably due to the different spatial resolutions of both sensors. VIIRS might detect smaller and/or less intense fires that were not detectable by MODIS. However, the agreements improved during a severe fire season though about 53% of VIIRS hotspots were still not detected by MODIS. For large fires, the detection rate were over 80% for both sensors though VIIRS performed better probably also due to the improved resolution.

Keywords: MODIS, VIIRS, Vegetation Fire, Active Fire Detection

A NEW APPROACH FOR ON-ORBIT SPATIAL CHARACTERISATION BASED ON IMAGE STRUCTURES

Jessica Wong Soo Mee (1), Ng Su Wai (1), Adhwa Amir Tan (1)

[1] National Space Agency, Ministry of Energy, Science, Technology, Environment and Climate Change, 42700 Banting, Selangor D.E., Malaysia
Email: jessica@angkasa.gov.my; wayne@angkasa.gov.my; adhwa@angkasa.gov.my

Abstract: One practical way to characterise the spatial performance of the optical imaging system of a satellite that already on the orbit is to determine its Modulation Transfer Function (MTF) from its remotely sensed images on the ground. While many measurement techniques exist, the technique utilised is designed to provide accurate measurements for high resolution imaging systems that usually rely on the presence and the manual identification of well separated characteristics target. The objective of this paper is to introduce an insight that a degradation function based on MTF can be estimated effectively by analysing the nonlocal self similarity characteristics, namely the structural component of the observed image. To this end, we develop a framework with several strategies to realise the objective of this work. First, we develop a segmentation method to select the ideal candidates; second, we develop an adaptive structure selection method that removes detrimental structures and selects useful information for Point Spread Function (PSF) estimation; and finally, we develop a robust estimation method by introducing a new spatial prior that simultaneously suppresses noise while preserving the sparsity and continuity of PSF kernels for MTF estimation. The datasets used in the analysis were synthetically blurred images simulated from Level-2A product of IKONOS and real remotely-sensed images from the Level-0 product of RazakSAT. The experimental results demonstrate that the proposed method is practical and effective, the difference in relative standard deviation at the Nyquist frequency is less than 2.25% as compared to the well established edge method. This indicates that the proposed framework produces reliable results for on-orbit Spatial Characterisation. The proposed framework offers an automated approach for spatial characterisation, thus overcomes the constraints in manual identification process and dependence on the presence of well-separated characteristic target in the image.

Keywords: Spatial characterisation, Point Spread Function, Modulation Transfer Function, nonlocal self-similarity characteristics, Spatial prior.

AUTOMATIC RECOVERY OF CAMERA POSES BASED ON SATELLITE IMAGE SEQUENCE CAPTURED BY A HIGH FRAME RATE IMAGE SENSOR

Ya-Chu Chang (1), Yi-Hsing Tseng (1), Chao-Hung Lin (1)

[1] Department of Geomatics, National Cheng Kung University, No. 1, Daxue Rd, Tainan City 70101, Taiwan
Email: p66064031@mail.ncku.edu.tw; tseng@mail.ncku.edu.tw; linhung@mail.ncku.edu.tw

Abstract: Satellite imagery have the advantage of rapid and cyclical monitoring of changes in environment, land use, natural resources, etc. Registering a satellite image sequence and further making it into a video by recovering camera poses will strengthen the merit mentioned above. The image sensor used in this study is a push-broom and frame-based sensor mounted on an aircraft flying in high altitude to simulate satellite images, and the images are captured with high frame rate. Frame-to-frame registration between subsequent frames should be done first. SURF (Speeded-Up Robust Features) is the feature based image matching algorithm used for keypoint detection, description and matching, and followed by RANSAC (Random Sample Consensus) to remove the wrong matching pairs. In order to improve the registration accuracy, overcoming the influence of relief displacement on image registration is needed, that is, only the keypoints belonging to the ground point are used for registration. Since the features in the images are not coplanar, there is no simple geometric transformation model to describe the relationship between the images, which means that we cannot solve the problem of keypoint clustering by analyzing the geometric relationship of the corresponding keypoint pairs in image space, but should solve in the object space. Therefore, we use the corresponding keypoints and the camera matrices obtained by camera calibration to recover camera poses and reconstruct the 3D structure of the scene by triangulation methods. Finally, the keypoints are clustered by their altitudes to take out the ground points for precise registration and video production.

Keywords: satellite image sequence, SURF, keypoint clustering, precise registration

A STUDY ON THE COMPATIBILITY OF THE SEA SURFACE TEMPERATURES BETWEEN HIMAWARI-8/AHI AND LANDSAT-8/TIRS

Yoshinari Oguro (1), Tomohisa Konishi (1), Seiji Ito (1), Chiemi Miura (1), Toshiharu Iwai (2)

[1] Department of Global Environment Studies, Faculty of Environmental Studies, Hiroshima Institute of Technology, 2-1-1 Miyake, Saeki-ku, Hiroshima, Hiroshima, 731-5193, Japan
[2] Department of Science and Technology for Biological Resources and Environment, Graduate School of Agriculture, Ehime University, 3-5-7 Tarumi, Matsuyama, Ehime, 790-8566, Japan
Email: y.oguro.yx@it-hiroshima.ac.jp; t.konishi.vd@it-hiroshima.ac.jp; s.itoh.us@it-hiroshima.ac.jp; c.miura.6u@it-hiroshima.ac.jp; t-iwai@agr.ehime-u.ac.jp

Abstract: Japanese geostationary meteorological satellite Himawari-8 was launched on October 7, 2014. The Himawari-8 is equipped with the Advanced Himawari Imager (AHI). The AHI has total of 16 observation bands (3 for visible, 3 for near-infrared and 10 for infrared). The Himawari-8 observes the whole of Japan with 2.5 minutes intervals. The spatial resolutions of Himawari-8 are 0.5 - 1 km for visible bands and 1 - 2 km for near-infrared and infrared bands. On the other hand, American earth observation satellite Landsat-8 was launched on February 11, 2013. The Landsat-8 is equipped with Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS). The OLI has total of 8 observation bands (4 for visible, 3 for near-infrared and 1 for infrared) and the TIRS has 2 observation bands (2 for infrared). The Landsat-8 observes the same area with 16 days intervals. The spatial resolutions of OLI are 30 m and those of TIRS are 100 m. Utilizing the data of bands 13 and 14 of Himawari-8/AHI which observed the whole of Japan, and the data of bands 10 and 11 of Landsat-8/TIRS which observed over the Uwa Sea of Japan, we compared the Brightness temperatures (BTs) and the Sea Surface Temperatures (SSTs) obtained from the synchronous observation by both satellites. From the analysis of correlation of the BTs of Himawari-8/AHI and those of Landsat-8/TIRS in the thermal infrared bands of similar wavelength, we found that the correlation coefficient was the highest between the band 13 (10.194-10.612 μm) of Himawari-8/AHI and the band 10 (10.780-11.280 μm) of Landsat-8/TIRS. Finally an atmospheric correction and an emissivity correction were applied to the BTs, we compared the measurement SSTs of in situ survey and the computed SSTs obtained from satellites over the Uwa Sea of Japan. From the analysis, we confirmed that the error between the measured SSTs and the computed SSTs of both satellites were within approximately 1 Kelvins.

Keywords: brightness temperature, sea surface temperature, band compatibility, Himawari-8/AHI, Landsat-8/TIRS

MAPPING SOLAR ENERGY POTENTIAL IN SRI LANKA WITH THE USE OF MODIS SATELLITE DATA

Udeshini I. Manatunga (1), Niluka Munasinghe (2), Lakmal Deshapriya (3)

[1]Water Resources Planning Division, Department of Irrigation, PO Box 1138, 230, Bauddhaloka Mawatha, Colombo 07, Sri Lanka
[2] Center for Urban Water, 10th floor wing C, Sethsiripaya, Battaramulla, Sri Lanka
[3] Geoinformatics Center, Asian Institute of Technology, P.O. Box 4, Klong Luang, Pathumthani,12120, Thailand
Email: mana.udeshini919@gmail.com; mniluka@gmail.com; lakmal@ait.ac.th

Abstract: Sri Lanka is a tropical country and substantial solar energy resources are available throughout the year with low seasonal variations. Information on distribution and extent of solar energy resources in Sri Lanka is essential for solar energy applications including sizing models in solar Photovoltaic (PV) power systems, building design applications and atmospheric research. Sunshine data are recorded at a number of weather and agricultural stations throughout the country. However, the solar radiation observations are relatively insufficient in inaccessible areas. The estimation of the solar energy resources and the elaboration of solar radiation maps are currently conducted using satellite derived information in the world. In this study, a new approach to estimate the global solar radiation is presented. The sum of the direct, diffuse and reflected radiation is called as the global solar radiation. Since the reflected radiation generally constitutes only a small proportion of total radiation, the total radiation is calculated as the sum of the direct and diffuse radiation in this research. The extraterrestrial radiation incident on the surface tangent to the outer surface of the atmosphere is calculated by existing mathematical formulas. The solar radiation reaching the earth surface depends on many factors. In addition to daily and seasonal cycles, clouds are the largest modulator of solar radiative flux reaching the earth's surface caused by their spatial and temporal variability. The atmospheric effect is compensated by extracting the cloud probability values derived using the MODIS (Moderate Resolution Imaging Spectroradiometer) Aqua / Terra 7-2-1 products. The validation of the monthly solar irradiation has been carried out using ground measurements obtained in three weather stations located in Colombo, Jaffna, and Kegalle. Finally, the solar resource Atlas of Sri Lanka for each month is presented. The research emphasizes a simple and accurate method to calculate the global solar radiation with compared to the ground observations.

Keywords: solar irradiation mapping, MODIS, renewable energy, atmospheric correction

RICE PADDY DRYER USING A CONTROL SYSTEM WITH HUMIDITY AND TEMPERATURE SENSORS

Vladimer A. Delos Reyes (1), Reihnier J. Navales (1), Armin Blaise P. Violago (1), Engr. Ernesto Vergara Jr. (1), Engr Ramon G. Garcia (1)

[1]Mapua University, *mapua.edu.ph.*
Email: vladimerdr@gmail.com; reihniernavales@gmail.com; arminviolago@gmail.com

Abstract: The main objective of this paper is to build a rice paddy dryer with control system for humidity and temperature. The dryer uses DHT22 sensor to monitor humidity and temperature with sensitivity of 0.1% RH and 0.1°C. The drying process starts with preheating of the dryer. When temperature exceeds 40°C, the heat source is turned off, otherwise it is turned on. When humidity level is below 50% RH, humidifier is turned on, otherwise it is turned off. Drying process stops when grain moisture content is within 12.5% to 14%. The switching operations of the humidifier and heat source uses two normally close relays connected to ACEduinoATmega328. The researchers performed three experimentations to: (1) demonstrate humidity and temperature control, (2) correlate humidity and temperature, and (3) compare the drying time of rice paddy dryer to sun drying with grain moisture content within 12.5% to 14%. The data gathered for table A in pg.6-7show that the researchers were able to regulate humidity and temperature with almost linear plot after the desired values of humidity and temperature were reached. The test for correlation in pg. 8-9table B using linear regression results to R values -0.8490, -0.9171, -0.9099, -0.9442, and -0.8413 for samples 1 to 5 respectively. The results of t- tests in table C, pg. 10- 14 show that the rice paddy dryer took 46.37 minutes to 64.58 minutes to attain moisture content within 12.8 % to 13.5% MC while sun drying took 60 minutes to 90 minutes to reach 12.5% to 14% MC.

Keywords: humidity, moisture content, rice paddy, sun drying, temperature

RESEARCH ON RELATIVE RADIATION CALIBRATION METHODS OF MULTI-SOURCE SENSORS IN OFFSHORE CULTURE ZONES

Xing Xufeng (1), Xie Shiyi (1), Huang Miaofen (1), Sun Zhongyong (1), Wang Zhonglin (1)

[1] Faculty of Mathematics and Computer Science, Guangdong Ocean University, 524088 Guangdong Zhanjiang China
Email: 4918585@qq.com; shiyixie@126.com; hmf808@163.com; 1027126966@qq.com; wzlin19@qq.com

Abstract: Aquaculture environment parameters in offshore aquaculture zones have the features that they fluctuate strongly in time and space. Marine remote sensing satellite and Meteorological satellite cannot satisfy the mariculture production demand due to their low spatial resolution, although they have the high temporal resolution. If the remote sensing satellites carrying with medium or high spatial resolution sensors can constitute a virtual constellation oriented the goal, it can be realized for long-term high dynamic monitoring of these parameters. One of the problems of the multi-source sensors integrated application is the difference between sensors in band width and the characteristics of the radiation. The solution of this problem can be that the high spatial resolution sensors are applied to the quantitative relative calibration technique of regional water. At present there are many successful research precedent that the relative radiation work were applied in a single Landsat sensors with EOS/MODIS sensor as a reference. However, the research on multi-source remote sensor relative radiation calibration is not reported both at home and abroad. Taking culture zones in Dalian of Liaoning province, China as the study area and based on the analysis of the existing satellite data characteristics such as CBERS - 04, HJ-1A, HJ-1B, GF-1, GF-2, GF- 4, Landsat 5 and Landsat 8, the relative radiation calibration equations for different sensors were built on the basis of EOS/MODIS satellite sensor reference to relative radiation sensor calibration. It makes each sensor data have comparability and lay the foundation for subsequent environment parameters of remote sensing quantitative accurate inversion model. Finally, according to the field observation data the accuracy of the result of the relative radiation calibration were verified, and the spatial variability analysed.

Keywords: relative radiation calibration, multi-source sensors, offshore culture zones, spatial variability

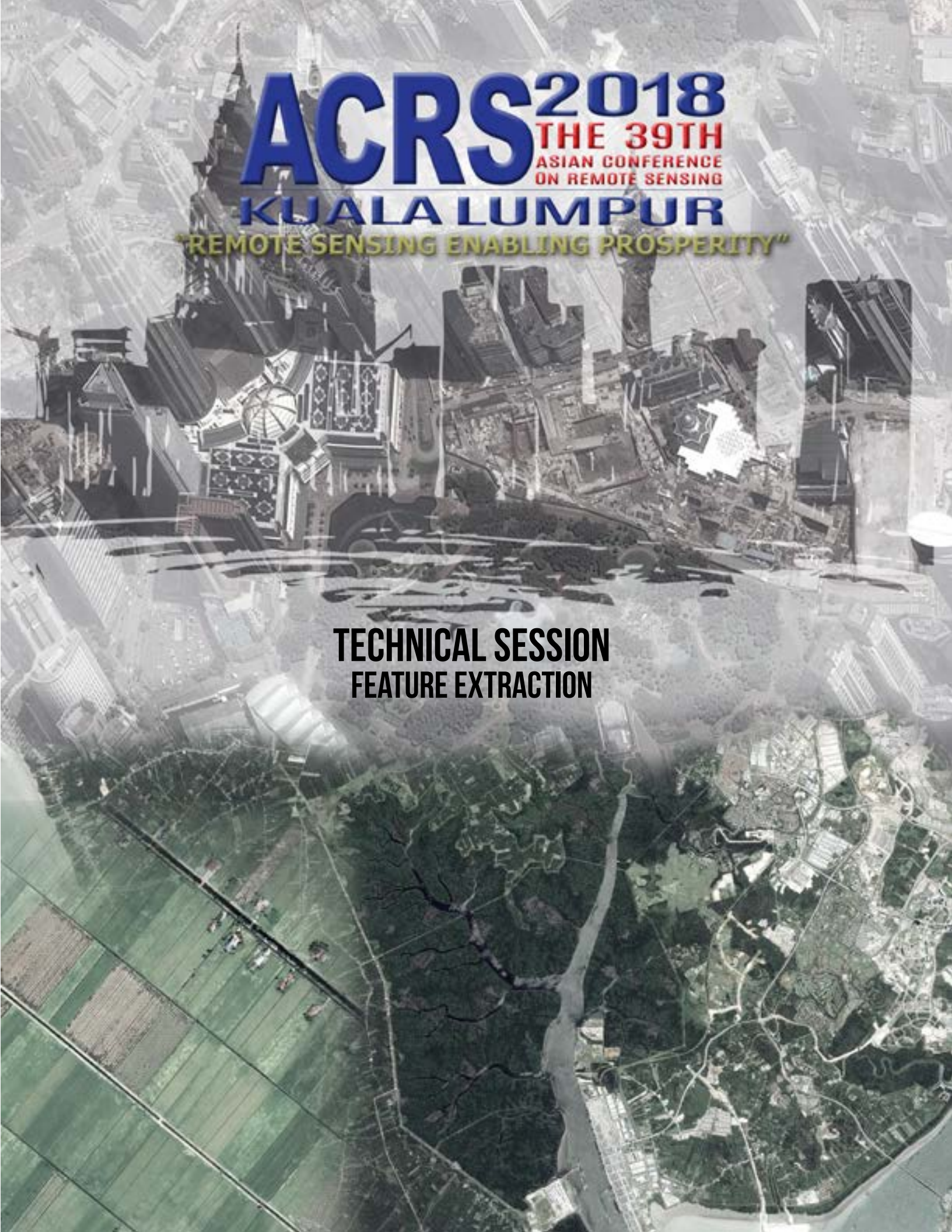
CLASSIFICATION MODEL OF WATER REGION USING ENTROPY EVALUATION OF SPECTRAL AND INTENSITY INFORMATION OF OBJECT – BASED IMAGE ANALYSIS

Alejandro H. Ballado, Jr. (1), Sarah Alma P. Bentir (2), Ariel Kelly D. Balan (2), Jose B. Lazaro Jr. (1)

[1] School of Electrical, Electronics, and Computer Engineering Mapúa University, 658 Muralla St., Intramuros Manila 1002, Philippines
[2] School of Information Technology Mapúa University, 333 Sen. Gil Puyat Ave., Makati 1200, Philippines
Email: ahballado@mapua.edu.ph; sapbentir@gmail.com; akdbalan@mapua.edu.ph; jblazaro@mapua.edu.ph

Abstract: Variables and features have become the focus of much research in areas of data mining application for which datasets with tens or hundreds of thousands of variables are available. Different spectral amount of red, green, and blue light. RGB color is the commonly used way to describe the image characteristics. This study identified important attributes based on the entropy measurement using Infogain attribute evaluator performed in Waikato Environment for Knowledge Analysis (WEKA) software to compare Bayes, Functions, and trees algorithms. Result shows that Naïvebayes has 96.4794 Overall Accuracy with 0.5222 kappa, SMO has 97.0750 Overall Accuracy with 0.4960 kappa, and J48 has 97.9752 Overall Accuracy with 0.7209 kappa values. Hence, the classification model has been performed in J48 classifier with 10 fold cross.

Keywords: RGB color, Spectral Evaluation, WEKA, Object-based Image Analysis



TECHNICAL SESSION
FEATURE EXTRACTION

UAV IMAGE FEATURE RECOGNITION USING SIFT ALGORITHM

Ranu Bhardwaj (1), Kamal Jain (2)

[1]Research Associate, Indian Institute of Technology Roorkee
[2]Professor, Indian Institute of Technology Roorkee
Email: ranubhardwaj57@gmail.com

Abstract: In this paper we introduce the new use of SIFT (Scale Invariant Feature Transform) algorithm in feature recognition. We can recognize all the same features in an image by matching it to the sample feature image. Here we require UAV (Unmanned aerial vehicle) images and using UAV images we show that how this is applicable in monitoring of broken Railway bolt. Similarly, we can use this concept in monitoring Bridges maintenance, and overhead electrification monitoring using SIFT algorithm.

Keywords: UAV image, MATLAB software**.**

INTEGRATED USE OF SENTIEL-2, LANDSAT-8 AND CARTOSAT DEM FOR AUTOMATIC LINEAMENT EXTRACTION, TO STUDY ACTIVE TECTONICS IN PARTS OF NW HIMALAYAN FRONTAL THRUST BY USING REMOTE SENSING AND GIS TECHNIQUES

L. N. Sharma (1), Pooja Pandey (1)

[1] Department of Applied Sciences, PEC (Deemed to be University), Sector-12, Chandigarh-160012, India

Abstract: The lineaments are important structural and geological indicator to determine tectonic trends and fractures zones in the rocks. Study involves automatic extraction and digital analysis of lineaments to understand tectonic setting of the area. The scope of the work is to avoid the bias related to visual interpretation of lineaments and to increase the speed of data processing. Himalayan Frontal Thrust (HFT) demarcates a sharp physiographic and active tectonic boundary between Himalayan foothills and recent alluvial plain. The study area constitutes NW part of Sub-Himalaya between Sutlej to Ghaggar river The aim of this work is to use of Cartosat DEM derived auxiliary data (hill shade, slope, aspect and drainage map) and lineaments extracted from Sentinel-2 and Landsat-8 data in tectonic induction. The methodology involves: (1) essential input data, (2) preprocessing of the satellite image (3) extracting of lineaments from satellite images (4) interpreting the lineaments using DEM and auxiliary data. The softwares ENVI 5.3 is used for image pre-processing, Geomatica for lineament extraction, ArcGIS 10.3 for splitting of lineament, density map generation, auxiliary data generation and Rockwork 16 for the rose diagram. Three geospatial analyses are applied in order to evaluate the lineaments i.e. length, density, and orientation. It is observed that predominant direction of lineaments is in NE-SW and is perpendicular to the major structural trend (NNW-SSE). The trend of lineament indicates direction of maximum principle compressive stress and displacement along major faults. The maximum density of lineaments lies along major fault zones of the area. The lineament density value is relatively higher in the high relief area due presence of fractured rocks owing to the structurally active terrain along the Siwalik range. Overlaying of detected lineaments, drainage and slope-aspect map illustrates their geospatial relation with the regional tectonic setting. The drainage pattern (Sub-parallel & Trellis) and drainage anomalies (offset streams, stream capture) found associated with Himalayan frontal thrust, Pinjor Garden Fault and Nalagarh thrust attributed active tectonic activities in the area. From the integrated approach of multispectral remote sensing data and DEM it is concluded that the north-western part of Sub-Himalaya is seismically very active.

Keywords: Himalayan Frontal Thrust, Lineament Extraction, Sentinel-2 and Landsat-8 data, Tectonics

A STATISTICAL APPROACH FOR CLOUD-FREE MOSAIC OF LANDSAT-8 IMAGERIES (CASE STUDY: INDONESIA)

Kustiyo (1), Judin Purwanto (2), Arief Wijaya (3), Orbita Roswintiarti (1)

[1] National Institute of Aeronautics and Space of the Rep. of Indonesia (LAPAN), Jakarta, Indonesia
[2] Ministry of Environment and Forestry, Jakarta, Indonesia
[3] World Resources Institute (WRI) Indonesia, Jakarta, Indonesia
Email: kustiyo@lapan.go.id; judinpurwanto@gmail.com; arief.wijaya@wri.org; orbita@lapan.go.id

Abstract: Monitoring forest and land use dynamic are crucial for better policy making processes. As one of tropical countries, parts of Indonesia are mostly covered by cloud almost all year round. It caused a challenge to acquire cloud-free images in a single acquisition data, as we need 255 Landsat-8 scenes to cover the entire country. Combining multi-temporal data acquisitions could be used to generate mosaic cloud-free satellite data. This research uses the statistical approach to twenty three available Landsat-8 data in 2017 for Indonesia region. Preprocessing steps include Top of Atmospheric (TOA) correction, Bidirectional Reflectance Distribution Function (BRDF), and cloud masking. These processing are applied to each of L1T Landsat-8 data to produce consistent reflectance data. Next, statistical minimum, maximum, and mean are extracted from any cloud-free pixel of the reflectance data for Red, Near Infrared (NIR), and Short Wave Infrared-1 (SWIR-1) bands. The results are several mosaic layers of minimum, maximum and mean from Red, NIR, and SWIR-1 bands. Because of the sensitivity of the SWIR-1 spectral in detecting open areas, large numbers of these pixels are detected by high value of SWIR-1 time series pixels, while high NIR spectral reflectance shows mostly vegetated pixels. We observed that RGB combination of the mosaic image can be accurately used to detect vegetated or opened areas. Most effective RGB combination for detecting vegetated pixels are: SWIR1-maximum, NIR-minimum, and Red-mean. Whereas open areas can be best detected using the RGB combination of SWIR1-minimum, NIR-maximum, and Red-mean. The comparison between both RGB combinations can be used to investigate land cover change across the years. Comparisons of mosaic Landsat-8 data from this study was compared with others mosaics data generated using pixel and tile-based approaches.

Keywords: cloud-free, mosaic, Landsat-8, statistical approach

SHIP DETECTION IN SATELLITE IMAGERY VIA CONVOLUTIONAL NEURAL NETWORKS

Amgad Agoub (1), Tom Lutherborrow (1), Martin Kada (1)

[1] Technische Universität Berlin, Methods of Geoinformation Science, Straße des 17. Juni 135, 10623 Berlin, Germany
Email: t.lutherborrow@campus.tu-berlin.de; amgad.agoub@tu-berlin.de; martin.kada@tu-berlin.de

Abstract: Ship detection from satellite imagery is a valuable tool for maritime traffic surveillance, detecting illegal fishing, oil discharge control, and sea pollution monitoring. Over the last decade, deep learning using convolutional neural networks (CNN) has become the dominant paradigm for various computer vision tasks like object classification, object detection, and segmentation, far surpassing traditional techniques. However, research and development are often focused on popular large-scale datasets, consisting of images that are vastly different from satellite imagery. We therefore trained and evaluated the Single-Shot MultiBox Detector (SSD) model for detection ships in satellite imagery on a small-scale custom dataset consisting of 794 images of ships collected near harbors and coastlines. In order to artificially increase the size of the dataset, standard data augmentation techniques were applied. Rather than training the entire model from scratch, pre-trained weights were loaded into the model before re-training on the ship dataset. Two slightly different approaches were trialed for comparison: (1) Only the base architecture layers from the VGG-16 network were initialized with pre-trained weights produced from the ImageNet dataset and then the subsequent layers trained in a typical transfer learning setting. (2) All layers of the network were initialized with pre-trained weights produced from the Microsoft COCO dataset and then fine-tuned by retraining every layer with our dataset. To evaluate the performance of the final models, the network was tested on the testing subset consisting of 100 images. The evaluation algorithms provided by the Pascal VOC competition were used to produce precision-recall (PR) curves and determine the overall mean average precision (mAP). With transfer learning (1), the network achieved a mAP value of 77.5%, while with fine-tuning (2), the network achieved a mAP value of 87.3%. The results confirm the effectiveness of the SSD model for object detection tasks, particularly in the case of satellite imagery. Our results also indicate that training with the SSD model can be greatly improved by fine-tuning pre-trained weights rather than training the entire network from scratch or transfer learning on the later layers of the network.

Keywords: Object detection, ships, convolutional neural networks (CNN), transfer-learning, fine-tuning

DEFINING THE EFFECTS OF TRAFFIC VIOLATIONS ON CRASH FREQUENCY AND FATALITIES BY APPLYING A SPATIAL PANEL MODEL

Pei-Fen Kuo (1), I Gede Brawiswa Putra (1), Chui-Sheng Chiu (1), Cheng-Yen Wu (1), Hafsah Fatihul Ilmy (1)

[1]Geomatics Department National Cheng Kung University, 1 University Road, Tainan City, Taiwan, R.O.C. 70101
Email: peifenkuo@gmail.com

Abstract: Previous studies have examined the relationship between traffic violations and crash risk, and most have shown that increasing the density of traffic enforcement and issuing more tickets may deter aggressive driving and reduce local crash risk. However, few studies have discussed the spatial-temporal effects. Hence, this research applied Moran's I and a spatial panel model to define the effects of traffic violations on the frequency of crashes and number of fatalities. Important environmental factors were used as control variables in order to capture the spatial-temporal relationship. The results show that if the violations are related to driving style, such as DUIs and speeding, increasing the corresponding enforcement and issuing more tickets will decrease both crash risk and the number of fatalities. However, if the violations are related to drivers' daily car use habits, then areas with higher numbers of violations may represent urban areas with more drivers and greater traffic exposure. The final model we suggest is a spatial autoregressive model with a fixed effect (SAR_FE) model, which indicates that while there were differences in crashes and fatalities by city, there were still some spatial patterns caused by unobserved variables. This model shows this unexplained spatial pattern in the error term. Based on our results, police authorities should try increasing their enforcement density (for violations resulting from driving style) in target cities; the corresponding crash frequency or number of fatalities could be reduced due to deterrent effects.

Keywords: Spatial Panel Model, Crash Prediction, Traffic Violation

CLASSIFICATION OF STRUCTURE ELEMENT USING GEOSPATIAL DATA FOR FLOOD VULNERABILITY ASSESSMENT

Nurul Zakirah Zainal (1), Muhammd Zulkarnain Abdul Rahman (1)(2), Tze-Huey Tam (1), Ismail Usman Kaoje (1)

[1] Fakuti Alam Bina & Ukur, Universiti Teknologi Malaysia, 81310 UTM, Johor Bahru, Malaysia
[2] TropicalMap, Universiti Teknologi Malaysia, 81310 UTM, Johor Bahru, Malaysia
Email: nurulzakirahzainal@gmail.com; mdzulkarnain@utm.my; tzehuey85@hotmail.com; usman.kaoje.@graduate.utm.my

Abstract: Floods have been causing substantial monetary damage to a nation's economy. There are no losses when the flooded area does not have any elements on it. These elements include a human system, built environment system and natural system that are at risk of flooding in a given area. The risk is a combination of hazard and vulnerability. Geospatial technologies are widely been used in hazard assessment. This study aims to classify the elements-at-risk on the basis of using high-resolution remote sensing data in order to extract structure element for flood vulnerability assessment. First, an object-based image analysis performed on the satellite image for classification of Land Use Land Cover (LULC) map. Characterization of buildings features is based on green area, impervious area, vacant area and buildings area by calculating the percentage of LULC map for each regular grid using zonal statistical analysis. The results show that the double storey confined brick masonry building produced a highest accuracy of 48%, followed by Single storey reinforced frame masonry building with 23% accuracy, single storey confined brick masonry building has 16% accuracy, the accuracy of the double storey or higher concrete reinforced frame masonry building is 10%. Wood/zinc/cement-board building produced the lowest accuracy of 1%. The overall accuracy for classification structure element is 50%. Further analysis should be carried out in order to refine the accuracy in order to carry out details assessment of flood vulnerability.

Keywords: Urban Structure, Flood Vulnerability, Object-Based Image Analysis, Land Use Land Cover

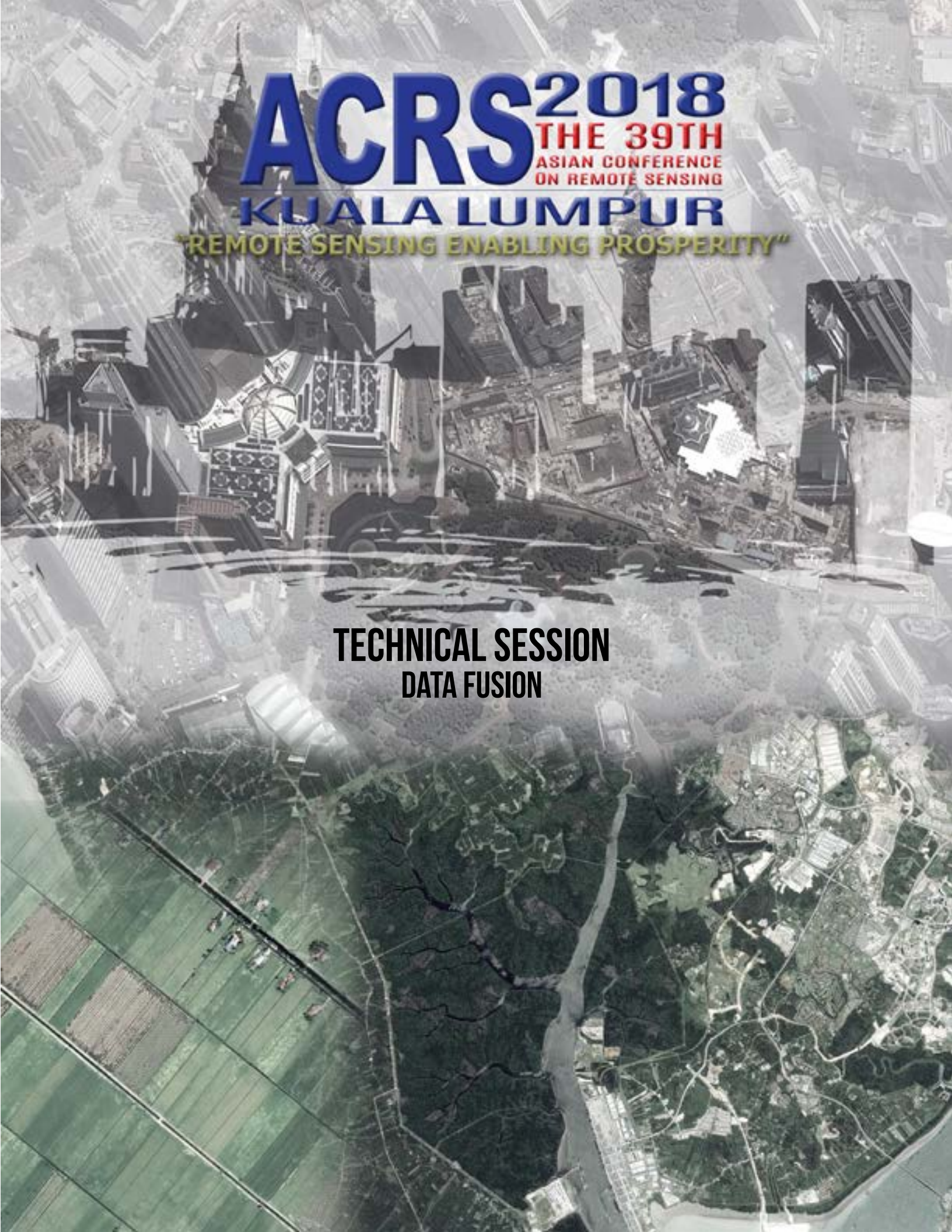
APPLICATION OF SATELLITE IMAGES LANDSAT 8 FOR INTERPRETATION OF PM10 DISTRIBUTION IN THE INNER CITY OF HO CHI MINH

Nguyen Chau My Duyen (1), Pham Truong Hoai Tham (1), Bui Ta Long (1)

[1] Hochiminh City University of Technology, No. 268, Ly Thuong Kiet, Ward 14, District 10, Hochiminh City, Vietnam
Email: longbt62@hcmut.edu.vn

Abstract: This research is to focus on the application of Landsat 8 OLI remote sensing in 2017 to map PM10 dust emulation for the inner city, Ho Chi Minh City, using the method of calculating value of Aerosol Optical Thickness (AOT) and correlative regression between concentration of PM10 dust observed from ground stations and values reflected on each band. The results show that there is the best correlation on the linear regression function between the blue channel B2 and green channel B3 with the real measured data ($R^2 = 0.947$). Dust pollution in the air is increasing, PM10 dust concentration in Iinner City, Ho Chi Minh City has a value of 100-200µg / m3, the area has concentration of PM10 dust higher than 200µg / m3 are discovered penetrating in residential areas, industrial zones and the most is concentrated in the traffic routes simulated on the image. The research results also compare the difference between observation value of ground surface observation and image analysis, which shows that satellite image remote sensing technology is reliable, can calculate and simulate air pollution and use it as an effective and useful tool for monitoring the air quality of big cities, especially in the inner urban areas.

Keywords: AOT optical thickness, remote sensing, PM10



TECHNICAL SESSION
DATA FUSION

DATA FUSION TECHNIQUE FOR KOMPSAT-6 SAR AND AIS PAYLOAD

Tae-Bong Oh (1), Jung-Hwan Song (2), Chul-Ho Jung (2)

[1] Korea Aerospace Research Institute, Image Data System Development Division 169-84 Gwahak-ro, Yuseong-gu, Daejeon, 34133, South Korea
[2] EchoSensing, R&D Research Lab, 289 Pangyo-ro, Seongnam, 13488, South Korea
Email: tboh@kari.re.kr; jhsong@echosensing.com; chjung@echosensing.com

Abstract: The objective of this paper is to develop core technology for fusion of ship targets and AIS data obtained from KOMPSAT-6 SAR and AIS payload. This paper presents the structure of data fusion algorithm for satellite SAR & AIS payload, and the result of the fusion. Ship target detection algorithm using satellite SAR image consists of following steps: Pre-processing which includes speckle filtering, land-sea masking and clutter analysis, Pre-screening for ship-like target detection, and Discrimination/feature extraction of ship targets. And the procedure for AIS data pre-processing, timeline synchronization and target track filtering is described. The last phase of data fusion is based on the results of ship target detection and AIS data processing. Final result of the research is to match targets in consideration of validity of AIS information and classified ship target. For feasibility study, real AIS data and KOMPSAT-5 SAR images are acquired around a test-bed which is designated in this research. And then the algorithm is examined by data fusion processing using the above data. The work is still continuing to analysis the data fusion algorithm with other data and reach certain conclusion from real KOMPSAT-6 payloads.

Keywords: KOMPSAT-6, SAR, AIS, Data Fusion

FUSION OF PANCHROMATIC AND MULTISPECTRAL IMAGES USING LAGRANGE OPTIMIZATION

Mutum Bidyarani Devi (1), R Devanathan (1)

[1] Hindustan Institute of Technology and Science, School of Electrical Sciences, Chennai, India
Email: bidyarani.mutum@gmail.com; devanathanr@hindustanuniv.ac.in

Abstract: The availability of heterogenous resolutions (spatial and spectral) among the sensors increases the importance of data fusion in the remote sensing society. The kind of spatial and spectral resolutions needed differs from one application to another. To fulfil the necessity, fusion is done to obtain the required output. In particular, image fusion of IKONOS panchromatic and multispectral image data in which the images differ in resolutions spatially (4:1) and spectrally is addressed in this paper. The use of multisensor fusion exists in the literature. Mostly, many of the existing works consider building a fusion model based on the sensor imaging physics. In our work, we build a data-driven model where the fusion process is performed based on the reflectance data which includes the effect of sensor as well as that of the imaged object. We downsample the data and a linear regression model is developed based on the deviation variables from the sample average. A convex optimization problem is formulated in terms of Lagrange multiplier where the minimization function is to preserve the color contents of the multispectral channels and also to minimize the difference in variances between the actual data variance and the computed data variance. Three different cases for fusion are discussed separately using data provided by the IKONOS satellite. Simulation results are provided and compared for the three cases. Validation of our method consists of building a reference sample data for multispectral channels by downsampling the actual multispectral sample data once; this involves double downsampling the panchromatic channel to bring it to the same resolution as the color channels. In order to evaluate the fitness of the data obtained, we performed a chi-square goodness of fit test. Based on the critical value and the p- value obtained against the degrees of freedom assigned, we conclude that the fit is satisfactory in all the three cases considered.

Keywords: Image Fusion, Lagrange Multiplier, Chi-Square Test, Pansharpening, Spectral Consistency

MULTISPECTRAL AND SAR IMAGE FUSION BASED ON LAPLACIAN PYRAMID AND SPARSE REPRESENTATION

Hai Zhang (1), Huanfeng Shen (1), Qiangqiang Yuan (2)

[1] School of Resource and Environmental Sciences, Wuhan University, No.129 Luoyu Road, 430079 Wuhan, Hubei, P. R. China
[2] School of Geodesy and Geomatics, Wuhan University, No.129 Luoyu Road, 430079 Wuhan, Hubei, P. R. China
Email: haizhang@whu.edu.cn; shenhf@whu.edu.cn; yqiang86@gmail.com

Abstract: Multispectral (MS) images contain plentiful spectral information of the Earth's surface that is beneficial for identifying land cover types, while Synthetic Aperture Radar (SAR) images can provide abundant information on texture and structure of target objects. Complementary information from multi-sensors can be combined to improve the availability and reliability of stand-alone data. Therefore, this paper presents a fusion framework based on Laplacian pyramid (LP) and sparse representation (SR) theory to integrate information from MS and SAR images. Laplacian pyramid is performed to decompose both the multispectral and SAR images into multi-level detail images (high-frequency components) and approximation images (low-frequency components). High-frequency components are combined based on the absolute values of coefficients while low-frequency components are merged employing a SR-based fusion strategy. Finally, LP reconstruction is performed on fused detail and approximation images to obtain the integrated image. We conduct experiments on several datasets to verify the effectiveness of proposed method. Both visual interpretation and statistical analyses demonstrate that the proposed method strike a satisfactory balance between spectral information preservation and enhancement of spatial and textual characteristics. In addition, a further discussion about different emphases on injection of SAR features into multispectral image via adjustment of LP decomposition levels is involved. The adjustability property makes the proposed method more flexible in further application scenarios.

Keywords: Laplacian pyramid, sparse representation, multi-sensor image fusion, image quality assessment, synthetic aperture radar (SAR)

IMAGE FUSION FOR SYNTHETIC APERTURE RADAR, PANCHROMATIC, AND MULTISPECTRAL IMAGES BASED ON RANDOM FOREST REGRESSION

Dae Kyo Seo (1), Yong Hyun Kim (2), Yang Dam Eo (1), Wan Young Park (3)

[1] Konkuk University, Department of Advanced Technology Fusion, 120 Neungdong-ro, Gwangjin-gu, 05029, Seoul, Korea
[2] Seoul National University, Department of Civil and Environment Engineering, 1 Gwanak-ro, Gwanak-gu, 08826, Seoul, Korea
[3] Agency for Defense Development, 462 Jochiwan-gil, Yuseng-gu, 34060, Daejeon, Korea
Email: tjeory@konkuk.ac.kr; yhkeen@gmail.com; eoandrew@konkuk.ac.kr; wypark@add.re.kr

Abstract: A single remote sensing data source is not sufficient for information extraction, which leads to the complementary use of Synthetic aperture radar (SAR) and optical imagery. However, many classical approaches fail to deal with different imaging mechanisms. In this study, an alternative fusion method which can include characteristic of SAR image and colour information of optical image is proposed. SAR, panchromatic, and multispectral images are used, and image fusion is performed based on random forest (RF) regression. More specifically, the proposed method firstly corrects different characteristic by performing fusion between SAR and panchromatic images through RF regression. Then, the multispectral image is used to integrate colour information. The colour relationship between the initial fusion image and the multispectral image is also established through RF regression, and the final fusion image is obtained. In other words, a series of two relationship establishments are performed for the fusion of the SAR and optical images. The fused image is evaluated by comparison with other image fusion techniques. Experiments demonstrate that the proposed method outperforms in terms of spectral preservation and feature enhancement.

Keywords: Image fusion, synthetic aperture radar (SAR), panchromatic image, multispectral image, random forest (RF) regression

BURN SCAR EXTRACTION USING FUSED LANDSAT 8 OLI and SPOT 6 IMAGERIES IN PEAT SWAMP FOREST

Nurul Aina Abdul Aziz (1), Norimaniah Mazelan (1), Siti Atikah M. Hashim (1),

[1] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC), No.13 JalanTun Ismail, 50480, Kuala Lumpur, Malaysia
Email: aina@remotesensing.gov.my; iman@remotesensing.gov.my; atikah@remotesensing.gov.my

Abstract: Burn scar is an important parameter when describing the impact of forest fire to the ecosystem. Burn scar extraction using remote sensing data is an efficient way to evaluate burn area. However, MODIS date is not suitable for small-scale fire event, which occurred locally. The accuracies is less due to blurred and irregular edges in response to the 1km x 1km pixels of MODIS data. Therefore, this paper introduced techniques of burn scar extraction using higher imagery i.e. Landsat 8 and SPOT 6. In this research, different types of fused image techniques were used to both pre and post fire imageries to identified burn scar areas. Three fusion techniques investigated including HPF Resolution Merge, Modified IHS Resolution Merge and Wavelet Resolution Merge. Quality assessment of the fused image based on the quality and the quantitative aspects of the spatial and the spectral visibility of the images. High Past Filter techniques on fused imaged gives best result for burn scar identification visually. Based on this best-fused image, further Normalized Burned Ratio (NBR) analysis conducted to calculate and produced burn severity map. The burn severity map will eventually help authorities evaluate fire damage and take measures on rejuvenation the forest.

Keywords: Burn Scar, Normalized Burn Ratio, Burn Severity Map, Fused Image, Peat Swamp Forest

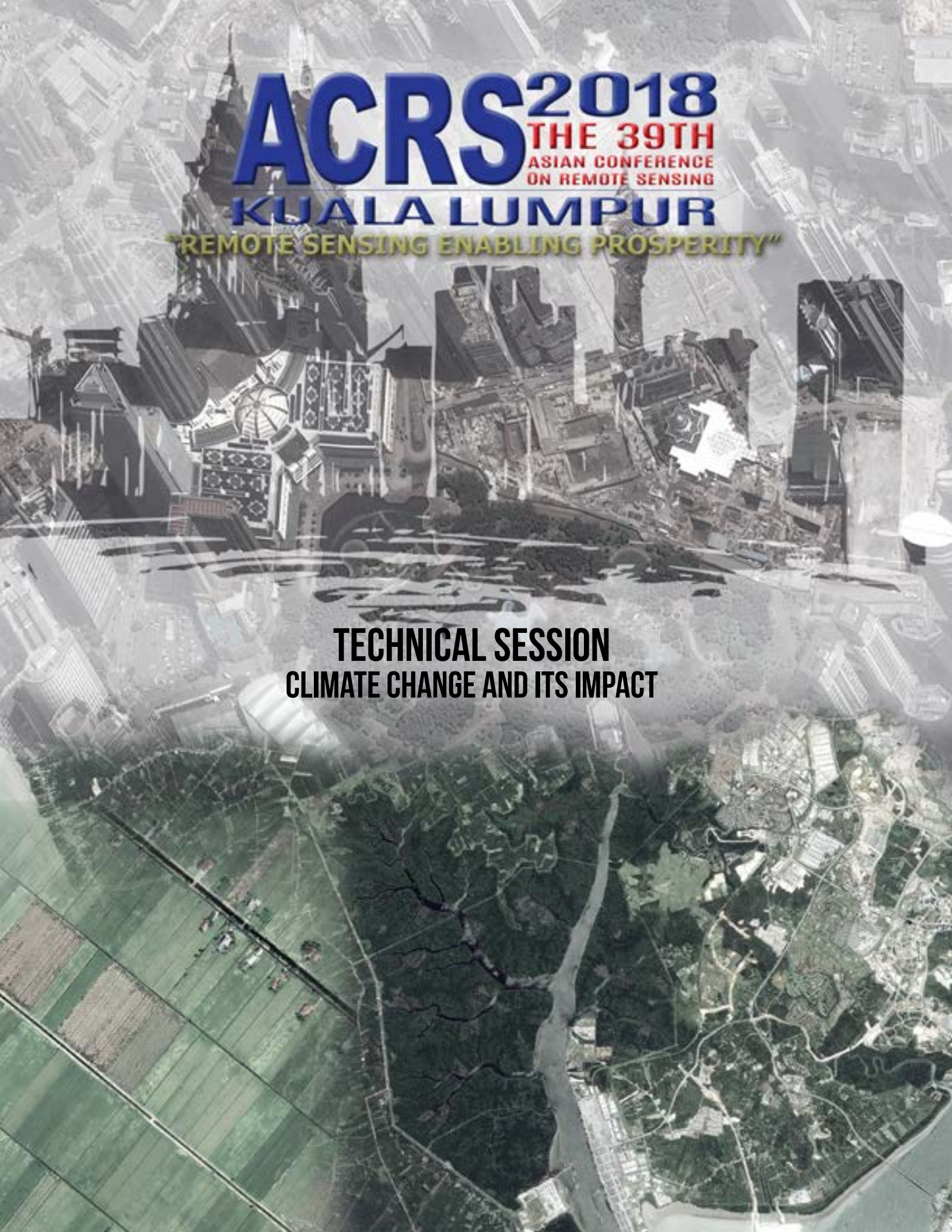
SURVEY ON IMAGE FUSION TECHNIQUES USED IN REMOTE SENSING

Kalyani Ulabhaje (1)

[1] G.H. Raisoni College of Engineering
Nagpur, CRPF Gate No. 1, Hingna Road
Nagpur, India
Email: Kalyani2507@gmail.com

Abstract: Image fusion in remote sensing has emerged as a sought-after protocol because it has proven beneficial in many areas, especially in studies of agriculture, environment and related fields. Simply put, image fusion involves garnering all pivotal data from many images and then merging them in fewer images, ideally into a solitary image. This is because this one fused image packs all the pertinent information and is more correct than any picture extracted from one solitary source. It also includes all the data that is required. Additional advantages are: it lessens the amount of data and it creates images that are appropriate and that can be understood by humans and machines. This paper reviews the three image fusing processing levels, which include feature level, decision level and pixel level. This paper also dwells upon image fusion methods that fall under four classes: MRA, CS, model-based solutions and hybrid and shows how each class has some distinct advantages as well as drawbacks.

Keywords: Image fusion, remote sensing, high resolution images, PAN images, MS images.



TECHNICAL SESSION

CLIMATE CHANGE AND ITS IMPACT

FOG HAZARD OF INDO-GANGETIC PLAIN: MAPPING, MODELLING AND DISPERSION TECHNIQUES

Arun K. Saraf (1), Josodhir Das (2), Kanika Sharma (1)

[1] Department of Earth Sciences,
[2] Department of Earthquake Engineering,
Indian Institute of Technology Roorkee
ROORKEE – 247667, INDIA
Email: arun.k.saraf@gmail.com; saraffes@iitr.ac.in

Abstract: Fog is a low stratus cloud, which normally touches ground. The great Indo-Gangetic Plain covering an enormous area, south of the Himalaya in Northern India is most affected by dense fog every year in the winter months (during December to February). Due to increasing air pollution, it has now become smog (smoke + fog) rather than normal fog. Increased air pollution adds the availability of aerosols which becomes prominent during winter months due to prevailing air flow conditions. Aerosols (are small particles of about 0.2 μm size) serve as cloud condensation nuclei which become smog during winter months. The characteristic meteorological, environmental and prevailing topographic conditions and increasing pollution over the Indo-Gangetic Plain are the common factors favouring fog formation. In the present study, the fog of Indo-Gangetic Plain has mapped (2002-2017), analyzed using NOAAAVHRR and Terra /Aqua-MODIS satellite data sets. GIS based analysis of different parametric surfaces derived through two different interpolations of meteorological and elevation data, the favourable conditions for fog formation were ascertained and forecasting has been done for few dates. Later fog formation forecasts were validated of using NOAA-AVHRR / Terra /AquaMODIS data sets in near real time. The dissipation and migration pattern of fog in the study area is also interpreted and analysed on the basis of the analysis of both meteorological and satellite data. A classification of the fog-affected area is also performed and the more fog prone zones in the belt were identified. The present paper also proposes ion based fog dispersion technique which initially has been tested in the lab and results show highly encouraging results. Field validations of ion based fog dispersion technique have also been planned.

Keywords: Smog, Remote Sensing, GIS, Modelling, Dispersion

CONVERSION OF NOAA SATELLITE DATA TO ET0 WITH ANN MODEL - CASE STUDY IN GAZVIN IRRIGATION NETWORK

Ali Rahimikhoob (1)

[1] Department of Irrigation and Drainage Engineering, College of Aburaihan, University of Tehran, Pakdasht, Iran
Email: akhob@ut.ac.ir

Abstract: Reference evapotranspiration (ET0) is one of the most important parameters for crop water requirement. The objective of this research is to evaluate whether it is possible to convert NOAA Satellite Data to ET0 by artificial neural network (ANN) for one of Irrigation Network in Iran. In this research, 231 images NOAA satellite during 2006 to 2008 were used. A cool pixel was selected for each image. The surface temperature at the cold pixel and extraterrestrial radiation were the input variables for ANN model. The FAO-56 Penman–Monteith model was used as a reference for evaluating the performance of the ANN model. The result showed that converting land surface temperature from satellite data to ET0 gave good match with the reference data. Coefficient determination (R2) and Root mean square error (RMSE) between reference and estimated ET0 were 0.85 and 7.5%, respectively.

Keywords: ANN model; cold pixel; surface temperature; Iran

MONITORING DROUGHT VIA TVDI DERIVED FROM 2000 - 2015 MODIS DATA: A CASE STUDY OF VIETNAMSESE MEKONG RIVER DELTA

Phan Hien Vu (1), Dinh Tung Vi (1), Zhongbo Su (2)

[1] University of Technology, Vietnam National University – Hochiminh City, Vietnam
[2] ITC, University of Twente, Netherland
Email: phanhienvu@hcmut.edu.vn

Abstract: During the last decades, drought has appeared sparsely and repeatedly in the Vietnamese Mekong River Delta. The paper focuses on exploiting the 2000 – 2015 MODIS data in summer to monitor drought in this region. For each acquisition time, TVDI (Temperature Vegetation Dryness Index) has been applied to determine dried levels for each pixel, related to soil moiture. Here, TVDI is determined based on NDVI, derived from MOD09GQ data, and LST, derived from MOD11A1 data. Then, a temporal trend of drought is estimated for each pixel using a linear regression in summer between 2000 and 2015. The results indicate that drought in the Vietnamese Mekong River Delta has mostly been at a moderate level, corresponding to TVDI from 0.4 to 0.6, while few areas have TVDI between 0.8 and 1.0, meaning to the highest drought level. Additionally, a temporal trend of drought has an increase in urban areas in the region during the observed period.

ANALYSIS AND MODELLING OF THE SEASONAL VARIATION IN UHI OVER THE NINE CITIES OF INDIA

Vinayak B. (1), Shirishkumar Gedam (1)

[1] CSRE, Indian Institute of Technology- Bombay, Powai, Mumbai 400076
Email: vinayakbhanage@iitb.ac.in; shirish@iitb.ac.in

Abstract: Current study has been carried out to model and analyse the seasonal variation of UHI over the nine, class-one cities of India. The association between seasonal variation of UHI and vegetation gradient has been evaluated in order to quantify the response of UHI to the seasonally varying gradient of vegetation. The magnitude of UHI and vegetation gradient were measured from the daytime satellite (Terra-MODIS) datasets using the method of fringe analysis. In the summer season, the maximum magnitude of UHI was experienced over the city of Kolhapur, whereas, during the winter spell, highest intensity of UHI was noticed over Pune Metropolitan area followed by the city of Ahmadabad. This study result that the summer mean and the seasonal alterations of UHI magnitude are mainly restrained by the changes in the vegetation gradient between urban-rural areas, on the other hand, the intensity of UHI during the winter season is mostly based on the temperature- vegetation conditions over the rural zone. For summer and seasonal changes of UHI, regression equations were fitted for UHI with the aid of vegetation gradient and the surface temperature of the urban area, which explains nearby 90% of UHI variation. In a similar way, the variation of UHI in winter season has been modelled that elucidates up to 84% of UHI discrepancy during the winter season. On a seasonal scale, decrement in the vigor of vegetation by 0.1 leads to an increase in the Seasonal intensity of UHI by 1.74ºc which is quite a significant augmentation. This study Emphasizes the contribution of the various factors in the alteration and development of seasonal UHI which is a key aspect for urban planners and policy makers in designing the mitigation strategies.

Keywords: MODIS, NDVI, Seasonal Variation, Urban Heat Island, Vegetation Gradient

CLIMATE CHANGE AND DECLINING SPECIES SUITABILITY FOR ENDANGERED GARCINIA GUMMI-GUTTA: PREDICTING HABITAT SUITABILITY AND CONSERVATION PLANNING UNDER CLIMATE CHANGE SCENARIO

Malay Pramanik (1)

[1] Jawaharlal Nehru University, New Delhi-110067, India
Email: malaygeo@gmail.com

Abstract: Climate change is continuously affecting the ecosystem, species distribution as well as global biodiversity. The assessment of the species potential distribution under various climate change scenarios is a significant step towards the conservation and mitigation of species loss and vulnerability. In this context, the present study aimed to predict the influence of current and future climate on an ecologically vulnerable medicinal species, Garcinia gummi-gutta, of the Western Ghats using Maximum Entropy modelling. The future projections were made for the period of 2050 and 2070 with RCP scenario of 4.5 and 8.5 using 84 species occurrence data, and climatic variables from three different models (HadGEM2-CC, GFDL-CM3, and NorESM1-M) of IPCC fifth assessment. Climatic variables contributions were assessed using jack-knife test and mean AOC 0.888, TSS 0.698, and kappa 0.733 indicate the model performs with very high accuracy. The major influencing variables will be annual precipitation (32.51±1.4%), precipitation of coldest quarter (16.57±0.6), precipitation seasonality (12.56±1.3), and precipitation of driest quarter (11.73±.73). The model result shows that the current high potential distribution of the species is around 1.90% of the study area, 7.78% is good potential; about 90.32% is moderate to very low potential for species suitability. Finally, the results of all model represented that there will be a drastic decline in the suitable habitat distribution by 2050 and 2070 for all the RCP scenarios. The results can be used to understand the suitable climatic conditions and the identification of suitable and alternate areas where is likely to reintroduce under climate change.

Keywords: Garcinia gummi-gutta; Maximum entropy modelling; Western Ghats; Medicinal plants; Climate change.

AN IMPROVED ALGORITHM OF CLOUD DROPLET SIZE DISTRIBUTION FROM POLDER POLARIZED MEASUREMENTS

Huazhe Shang (1), Husi Letu (1)(2), François-Marie Bréon (3), Jérôme Riedi (4), Takashi Y. Nakajima (5), Liangfu Chen (1)

[1] State Key Laboratory of Remote Sensing Science, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, China
[2]Tokai University Research and Information Center, 2-28-4 Tomigaya, Shibuya-ku, Tokyo 151-0063, Japan
[3] Laboratoire des Sciences du Climat et de l'Environnement, UMR CEA-CNRS-UVSQ, Gif-Sur-Yvette, France
[4] Laboratoire d'Optique Atmosphérique, UMR 8518, Université de Lille1 - Sciences et Technologies, CNRS, France
[5] University of Chinese Academy of Sciences, Beijing, China
Email: huazhe_shang@radi.ac.cn; husiletu@radi.ac.cn

Abstract: The Polarization and Directionality of Earth Reflectances (POLDER) instrument provides unique cloud droplet radius (CDR) and effective variance (EV) observations for the analysis of clouds on the global scale. However, cloud droplet size distribution estimated from POLDER conventional algorithm is limited by its coarse spatial resolution (150 km) and insufficient information for large droplets (CDR>15 μm). In this study, we proposed an improved primary cloudbow retrieval (PCR) algorithm to estimate CDR and EV from POLDER. Simulated retrievals based on a radiatve transfer model indicate that primary cloudbow measurements are sensitive to large droplets (CDR>15 μm) and enable the retrieval to be applied at a higher spatial resolution, therefore we employ POLDER polarized measurements from both primary and supernumery cloudbow regions in the PCR algorithm. Retrieval cases using POLDER measurements reveal that the PCR algorithm is robust when the cloud fields are homogeneous. When the cloud field is heterogeneous, the estimation of CDR is sensitive to the scattering angle ranges as well as the grid size, with uncertainty less than 1 μm. In addition, we found that a spatial resolution of 40-60 km is suitable for PCR algorithm based on the relationship between the retrieval grid size and the total successful retrievals. Further comparisons between the PCR retrievals and operational products are conducted on the global scale using POLDER measurements for February, May, August and November 2008, it is found that PCR retrievals agreed well with operational products on the global scale as CDR<15 μm. Our CDR retrievals have more large droplets over the ocean and continental regions. The PCR algorithm permits an extended range of CDR (3-25 μm) and EV (0.01-0.29) estimates and a higher resolution (40-60km) in the retrieval.

Keywords: Polarization, Effective radius, Cloud droplet size distribution, POLDER

STUDY OF ICE DYNAMICS OF TOTTEN GLACIER, EAST ANTARCTICA USING SATELLITE DATA

Simone Darji (1), Naveen Tripathi (2), Sandip Oza (2), Rajesh Shah (1), I.M. Bahuguna (2)

[1]M.G. Science Institute, Gujarat University, Navrangpura, Ahmedabad-380009
[2]Space Applications Centre, ISRO, Jodhpur Tekra, satellite-380015
Email: dsimone24@gmail.com; naveent@sac.isro.gov.in; sandipoza@sac.isro.gov.in; rdshahmg@yahoo.com; imbahuguna@sac.isro.gov.in

Abstract: Totten glacier has the largest ice discharge in the East Antarctica. It has potential to raise the sea level by 11 feet if it all melted. Its catchment area estimated to be 538,000 km2 extending approximately 1100 km in its interior. The study reveals that the Totten is thinning; losing weight and the flow rate is increased. There are various reason for the speeding up the flow of glacier, which includes its surface velocity and warmer deep oceanic water. The ice flow deviated into two tributaries along the flanks of Law Dome. One is towards Vanderford glacier to the West and one is Totten glacier on the east. The present study deals with the surface velocity of Totten glacier using MODIS (Moderate Resolution Image Spectroradiometer) data. Here we had studied the times series of ice velocity for Totten glacier. We had estimated the annual velocity of Totten glacier between 2000 and 2018. We measured ice velocity using feature-tracking method based on normalised cross correlation method. The average annual velocity of Totten glacier is ~2000 meters/years. However, it keeps on accelerating since last five years, but overall it has stagnant velocity from 2007. It is one of the major concern of study in Eastern Antarctica. The variation in the ice discharge estimated using Digital Elevation Model (DEM) data of different year. The Normalised cross correlation technique, used to evaluate the change in speed of glacier, which is the highly effective method for in image matching technique. The image matching is a group of techniques of finding corresponding features or image patches in two or more images. An attempt made to study the effect of spatial resolution on the estimated velocity using 250m MODIS data and 30m Landsat data. Velocity derived with one, two and three-year time interval between two images for tracking the features, to study the effect of time interval between the pair of images on the retrieved velocity. Findings suggest that correlation becomes poor beyond two years of time interval between selected images for the derivation of velocity.

Keywords: Velocity, Normalised Cross Correlation, Image Matching

MULTI-MISSION SATELLITE DERIVED SEA LEVEL ANOMALY MAPPING FOR TROPICAL CYCLONE IDENTIFICATION IN SOUTH CHINA SEA

Syarawi Sharoni (2)(3), Mohd Nadzri Md Reba (1)(2), Mazlan Hashim (1)(2)

[1] Institute of Geospatial Science and Technology (INSTeG),
Research Institute for Sustainability and Environment (RISE)
[2] Faculty of Built Environment and Survey, Universiti Teknologi Malaysia
81310 UTM Johor Bahru, Johor, Malaysia
[3] School of Physics, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia
Email: syarawimuhammadhusni@graduate.utm.my; nadzri@utm.my; mazlanhashim@utm.my

Abstract: Continuous and synoptic mapping of sea level anomaly (SLA) across the marginal seas is possible thanks to the abundance of altimeter satellite with regulated orbits around the Earth. Though misestimation of satellite-derived SLA due to spatial and temporal variation is evident and has led to the significant total bias on the final estimation. The SLA estimation in the South China Sea (SCS) helps in deducing the signature impact of tropical cyclones (TC) in which the TC derived anomalous sea level height can be distinguished from the normal tidal seasonal variation. Sparse and small number of tide gauges and buoys available in the SCS limit the spatial and temporal distribution for sea-truth SLA acquisition. This limitation becomes more significant when the single mission satellite data produces SLA data with non-reliable and void pixels. Therefore, this study is designed to estimate the comprehensive SLA from different and multimission satellite altimeter using spatio-temporal integration function to reconstruct the missing spatial and temporal gaps and later to assess the accuracy of the interpolated satellite-derived SLA map using the feasible gauge data. For this study, at least three altimeter satellite missions namely ERS-2, Jason-1 and Envisat-1 were incorporated to acquire SLA during the severe and energetic TC events (four in Category 4 and one in Category 5) in 2006. The empirical orthogonal function (EOF) was chosen to define the physical response of TC impact by mapping the SLA at lowest spatio-temporal gaps parallelly derived by the three altimeter satellite observation over the SCS. The method also allows estimation of SLA pixels between acquisition tracks. Statistical and regression tools were used together with sea-truth data from buoys and tide gauges for accuracy assessment and validation. The results show good agreement of interpolated SLA maps with the TC event nearby at the time of occurrence and magnitude of the non-seasonal SLA variation. This study concludes that multi-mission satellite data has prominent advantages for synoptic mapping the non-seasonal sea level anomaly variation during the tropical cyclone activities.

Keywords: Multi-Mission Satellites, Altimeter, Sea Level Anomaly, Tropical Cyclone, South China Sea

ANALYSIS OF SEASONAL TRENDS OF AEROSOL OPTICAL DEPTH AND GROUND PM2.5: IMPACT OF RELATIVE HUMIDITY AND PBL HEIGHT

Santo V. Salinas (1), Soo Chin Liew (1)

[1] Centre for Remote Imaging Sensing and Processing, National University of Singapore,
Block S17 Level 2, 10 Lower Kent Ridge Rd, Singapore 119260
Email: crsscsv@nus.edu.sg; crslsc@nus.edu.sg

Abstract: Satellite and photometer based aerosol optical depth (AOD) have been used as a possible proxy to estimate submicron particulate matter concentrations (PM2.5/10) at ground level. Several studies have demonstrated that such approach is space and time dependent and as such much care should be exercised when building such a correlations. At higher temperate latitudes the effect of aerosol particulate growth due to water absorption is restricted somewhat due low relative humidity. Moreover, the lower convective part of our atmosphere, the PBL, is relatively stable at least seasonally. However, tropical region of South-East Asia host a very complex environment due to its highly convective and interrelated regional meteorology at several time scales i.e. influence of ENSO, ITCZ, MJO etc. resulting in highly variable and deeply convective PBL as well as hosting a very humid environment. Under such conditions, finding acceptable AOD vs PM2.5 correlations is a challenge. In this work, we present a 2 year analysis of AOD (AERONET), PBL height (MPLNET) and PM2.5 (NEA*, public data) collected over Singapore. Seasonal trends were analyzed, physical corrections for %RH and PBL height variability was applied resulting on a set of 18 linear models (3 physical models applied to 6 seasons) and a subsequent statistical analysis was performed. Results shows a clear separation due to seasonality as well as physical model analyzed. Strongest correlations were found during the months of August to November while it was weaker during May-June periods. Linear correlations shows large slopes (higher PM2.5 concentrations) during the periods of December-February and September-November and smaller in March to April. However, the linear intercepts were low during first half of the year and high during the second half of the year showing a consistent bias in the linear relationship.

Keywords: Aerosols, PM2.5, AERONET, MPLNET

ASSESSMENT OF URBAN GREEN SPACE LANDSCAPE TRUCTURE AND FUNCTION FOR CLIMATE CHANGE ADAPTATION IN BUILT ENVIRONMENT

Amal Najihah Muhamad Nor (1), Muhamad Azahar Abas (1), Kamarul Ariffin Kambali @ Hambali (1), Rohazaini Mohd Jamil (1), Siti Aisyah Nawawi (1), Hasifah Abdul Aziz (1), Nor Hizami Hassin (1), Nur Hanisah Abdul Malek (1), Norfadhilah Ibrahim (2)

[1] Faculty of Earth Science, Universiti Malaysia Kelantan, Jeli Campus, 17600 Jeli, Kelantan [2] Faculty of Bioengineering and Technology, Universiti Malaysia Kelantan, Jeli Campus, 17600 Jeli, Kelantan
Email: amalnajihah@umk.edu.my; azahar.a@umk.edu.my; kamarul@umk.edu.my; rohazaini@umk.edu.my; aisyah.n@umk.edu.my; hasifah@umk.edu.my; hizami.h@umk.edu.my; hanisah.abd@umk.edu.my; nfadhilah@umk.edu.my

Abstract: Uncontrolled urban development and uncoordinated master planning is common place. Managing green space for climate adaptation may difficult. There is a lack of empirical information in the past and present spatial distribution to predict for land surface temperature (LST). LST is most important parameters to study the energy interactions and cycles between the atmosphere and ground surface. LST is governed by surface heat fluxes, which in turn is affected by urbanization. Surface and atmospheric modifications due to urbanization generally lead to a modified thermal climate that is warmer than the surrounding rural areas, particularly at night. This phenomenon is known as urban heat island (UHI), and when LST is used for analyzing the UHI effect, it is called surface UHI (SUHI). The main cause of SUHI is modification of the land surfaces through urban development using the materials that effectively retain heat. This work aims at determining and analyzing the relationship between green space change and land surface temperature (LST) patterns in the context of urban expansion. The integrated approaches of remote sensing, GIS and Land Change Modeler as a decision support tools are needed to provide a basis for effective green space planning. This study evaluate the spatial structure and pattern of green space in Kelantan and its relationship with land surface temperature. The result from this study may provide significant insight into understanding the important of landscape structure of green space for cooling the area and provide healthy environment for dwellers.

Keywords: Climate Change; Urban Green Space; Remote Sensing; Land Change Modeler; Sustainable Planning and Management.

THE URBAN HEAT ISLAND IN KATHMANDU, NEPAL: SPATIAL DISTRIBUTION OF CHANGES IN NORMALIZED DIFFERENCE VEGETATION INDEX AND LAND SURFACE TEMPERATURES 2000-2016

Bijesh Mishra (1), Jeremy Sandifer (1), Buddhi Gyawali (1)

[1] Division of Environmental Studies and Sustainable Systems, College of Agriculture, Food Science and Sustainable Systems, Kentucky State University, 400 East Main Street, Frankfort, KY 40601
Email: bijesh.mishra@kysu.edu; jeremy.sandifer@kysu.edu; buddhi.gyawali@kysu.edu

Abstract: The term "urban heat island" (UHI) describes the increased surface and atmospheric temperatures in an urban core relative to surrounding non-urbanized areas. Although the phenomenon has been studied to a great extent throughout the world, it is less understood for Kathmandu, Nepal. This study uses the Moderate Resolution Imaging Spectro-radiometer (MODIS) 8-day product (MOD11A2) to evaluate land surface temperatures (LSTs), the MODIS derived Normalized Difference Vegetation Index (NDVI) product (MOD13Q1) to quantify land surface characteristics, and the MODIS annual land cover classification product (MCD12Q1) to identify major land cover classes We evaluated the spatial correlation between significant changes in LSTs and NDVI between 2000–2016 during the month of May. Overall, urban LSTs were consistently greater than non-urban LSTs; however, the rate of increase in temperature was higher outside the urban area. Furthermore, significant changes in NDVI values over time were more widespread and not spatially coincident with the significant changes in LST values. These results provide insight into systematic planning of open and green areas, construction of new infrastructure in peripheral areas, as well as highlight the challenges in applying traditional UHI methods to rapidly developing urban areas in Kathmandu, Nepal.

Keywords: NDVI, MODIS, Remote Sensing, Nepal, Urbanization

PERFORMANCE ASSESSMENT OF POTENTIAL EVAPOTRANSPIRATION DERIVED FROM INSAT-3D SATELLITE USING IN SITU MEASUREMENTS

Prachi Singh (1), Prashant K. Srivastava (1), R.K. Mall (1), Ramandeep Kaur M. Malhi (1)

[1]Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India
Email: prachisngh246@gmail.com; prashant.iesd@bhu.ac.in; rkmall@bhu.ac.in; deep_malhi56@yahoo.co.in

Abstract: Quantification of changes in potential evapotranspiration can provide significant information for understanding of hydrological processes and climate change. However, accurate measurements and predictions of evapotranspiration are difficult especially at large spatial scales. Remote sensing provides a cost-effective approach to determine potential evapotranspiration at both regional and global scales. In the present study, effectiveness of Hamon's method for measuring potential evapotranspiration based on INSAT-3D satellite data sets was evaluated for agricultural areas of Varanasi region, India. Satellite derived potential evapotranspiration data was compared with in situ data which indicate that the satellite derived product can be used for estimation of potential evapotranspiration with satisfactory performance.

Keywords: evapotranspiration, satellite, in situ, agriculture, meteorology

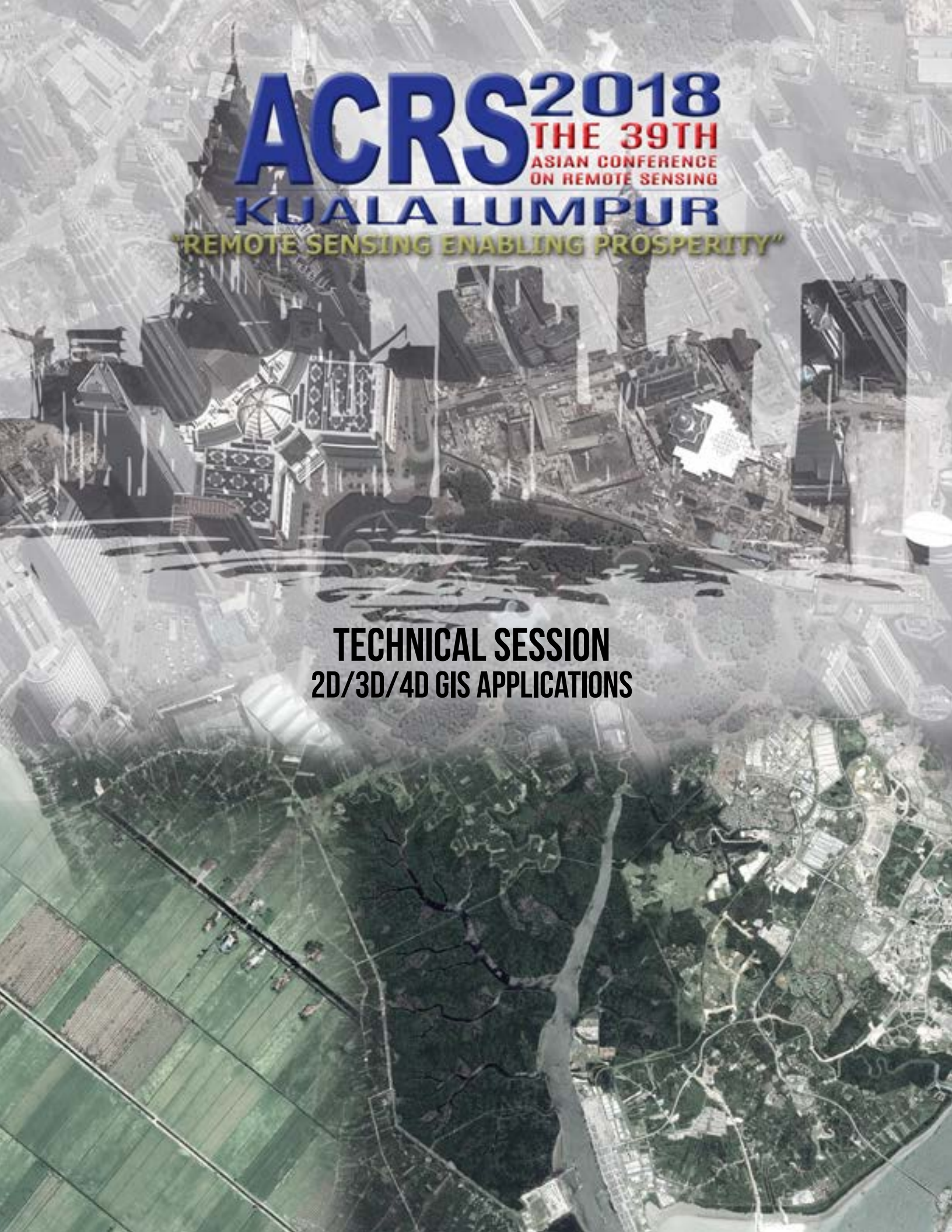
THE ANSELIN LOCAL MORANS I ANALYSIS ON THE HUMAN ACTIVITIES OF LAND SURFACE TEMPERATURE CHANGES IN YANGON CITY

Dr. Khin Mar Yee (1), Dr. Mu Mu Than (2), Dr. Kyi Lint (3), Dr. May Myat Thu (4), Dr. Mar Lar Han (5), Candidates of PGDGIS

[1] Associate Professor, Geospatial Technology Center, Geography Department, Dagon University
[2] Associate Professor, Geography Department, Dagon University
[3] Professor and Head, Geography Department, Dagon University
[4] Professor, Geospatial Technology Center, Dagon University
[5] Associate Professor, Geospatial Technology Center, Geography Department, Dagon University
Email: kmyee2012@gmail.com; mumumay2015@gmail.com; geogdup2@gmail.com

Abstract: Yangon City is old capital, densely populated and rapid urbanization area of Myanmar. This study was investigated human impact of urban environment characterization on surface temperature changes of Yangon City. Moreover, the intension of this study is to analyze with demonstration and verify the spatial distribution property of the LST with urban spatial information related with Normalized Difference Vegetation Index (NDVI) using the Remote Sensing (RS) data and Geographic Information System (GIS). The main data was six Landsat images selected the images of less than 10 percent cloud cover condition for the summer and winter seasons and downloaded the required images. The single channel method and spatial statistical method were applied to process for LST variation. The study revealed that the LST was increased 1.43 ºC from 1996 to 2006 and added again 1.46 ºC between 2006 and 2015. Moreover, the Auselin Local Morans I statistical analysis proved that HH (High-High) cluster situation LST of human activities were taken place at the downtown and surrounding townships.

Keywords: on City, Land Surface Temperature (LST), human activities



TECHNICAL SESSION
2D/3D/4D GIS APPLICATIONS

A STUDY OF OBJECTIVIZATION METHOD FOR AUTOMATIC PRODUCTION OF 3D LOD2 BUILDING MODEL

Tsen-Yann Lin (1), Shih-Hong Chio (1), Tzu-Ming Feng (1), Jou-An Lin (2)

[1] National Chengchi University, Department of Land Economics, No. 64, Sec. 2, ZhiNan Rd., Wenshan District, Taipei City 11605, Taiwan (R.O.C)
[2] Real World Engineering Consultants Inc. , 5F-1,No. 159, Sec. 1, Xintai 5th Rd., Xizhi District, New Taipei City, Taiwan (R.O.C)
Email: swallow850807@gmail.com; chio0119@gmail.com; 103207442@nccu.edu.tw; anne030303@gmail.com

Abstract: With the fast urbanization of the world, the concept of "Smart City" has been presented. Fields of photogrammetry, remote sensing, and computer vision have developed various geoinformatics technologies for the reconstruction of 3D city model to support the realization of smart city. However, the production of a large quantity of 3D building models in 3D city model may face many problems, e.g. the efficiency, the cost. This paper discusses an automatic objectivization method to create 3D building models of large area by combining airborne LiDAR point cloud data, DEM, and airborne vertical and oblique images. The approach is developed based upon a conversion of each building outline shapefile (.shp) into object file (.obj) and a subsequent appropriate texture mapping. After that, building texture is baked into one image according to its material template library file (.mtl). The procedure can be divided into the following four steps. First, the height corresponding to each building in shapefile is determined based on LiDAR point cloud data within each building outline and DEM. Second, individual 3D LOD1 building model with the standard of object file presented by triangulation networks can be transformed from the shapefile to object file, even 3D LOD1 building model with holes can be created. Third, from aerial vertical and oblique images and the whole 3D LOD1 building models, the appropriate texture corresponding to each triangulation of 3D LOD1 building model is determined by minimum building occlusion rate for texture mapping. Finally, each complete 3D LOD2 building model is constructed by baking its corresponding texture images into the only one image. The relationship between object file and building textures is described by material template library file. In this study, the objectivization method is presented for automatically creating a large quantity of 3D building models, and it is hoped to provide a new method to efficiently produce 3D LOD2 building models for use in the future.

Keywords: 3D Building Model, LiDAR Point Cloud, DEM, Photogrammetry, Texture Baking

3D VISUALIZATION OF BUILDING INTERIOR USING OMNIDIRECTIONAL IMAGES

Alexis Richard C. Claridades (1), Jiyeong Lee (2), Ariel C. Blanco (1)

[1] Department of Geodetic Engineering, University of the Philippines – Diliman, Quezon City 1101 Philippines
[2] Department of Geoinformatics, University of Seoul, 163 Seoulsiripdae-ro, Dongdaemun-gu, Seoul, 02504 South Korea
Email: acclaridades@up.edu.ph; jlee@uos.ac.kr; acblanco@up.edu.ph

Abstract: Until recently, most mapping and visualization efforts have been concentrated for the outdoor environment. Nowadays, the development of maps of the indoor environment have been catching up with new technologies for data collection, processing, and modelling. The need for indoor maps is also emphasized with the demand for data and information about indoor spaces, and for its applications in evacuation, way-finding and visualization. Omnidirectional images present a simple yet realistic method for geographically representing indoor space compared to commonly-utilized data like point cloud or solid object models, since (x, y, z) coordinates may be obtained from each pixel because they may be georeferenced. In addition, its 360-degree field-of view (FOV) gives detailed and seamless visualization to users. This paper presents a workflow for collecting omnidirectional images for generating a 3D visualization of a building interior in the form of a virtual tour. The experiment was conducted in a building in a university campus. CAD files of the building were used as a guide for selecting the Shooting Points, which are locations in the hallway from which image capture is carried out. A DSLR camera with a fisheye lens mounted on a rotator and tripod was used at these Shooting Points to acquire at least 6 fisheye images completing a 360-degree FOV to ensure sufficient overlap. The images captured at each Shooting Point were processed using PTGui, a panoramic stitching tool. The overlaps ensured that control points common for at least 2 images in the set would be selected and used for stitching. The stitched image is checked for misalignment or erroneous stitching, and additional control points may be selected if necessary. To generate the 3D virtual tour, the images were linked based on how each Shooting Point is connected to an adjacent Shooting Point using PanoTour. In PanoTour, the location of adjacent Shooting Points would be pinpointed, and the corresponding view from those points in the corresponding images would be indicated. This results in a virtual tour that may be opened with any web browser and gives an immersive and seamless visualization of navigation a 3D indoor environment.

Keywords: Omnidirectional Images, 3D Visualization, Virtual Tour, Indoor Navigation

3D MODELING BY UAV FOR THE MOUNDED TOMB OF HIMIKO

Yukiya Taniguchi (1), Susumu Ogawa (2), Takako Sakurai, Shinzo Fukunaga, Haruhiro Hidaka, Toshiro Harunari

[1] Institute of Spatial Technology, Tokyo, 3-1-5, Toyo, Koto-ku, Tokyo, Japan
[2] Nagasaki University1-14, Bunkyomachi, Nagasaki, Japan
Email: bb35515021@ms.nagasaki-u.ac.jp

Abstract: The mounded tomb of Himiko was discovered at Uchida, Tagawa, Fukuoka. Himiko was an emperor of Yamataikoku in the 3rd century in Japan, but her details are unknown except in Sanguozhi, which described the radius of the mound was more than one hundred steps. This mound was surveyed by using UAV. The diameter of the mound measured by UAV and open data were coincident with the previous literature. Land profile and altitude maps of the topography were also examined by UAV and open data. Google Earth and Geographical Survey Institute Maps were used as open data. Furthermore, as future development, the authors are studying extraction of mounded tomb-type terrain in Fukuoka, using *Rekognition* software which was developed by *Amazon.*

Keywords: archaeology, GIS, Land profile, Land use

LAND DEGRADATION ASSESSMENT THROUGH SPATIAL DATA INTEGRATION IN EASTERN CHOTANAGPUR PLATEAU, INDIA

Avijit Mahala (1)

[1] Research Scholar, Center for the Study of Regional Development, Jawaharlal Nehru University, New Delhi, 110067
Email: mahala.avijit@gmail.com

Abstract: Present study is primarily concerned with the physical processes and status of land degradation in a tropical plateau fringe. Chotanagpur plateau is one of the most water erosion related degraded areas of India. The granite gneiss geological formation, low to medium developed soil cover, undulating lateritic uplands, high drainage density, low to medium rainfall (100-140cm), dry tropical deciduous forest cover makes the Silabati River basin a truly representative of the tropical environment. The different physical factors have been taken for land degradation study includes- physiographic formations, hydrologic characteristics, and vegetation cover. Water erosion, vegetal degradation, soil quality decline are the major processes of land degradation in study area. Granite-gneiss geological formation is responsible for developing undulating landforms. Less developed soil profile, low organic matter, poor structure of soil causes high soil erosion. High relief and sloppy areas cause unstable environment. The dissected highland causes topographic hindrance in productivity. High drainage density and frequency in rugged upland and intense erosion in sloppy areas causes high soil erosion of the basin. Decreasing rainfall and increasing aridity (low P/PET) threats water stress condition. Green biomass cover area is also continuously declining. Through overlaying the different physical factors (geological formation, soil characteristics, geomorphological characteristics etc.) of considerable importance in GIS environment the varying intensities of land degradation areas has been identified. Middle reaches of Silabati basin with highly eroded laterite soil cover areas are more prone to land degradation.

Keywords: Land degradation, Tropical environment, Lateritic upland, Aridity, GIS environment.
Abstract topic: - 2D/3D/4D GIS Applications UNDER Geographic Information System (GIS)

DEVELOPMENT OF THE 3D SPATIAL INFORMATION VISUALIZATION TECHNIQUES USING UNITY 3D

Seo-i, Cheon (1), Eung-Joon Lee (1), Yu-Yeon Lee (1), Jang-Bae Lee (1)

[1] Institute of Spatial Information Technology Research, GEO C&I Co., Ltd, 435 Hwarang-ro, dong-gu, Daegu, Republic of Korea
Email: sicheon@geocni.com; ejlee00@geocni.com; yylee@geocni.com; jblee@geocni.com

Abstract: With a growing number of people conducting water-friendly activities using river spaces recently, a social demand for river information is surging. In addition, with the advancement of ICT development, the demand for 3D spatial information identical with the real world is increasing, leading to the diversification of 3D high-precision spatial information-based studies. In order to construct 3D spatial information, large-volume high-resolution satellite images and DEM should be used, thus creating the problem of delaying the data processing speed and visualization. Thus, this study used the Unity 3D engine, recently used in the field of games, to resolve the data service speed in relation to the construction of 3D spatial information. For large-volume DEM, when creating the mesh of topographic information in Unity 3D, the identical altitude values of adjoining positions were incorporated into a mesh instead of creating additional meshes, thus reducing DEM data volume. High-resolution satellite images were divided into segmented images using the division technique, and were mapped. As a result, when operating the system initially, the user stand-by time was improved by 80% compared to the existing time. When constructing 3D spatial information based on large-volume high-precision river space in the future, the Unity 3D engine is expected to be effectively utilized in resolving data processing and system speed problems.

Keywords: 3D Spatial Information, DEM, Satellite Imagery, Unity 3D

A STUDY ON 3D BLOCK TECHNIQUE URBAN INUNDATION BY UNITY 3D

Yeong-cheol Choi (1), Hye-ji Park (1), Dae-hun Yun (1), Bon-yup Gu (1)

[1] Institute of Spatial Information Technology Research, GEO C&I Co., Ltd, 435 Hwarang-ro, dong-gu, Daegu, Republic of Korea
Email: ycchoi@geocni.com; dhyun@geocni.com; hjpark@geocni.com; bygu@geocni.com

Abstract: Urban flooding occurs when the rainfall amount is more than the discharge amount through sewers and drainage facilities. To reduce flooding damage, studies are being actively conducted to diagnose the vulnerability of urban flooding and to forecast flooding areas. To identify and respond to urban flooding situations, this study also deals with effective visualization and analysis function development using the Unity3D engine. First, a test bed was determined by selecting an area where the population was densely clustered with frequent flooding. To achieve virtual visualization, a virtual base map was constructed using the Unity 3D engine terrain. In order to achieve 3D urban flooding modeling, the overflow by manhole was used. Data was converted into array, underwent the 3D block creation modularization constructed in the Unity 3D engine, and was modeled. The 3D block module was arranged so as to receive the overflow input values, redistribute them according to legend based on arbitrary criteria, and to intuitively identify the depth levels of flooding. For more efficient visualization, the buildings and overflow amount in the test bed were simultaneously displayed. In addition, by mapping the past flooding traces, administrative districts, road networks, evacuation information, etc., the system was constructed so as to compare the past data with the current flooding. The 3D block creation module, developed herein, could effectively analyze the urban flooding, and can intuitively identify the disaster situations.

Keywords: Urban Inundation, Unity 3D, 3D Block Technique

CORRECTION OF TOPOLOGICAL ERRORS OF UTILITY NETWORK SYSTEM

Murat Demircan (1), Dursun Zafer Seker (1), Sinasi Kaya (1)

[1] ITU, Istanbul Technical University, Department of Geomatics Engineering 34469 Maslak Istanbul Turkey
Email: demircanmurat1@gmail.com; seker@itu.edu.tr

Abstract: Utility infrastructure networks are becoming a larger and more complex system. For this reason, operators need a real-time, simple and powerful engineering infrastructure for operation. Nowadays, utility companies need to apply the Smart Grid concept to manage their physical assets and provide a better service to their customers and update these systems integrating with Geographical Information System (GIS). Infrastructure distribution agencies collect data of features in order to record their physical parameters. This collected dataset is stored in the GIS. The cost of collecting spatial data is much higher than the costs of other systems. However, the collected data may not be suitable for the system used. Faults can be occurred when importing data from fieldwork or objects drawn on GIS. In this case, a misplaced, inexhaustible spatial data set emerges. It is not possible using unverified data. Collected data from the fieldwork is no longer integrated into the system if data is not appropriate. In this thesis study, the problems that utility companies have related to spatial data have been examined and network data that the utility companies have been kept in GIS have been analyzed. And topological solutions were presented to increase the quality of the data. In this way, the topology of the network was improved and the network relations were corrected in the GIS environment b using simple micro program prepared via Python. The physical parameters of utilities are stored in a large and complex database of GIS system. It takes large amount of time to check, correct and report such large data by the team. Moreover, these kinds of mistakes can be repeated. By means of the improvements carried out in this study, used algorithms and programs were used successfully to automate the correction process of the topological errors in utility GIS network to obtain error free data set.

Keywords: Topology, GIS, Utility network

TOWARDS A REAL WORLD 3D TERRAIN GENERATION AND REAL TIME VISUALIZATION FRAMEWORK USING GAME ENGINE

Danial Tahira (1), Zafar Masood (2), Sajid Ghuffar (1)

[1] Institute of Space Technology, Department of Space Science, 44000Islamabad, Pakistan
[2] National Engineering and Scientific Commission, Pakistan
Email: danialtahir219@gmail.com; zafar_iiui@hotmail.com; sajid.ghuffar@grel.ist.edu.pk

Abstract: Applications of Real world 3D terrain generation and visualization is widespread in various domains i.e. Geographic information systems, strategic mission planning systems, flight simulators, exploration missions, and entertainment etc. 3D Globe engines are specialized frameworks for 3D rendering of Geographic information system data for both desktop and web environments. 3D Game engines are frameworks providing generic constructs for design and development of user interactive, distributed, real time, rich graphics rendering entertainment applications using virtual environments. This paper describes the design and development of a generic framework for 3D real world scene generation and visualization based on game engine i.e. Unity 3D. Framework design consist modules for online geospatial data acquisition and management, real time terrain model generation and management, acquisition of offline or online flight data path, navigation of 3D scene using path information, and display of user information. Proposed Framework software design is flexible, extendable, scale able and portable for different execution environments i.e. desktop, web, mobile etc. This framework can be used for developing real world, real time, and user interactive entertainment or flight simulation applications while its design can be extended for real world detailed ground rendering. The framework provides real world scene generation and visualization layer for game engines environment which can be used and extended for real world entertainment and simulation applications very easily.

Keywords: Geographic Information System, 3D Terrain Generation, 3D Scene Generation, Framework, Unity 3D

A STUDY ON APPLYING UNITY- BASED GPU PARALLEL PROCESSING METHOD FOR DISASTER INFORMATION 3D SERVICE

Eung-Joon Lee (1), Seung-Hyeon Lee (1), Seung-wook Choi (1), Soo-young Choi (1)

[1] Institute of Spatial Information Technology Research, GEO C&I Co., Ltd, 435 Hwarang-ro, dong-gu, Daegu, Republic of Korea
Email: ejlee00@geocni.com; shlee@geocni.com; swchoi@geocni.com; sychoi@geocni.com

Abstract: With global warming occurring recently, large-scale natural disasters, such as typhoons and heavy rain, are occurring across the world, causing expansive human and material damage. To manage and prevent such disasters, this study used the Unity 3D game engine enabling the intuitive recognition of disaster situations to construct the 3D disaster display system. This system simulates and conducts a real-time of calculation of the damage size and risks of disasters based on topographies and 3D building data made from large-volume high-precision spatial information and on high-resolution images, but it creates the problem of delaying the operation speed. This study used GPGPU (General Purpose Graphic Processing Unit) technique in order to increase the system operation speed using the Unity 3D engine. GPGPU is the technique to not only conduct the graphic operation of GPU (Graphics Processing Unit) favorable for mass calculation but also help CPU operation in increasing the system operation speed by being used a parallel calculation processor for general universal purposes. This study used the GPGPU technique in processing the operation of similar and simple geographic information so as to shorten the system loading time for the display of large volume 3D topographic information and disaster situations. Based on these results, it is deemed that it is possible to effectively conduct real-time 3D disaster-prevention GIS system services based on high-precision topographic information and on building information and to reduce a lot of human/material damage.

Keywords: High Resolution Arial Image, Game Engine, 3D GIS, GPGPU, 3D Visualization

SITE SUITABILITY ANALYSIS FOR A GREENFIELD AIRPORT IN KOLKATA USING GIS AND REMOTE SENSING

Siddharth Swain (1), Anul Haq (2)

[1]M.Tech GIS, NIIT University, Neemrana, Rajasthan, India 301705
[2]Associate Professor, NIIT University, Neemrana, Rajasthan, India 301705
Email: siddharth.swain@st.niituniversity.in; Anul.Haq@niituniversity.in

Abstract: Geographic Information Systems (GIS) and Remote Sensing are widely recognized as a valuable tool for capturing, storing, manipulating, analysing, managing and displaying all types of geographical data. Due to the complex nature of airport planning modalities, the potential of GIS applications in resolving several issues on airports is increasingly acknowledged by many. In this paper, we have discussed some of the potential benefits of GIS applications in airport site selection. Using site suitability analysis an attempt has been made by the authors to find the most suitable and feasible sites for the construction of a greenfield airport in Kolkata, West Bengal, India. Here, the study takes into consideration the most import and likely factors such as slope, drive-time buffer, land use/land cover information, restricted zones and the prevailing meteorological conditions. Accordingly, different candidate sites for the new airport have been analyzed. This paper also highlights the role of such a multi-criteria approach performed within the step by step decision-making process concerning the site selection for the development of a new airport at Kolkata.

Keywords: Netaji Subhash Chandra Bose Airport (NSCB), Greenfield Airport, Multi-Criteria Evaluation, Site Suitability Analysis, GIS and Remote Sensing

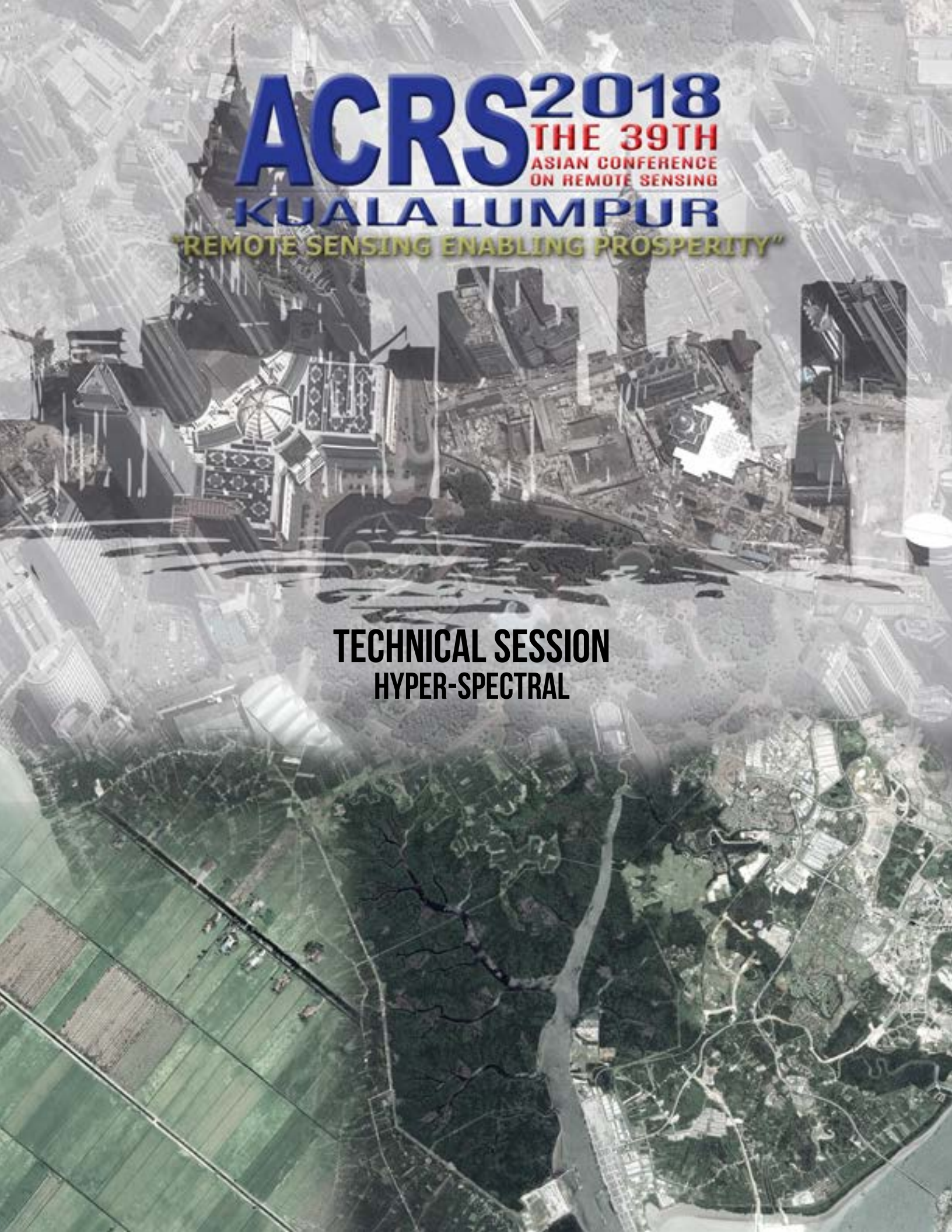
INTEGRATION GEOSPATIAL ELEMENTS TO ESTIMATE MILITARY TERRAIN MOBILITY CLASSIFICATION

Siti Muazah Md Zin (1), Maj. Mohamad Wasli Musa (1), Capt. Hasnul Hady Karim (1)

[1] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC), No.13 JalanTun Ismail, 50480, Kuala Lumpur, Malaysia
Email: muazah@remotesensing.gov.my; wasli@remotesensing.gov.my; hhady@remotesensing.gov.my

Abstract: Terrain mobility is important elements to provide critical information in aspect of operation that involve the vehicle deployment. The capability to estimate the mobility based on terrain permit will assist planning process to identify accurately location and route to utilising the deployment of vehicle. Ability to locate and oriented the terrain mobility will depict clear surface that provide advantage to perform cross country mobility. The geospatial elements of slope, land use and soil type are crucial to understand the terrain mobility aspect especially the class of mobility level. On this issue, combination output from slope, land use and soil type will be reclassify to meet the need of military terrain classification in term of unrestricted, restricted or severely restricted. By manipulating the integration of geospatial elements using geographic information system (GIS) tools would be able to depict clearly terrain mobility to answer critical question that needed for planning consideration. In this paper, integration of geospatial elements is to estimate terrain permit for mobility that possible to influence of military deployment of vehicle. The aim of this study is to evaluate the output accuracy of terrain mobility classification to be manipulated into military terrain analysis process.

Keywords: Combine Obstacle Overlay, Slope Class, Restricted Terrain, Land Use and Soil Type Reclassification



TECHNICAL SESSION
HYPER-SPECTRAL

A NEW FRAMEWORK FOR WRAPPER BASED FEATURE SELECTION FOR HYPERSPECTRAL IMAGE CLASSIFICATION

Shrutika Sawant (1), Prabukumar M (1)

[1]Vellore Institute of Technology, School of Information Technology and Engineering, 632014 Vellore, India
Email: shrutika.sawant1@gmail.com; mprabukumar@vit.ac.in

Abstract: In hyperspectral image classification, various features such as, spectral, spatial texture, shape and statistical features, are exploited to well characterize the pixels from different perspectives. It has been proved that, by properly selecting multiple features always results in better classification performance. In this paper, we propose a new framework for selection of most relevant subset of features in the optimal way for purpose of hyperspectral image classification. Given a feature set and a feature evaluation criteria, the proposed framework ranks the features in groups instead of ranking individual features. A group with higher rank be made up of n highest ranked features each for one class. A group of features with m^{th} rank is highly discriminative than the group of features with $(m+1)^{th}$ rank. Therefore, the proposed framework selects the combination of topmost k groups of features for further processing. Subset of features belongs to each group are supposed to be capable of discriminating one class from other class. Moreover, the proposed framework eliminates the redundant as well as noisy features effectively. Experiments are conducted on three benchmark hyperspectral data sets such as Indian Pines, Pavia University and Salinas dataset with support vector machine classifier. The experimental results demonstrate that the proposed approach provides better classification performance in comparison to other feature selection approaches.

Keywords: Hyperspectral remote sensed image, Dimensionality reduction, Wrapper based feature selection, Classification

HYPERSPECTRAL REMOTE SENSING FOR BIOPHYSICAL PARAMETER ASSESSMENT

Prem Chandra Pandey (1), Prashant K. Srivastava (1)

[1] Institute of Environmental and Sustainable Development, Banaras Hindu University, Varanasi, India
Emel: prem26bit@gmail.com; prem.pandey1@bhu.ac.in

Abstract: Plant biophysical variables are important for agriculture and forestry studies, in order to estimate them. These are required to be assesses quantitatively along with the spatial distribution of these variables. This study focuses on the robustness of different spectral indices derived from Hyperspectral imaging datasets. These spectral indices includes Broadband Greenness, Narrowband Greenness, Light Use Efficiency, Canopy Nitrogen, Dry or Senescent Carbon, Leaf Pigments contents and Water Contents. In order to find the quantitative bio-physical variables of the plant species, each and every spectral index play an important role thus, they are related to the different variables using regression modeling. The Hyperspectral data utilized in the study includes EO-1 Hyperion data for the forest region. The aim is to find the correlation between different indices and their impact on the species spatial extent and their distribution. The linear regression and relationship between the different indices has been considered and graphs were plotted to find the R^2. Structure Insensitive Pigment Index (SIPI), Red Green Ratio Index (RGRI) has strong relationship with $R^2 = 0.80$ Plant Senescence Reflectance Index (PSRI) and 0.95-Carotenoid Reflectance Index (CRI) while Normalized Difference Water Index (NDWI) has strong correlation with Normalized Difference Infrared Index (NDII) ($R^2 = 0.90$). Moreover, to assess and estimate appropriate output it is required to model the multivariate regression model. According to the result outcomes, strong relationships were observed between several indices as mentioned while some of them are independent to other indices. SIPI with 0.95 with PSRI and the coefficient of determination ($R^2 = 0.85$) with CRI showed the one of the good spectral vegetation indices for biophysical variable estimation. These indices provide the pigments, photosynthetic activities of the plants and thus help in assessment of greenness and health status of the different species.

Keywords: Hyperspectral, Hyperion, Spectral indices, Nitrogen Pigments, Water Contents

GEOTHERMAL EXPLORATION WITH AN UAS-TIR OPERATION MANAGED BY A 4D CLOUD PLATFORM

Jin-King Liu (1), Wei-Chen Hsu (1), Ke-Shu Li (2)

[1] LIDAR Technology Co., Ltd., Zhubei City, Hsinchu County 30274, Taiwan
[2] RAISE project at ITRI and Project Manager at LIDAR Technology Co., Ltd., Zhubei City, Hsinchu County 30274, Taiwan
Email: jkliu@lidar.com.tw; ianhsu@lidar.com.tw; corwin@lidar.com.tw

Abstract: Remotely sensed thermal images are required for geothermal exploration for obtaining the temperature on ground surface for characterizing surface geology and modeling the temperature at the depth. There are two purposes of this study. One is to integrate a thermal sensor with a wind-resistant UAV for detecting geothermal anomalies suitable for conducting exploration in a mountainous terrain. The other one is to test UAS operation as managed and handled with a proprietary cloud 4d geospatial system which has been developed by LIDAR Technology Co., Taiwan. First, the specifications of the UAS-TIR, the experiment at XiaoYoukeng of northern Taiwan, and the results of the UAS imaging are presented. Subsequently, the operation management with earthbook - the 4d geospatial system is demonstrated with a real-time visualization of UAV deployment, a cloud computing, and a cloud publication and sharing of the UAV results. It is concluded that the integrated UAS-TIR system can be effectively applied in assisting quantitative assessment of geothermal reserves when the UAV-acquired thermal images are compared with those of airborne thermal systems. And, the effectiveness of the innovated cloud platform known as earthbook (URL: earthbook.xyz), is demonstrated as an effective tool for managing data acquisition, processing, publishing and sharing geospatial information with ordinary web-page browsers, such that there is no need to install any software and plugins.

Keywords: drone, green energy, hyperspectral imaging, situational awareness

UTILITY OF HYPERSPECTRAL DATA IN FOLIAR TRAIT RETRIEVAL OF TWO PLANT FUNCTIONAL TYPES OF DRY DECIDUOUS FORESTS

Ramandeep Kaur M. Malhi (1), G.Sandhya Kiran (2), Prashant K. Srivastava (1)

[1]Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India
[2]Ecophysiology and RS-GIS Lab, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara- 390002, Gujarat, India
Email: deep_malhi56@yahoo.co.in; sandhyakiran60@yahoo.com; prashant.iesd@bhu.ac.in

Abstract: Spatial information on foliar traits in particular leaf chlorophyll content (CC) is essential for timely execution of forest management and conservation practices since these traits underpin the forest vitality. These traits also aids in understanding various ecological processes including biogeochemical cycles and biosphere–atmosphere carbon exchange which in turn are key indicators of vegetation's responses to climate change. Hyperspectral remote sensing in large continuous narrow wavebands is considered as a primary tool for determining the subtle changes in these foliar traits which otherwise are indistinct in multispectral remote sensing. Number of spectral indices has been derived for determining foliar chlorophyll content but the efficacy of these indices for prediction of this pigment content in different plant functional types is unknown. The aim of the present study is to explore the potential of hyperspectral data in retrieval of foliar chlorophyll content of two different plant functional types i.e. dicot and monocot plants namely *Tectona grandis* L. and *Bambusa bambos* L. respectively growing in dry deciduous forests of Narmada district, Gujarat, India. Different hyperspectral vegetation indices (VI) namely NDVI, RENDVI, MRENDVI, CI, TVI, MTVI, MCARI, MRESR, VRE1 were derived from AVIRIS NG data using band math function of ENVI software and concurrently ground measurements of foliar CC was done for *Tectona* and *Bambusa*. Empirical relationships were established between ground measured foliar chlorophyll content and derived vegetation indices. The coefficients of determination for all CC-VI developed models for both the plant functional type exceeded 0.7 with MCARI being the most effective ($R2 > 0.8$, $p < 0.01$). It was also observed that plant functional type had a clear influence on the establishment of predictive equations as well as on the validation of the generated models. It can be stated that hyperspectral remote sensing has great potential for providing a reliable estimate of foliar trait namely chlorophyll at the leaf level through computed hyperspectral indices.

Keywords: Foliar, Trait, Chlorophyll, Hyperspectral, Indices

DIMENSIONALITY REDUCTION FOR HYPERSPECTRAL IMAGES TO IMPROVE OBJECT- BASED IMAGE CLASSIFICATION USING FEATURE SELECTION AND PRINCIPAL COMPONENTS ANALYSIS

Taskin Kavzoglu (1), Hasan Tonbul (1), Ismail Colkesen (1)

[1] Department of Geomatics Engineering, Gebze Technical University, 41400, Kocaeli, Turkey
Email: kavzoglu@gtu.edu.tr; htonbul@gtu.edu.tr; icolkesen@gtu.edu.tr

Abstract: Recent developments in remote sensing technology allow for the simultaneous acquisition of hundreds of spectral bands at very high spatial resolution. Consequently, more detailed discriminating ability is provided by hyperspectral images for image objects with similar spectral signatures. The redundant bands increase the computing complexity and reduce the resulting classification accuracy. Although hyperspectral images have high spectral and spatial resolution, the mapping accuracy of LULC classes is limited due to the heterogeneous nature of the LULC classes. Correspondingly, pixel based approaches have become insufficient depending on the increase of spectral information and spatial resolution of the images. In parallel to the increasing availability of high resolution imagery, object based image analysis (OBIA) has recently become a more important trend in remote sensing. Segmented objects significantly reduce the high-dimensionality and low-training size problems for classification process. On the other hand, Estimation of Scale Parameter (ESP-2) tool, which is commonly used to estimate optimal scale value, is limited to 30 spectral bands. This limits its use in hyperspectral images and, thus, compulsory reduction in number of spectral bands is required. In this study, a 103-band Pavia University hyperspectral dataset was utilized to conduct the objectives of the study. In this context, a feature extraction method (Principal Components Analysis-PCA) and a feature selection method (random forest-RF) were utilized for reducing the number of spectral bands to be used in ESP-2 tool for searching optimal scale parameter. While multi-resolution segmentation approach was employed with optimal parameter setting using ESP-2 tool, two robust machine learning methods, namely RF and rotation forest (RotFor) were applied for classification of the constructed image objects. The results showed that the classification accuracy obtained using RotFor was much higher than the random forest classifier (up to 6%) for the dataset selected by the random forest algorithm (10 bands). However, the difference in classifiers' performances was about 1% for the PCA dataset (first seven components representing 99% of the total variance). The performances of RF and RotFor classifiers were statistically analyzed using McNemar's test and found that classifier performances were statistically different for the PCA and RF-selected datasets.

Keywords: OBIA, hyperspectral, random forest, PCA, rotation forest

DEEP CONVOLUTION NEURAL NETWORKS WITH ResNet ARCHITECTURE FOR SPECTRAL-SPATIAL CLASSIFICATION OF DRONE BORNE AND GROUND BASED HIGH RESOLUTION HYPERSPECTRAL IMAGERY

Abhinav Galodha (1), Nidamanuri R.R. (1), Ramiya A.M. (1)

[1]Department of Earth and Space Science, Indian Institute of Space Science and Technology (IIST), Trivandrum, Kerala
Email: abhinavgalohda@gmail.com; ramarao.iit@gmail.com; amramiya@gmail.com

Abstract: Drones have been of vital importance in fields of surveillance, mapping and infrastructure inspection. With recent growth of computation power and development of algorithms for robust learning, neural learning based techniques have re-gained the prominence in contemporary research domain such as classification of common 2-D and 3-D images, object detection etc. Drones have played a vital role for acquiring high resolution images and with present need for precision farming; drones have helped in crop classification and monitoring crop patterns. Here we propose deep convolution architecture for classification of Aerial images captured by drones and high resolution Terrestrial Hyperspectral (THS) containing six layers with weights optimized including the input layer, the convolution layer, the max pooling layer, the fully connected layer, Softmax probability classifier and the output layer. We have acquired THS (Cubert data) and drone agricultural data comprising seasonal crops sowed from month of March till June for year 2017. Crop patterns include Cabbage, Eggplant and Tomato with varying nitrogen concentration for the region of Bangalore. To study the influence and impact of CNN, ResNets model has been applied. ResNets model and architecture is combined with Deep learning network followed with Recurrent Neural learning network model (RCNN).The HSI input layer with corresponding Ground Truth data of the region is fed into the ResNets model with a Spectral and Spatial residual network of 7*7*139 input HSI volume. The network includes two spectral and two spatial residual blocks. An average pooling layer and a fully connected layer transforms a 5*5*24 spectral-spatial feature volume into a single output feature vector. Furthermore, we are working upon using different optimization techniques including RMSProp, AdaBoost, Stochastic Gradient Descent (SGD) and Adam on every convolution layer to regularize the learning process and improve the classification performance of trained models. At present using RMSProp optimizer for error loss minimization when applied on drone dataset we were able to achieve overall accuracy of 97.16%. Similarly, for cabbage, eggplant and tomato acquired ground based we achieved 87.619%, 89.25% and 80.566% respectively with comparison to ground truth. Drones and ground based dataset equipped with computational techniques have become promising tools for improving the quality and efficiency for precision agriculture today.

Keywords: Precision Agriculture; Crop Classification; Deep residual networks (ResNet); Hyperspectral image classification; Convolution Neural Networks (CNN);

CLASSIFICATION OF DIFFERENT VARIETIES OF SNOW BASED ON SPECTRAL REFLECTANCE USING ASD SPECTRORADIOMETER FROM THE HIMALAYAS

L. N. Sharma1 (1), Pramod Kumar Maurya (1), Chander Shekhar (2), Snehmani (2)

[1] Department of Applied Sciences, PEC (Deemed to be University), Sec-12, Chandigarh, India,
[2] Snow & Avalanche Study Establishment, Him Parisar, Sec-37A, Chandigarh, India
Email: lnsharma.pec@gmail.com; pramodmaurya66@gmail.com; cskanda@gmail.com; snehmani@sase.drdo.in

Abstract: The monitoring of snow cover in the Indian Himalaya is important for climate research and for operational activities i.e. hydrology and weather forecasting. For this reliable and accessible snow data are required with spatial variability and long-term trends. Hyperspectral imagery requires ground truth data for better image interpretation and analysis. Spectroscopy is used to quantify snow optical properties, based on reflectance measurements in the visible (VIS), near-infrared (NIR) and short-wave infrared (SWIR) regions for the classification of different varieties of snow. Conventional crystal gauge with a magnifying glass was used in the field for observing snow properties. The spectral signature at Dhundi – Solang (snowbound) and Patio (glaciated), Himachal Pradesh, India during the successive years of 2017 and 2018. A total of 663 spectral signatures from different locations of the study areas were collected by measuring and analyzing their reflectance curves using Analytical Spectral Device (ASD) FieldSpec 4 in the range of 350-2500 nm. These spectra provide an integrative technique that measures the fundamental characteristics and composition of the snow and grain size. Clean, fine-grained snow is scattering-dominated and reflects the majority (9799%) of incident sunlight in ultra-violate to visible wavelengths (350-750 nm), and is more absorbing in NIR/SWIR (750-2500 nm). As the snow ages its grain size increases and the reflectance decrease 350 -2500 nm, however, maximum changes are recorded in the visible & NIR region. Reflectance differs for snow and ice depending on the actual composition of the material including impurities and grain size. For glacier bound snow area the debris being dominant contaminant plays an important role in the reflectance of different wavelength regions. A drastic change in reflectance for fresh and moderately dirty snow is noted in the visible portion. In general, snow has higher spectral contrast in visible and SWIR region, however, reflection in SWIR related to its microscopic liquid water content. Variation in reflectance for moderate to highly dirty snow is attributed to vehicular emission and construction upstream. Thus, the study proved its importance in improving the accuracy of snow and ice parameter retrieval from field-based spectroradiometer in turn useful climatic studies.

Keywords: Spectroradiometer, Spectral reflectance, Snow characteristics, Visible-NIRSWIR, Himalaya.

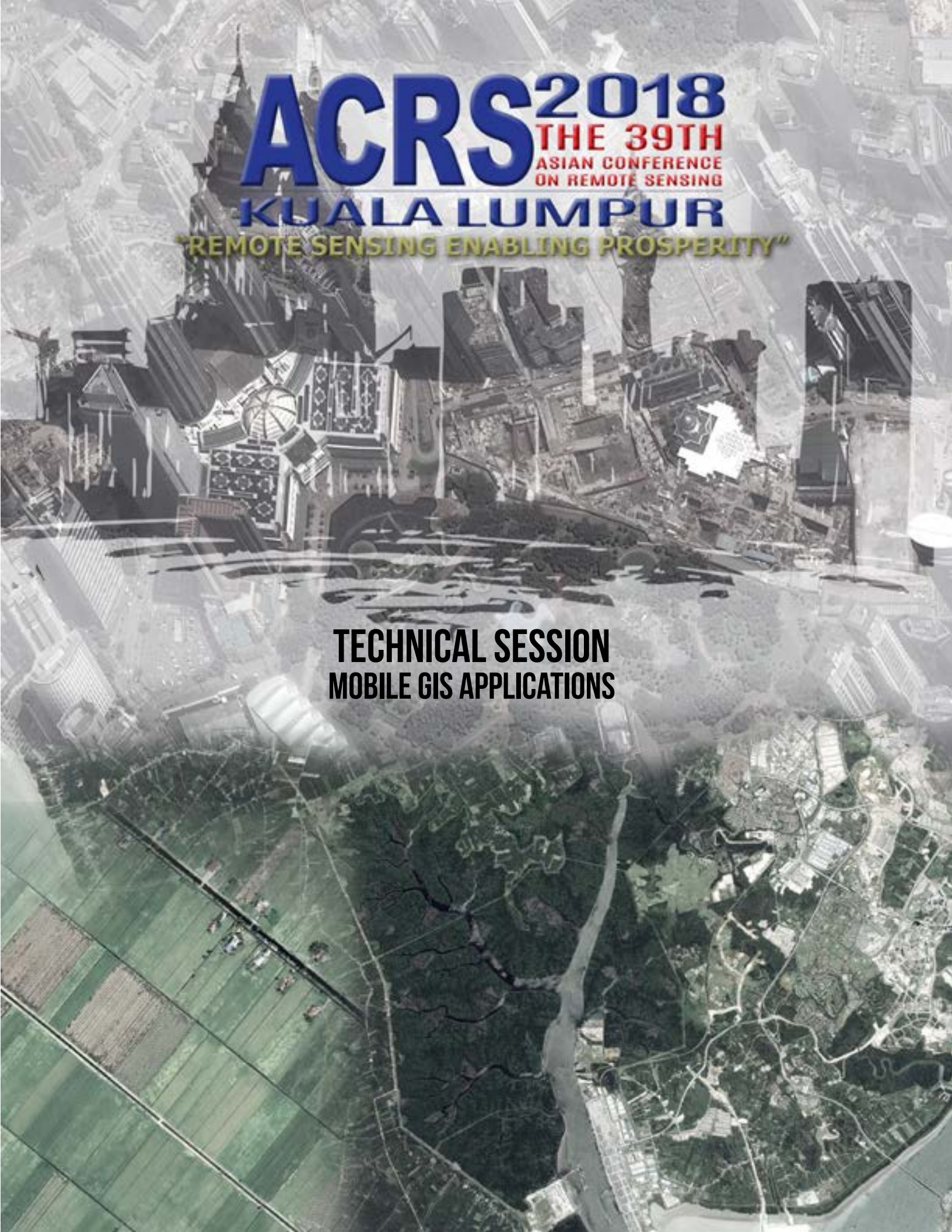
SID-SAM SPECTRAL SIMILARITY MEASURE APPLIED TO BUILD UP CROP HYPER-SPECTRA REPOSITORY FROM HYPERSPECTRAL IMAGE

Dr. Hasmukh Chauhan (1)

[1] Birla Vishvakarma Mahavidyalaya (An Autonomous Engineering Institution) Vallabh Vidya Nagar, Gujarat, India
Email: hjchauhan@bvmengineering.ac.in

Abstract: The present study was undertaken with the objective to check effectiveness of SID-SAM mixed measure as spectral similarity measure to develop crop Hyper-spectra from the image itself based on spectral similarity with collected hyperspectral field spectra. Crop Hyper-spectra through Field spectra; Crop Hyper-spectra generated by the spectra collected through field study for major crops. As the image and field have different environmental and signal characteristics field spectra do not match the image spectra. Hence it has more chances of misclassification for crop classes as crop classes are spectrally similar. Crop Hyper-spectra through image spectra derived from georeferenced remote sensing image; Spectra derived from georefrenced image for the locations where field data were collected. Reference spectra derived from georeferenced image may provide a good approach if neighborhood of 9 pixels (3X3) has same crop class. Hyperion data is used in this study which has spatial resolution of 30 m. During the field study it was also found that field sizes were small and also adjacent fields had different crop type. Therefore it had more chances that the resampled pixel lost its original location spectrum. Hence crop Hyper-spectra generated through image spectra derived from georeferenced remote sensing image also may not provide appropriate approach for crop classification for this study. Crop Hyper-spectra by SID-SAM Spectral Similarity; SID-SAM mixed measure based spectral similarity analysis is used for development of reference crop Hyper-spectra. Endmembers are extracted from hyperspectral image from crop fields. Spectra of endmembers were built and spectral repository prepared with unknown class labels. SID-SAM spectral similarity effectively used to assign class labels to endmembers and crop Hyper-spectra repository prepared. One by one image classification is carried out using spectra developed by field spectra, spectra derived from georeferenced image and spectra assigned by SID-SAM mixed measure based approach. To test the classification accuracy classified images are cross validated against ground truth collected during the field study. Overall classification accuracy of the image classified using field spectra is 66.98% for the image classified by spectra derived from georeferenced image it is 76.415 % and for the image classified by spectra assigned through SID-SAM mixed approach is nearly 80%. Reasonable higher classification accuracy shows a possible new approach to build up spectral repository based on spectral similarity measure.

Keywords: Hyper-spectra, Spectral Information Divergence (SID), Spectral Angle Mapper (SAM), SID-SAM mixed measure, spectral similarity.



TECHNICAL SESSION
MOBILE GIS APPLICATIONS

MAARG: GEO-PROCESSING AND INFORMATION FUSION APPROACH FOR ROAD CONDITION AND SURFACE MONITORING

Bhavana Gannu (1), Krishnan Sundara Rajan (1)

[1] Lab for Spatial Informatics, International Institute of Information Technology - Hyderabad, Gachibowli, Hyderabad, 500032, India
Email: gannu.bhavana@research.iiit.ac.in; rajan@iiit.ac.in

Abstract: In many cities, it is difficult for authorities to build road monitoring systems that are cost-friendly and effective. The existing road monitoring systems have sensors fitted onto heavy machinery which make them expensive for authorities to use for frequent monitoring. There are also some existing systems that use GPS and accelerometer data for determining such artifacts. So, it is evident that there is a need for a system that generates robust, frequent and accountable geo-tagged data. We propose a new collaborative model for such a purpose by fusion of data from multiple sensors hosted on smart-phones of several active geo-citizens. Image data is processed to obtain the road surface while the accelerometer and GPS data is used for identifying road condition and location information. This data is then fused based on location and timestamp information and stored as segments in the database. As the data obtained is crowd-sourced, there are multiple tracks for the same segment of the road and this segmented approach allows for collating multiple user-provided information and validation. If there is multiple track information available for a particular segment, a ranking model based on the number of collaborators is used to rank the status. The final database holds the information like segmentId, timestamp, GPS coordinates and status of the segment. This data serves as an input to the visualization service. The system focuses mainly on volunteered geographic information, in which users can use their respective smart-phones to collect the data required and upload it for further analysis. The server side of the system infuses this data into a PostGIS database and displays the road condition in a near real-time basis over a WebGIS. In addition to visualization, the WebGIS component also provides for timeline analysis of changes of road condition, which helps in the improved management of road infrastructure.

Keywords: Accelerometer, Camera, Collaborative model, Road condition monitoring

OPTIMIZATION OF BUS STOP ALLOCATION AND TIME SCHEDULING USING MOBILE CDR AND BUS GPS TRAJECTORY DATA

Thet Htun Aung (1), Kyaing (1), Ko Ko Lwin (2), Yoshihide Sekimoto (2)

[1] Department of Civil Engineering, Yangon Technological University, Ministry of Education, Insein 11011, Yangon, Myanmar
[2] Institute of Industrial Science, The University of Tokyo, Komaba 4thethtunaung.tu@gmail.com; kyaingkyaing63@gmail.com; -6-1, Meguro Ku, Japan
Email: kokolwin@iis.u-tokyo.ac.jp; sekimoto@ii.u-tokyo.ac.jp

Abstract: Many developing countries, public bus transportation is primary transportation mode for daily commuters inside the city. The efficiency of public bus transportation service is important to local government for public safety and energy saving. The main objective of this study is to understand current public bus transportation problems in Yangon city and propose a new optimized method for allocation of bus stops and their appropriate time schedules. In this case study, we used hourly fine scale 100m grid-population dataset and origin-destination matrices derived from one-week mobile call detail record (CDR) to understand hourly population movement and travel behavior patterns inside the city. We also conducted Web-GIS based smartphone application to collect bus passenger counts and bus GPS trajectory data to determine the passenger in-out volume and traffic congestion status along the bus routes. Finally, we build a GIS model to determine the optimized bus-stops locations and their time schedules based on predefined a set of rules such as maximum population reach to nearest bus-stop by 500m walk, origin destination trips (travel demands) by bus-stop served area, transit facility, passenger volume, traffic congestion status and other public facility locations (i.e. offices, shopping centers, etc.). We hope that this case study will help to Yangon Bus Service (YBS), a major bus transportation service in Yangon city, Myanmar.

Keywords: Optimization of bus-stop locations, hourly 100m grid-population, origin-destination matrices, traffic counts, bus GPS trajectory data

A CASE STUDY OF DOMESTIC TOURIST TRAVEL BEHAVIOR USING MOBILE CDR

Nan Thazin Khine Oo (1), Kyaing (1), Ko Ko Lwin (2), Yoshihide Sekimoto (2)

[1] Department of Civil Engineering, Yangon Technological University, Ministry of Education, Insein 11011, Yangon, Myanmar
[2] Institute of Industrial Science, The University of Tokyo, Komba 4-6-1, Meguro Ku, Japan
Email: nanthazin.1012.tz@gmail.com; kyaingkyaing63@gmail.com; kokolwin@iis.u-tokyo.ac.jp; sekimoto@ii.u-tokyo.ac.jp

Abstract: As the mobile devices are widely used, it is possible to study human mobility and travel behaviors by using mobile call detail record (CDR). Traditional travel surveys are time consuming and expensive. According to Ministry of Hotel and Tourism, the numbers of domestic tourists have increased 3.1 million to 7.1 million dues to political transformation in Myanmar since 2011. The aim of this study is to understand the travel behavior of domestic tourist travel behavior in Yangon City from Pathein Region which is the most populated region in Myanmar. The one-week period of origin-destination pairs have generated for the whole country from CDR data and analyzed their destination places such as amusements, religious places and other points of interest in Yangon City. We hope that the study result will help to improve government policy making and spatial planning in promotion of domestic tourism.

Keywords: CDR, domestic tourism, travel behaviors, origin-destination, points of interest

AUGMENTED REALITY MOBILE APPLICATION; ITU CAMPUS ASSISTANT EXAMPLE

Rashid Ramazanov (1), Dursun Zafer Seker (1)

[1] ITU, Istanbul Technical University, Department of Geomatics Engineering 34469 Maslak Istanbul Turkey
Email: ramazanov@itu.edu.tr; seker@itu.edu.tr

Abstract: In this study Istanbul Technical University Campus assistant have been created by researching use of augmented reality for navigational purposes. By researching latest databases, mostly preferred technologies by uses, project management and software development processes, augmented reality technology applied in the mobile application. The study helped to process CAD based 3D ITU Maslak campus map, convert it to Post GIS database and to provide connection between database and mobile applications by using RESTful application programming interfaces. Smart phones, nowadays, can use satellite connections and much more technologies to retrieve location data of users with high accuracy. Any mobile phone starting the ITU Campus Assistant application, user location is being determined using Global Navigation Satellite System (GNSS). After the location is determined, the building names in this area are inquired by creating a buffer of a certain diameter circularly with the condition that the detected location data is considered to be the center. Once the data is queried, direction information is calculated using the sensors of the device to implement augmented reality, and information about the buildings is displayed on the camera of the smart phone. In the mobile application, research and studies carried out for the optimum operation, even though high performance processes such as position, camera and internal sensors are used. In final stage, mobile application developed as a navigation assistant to Istanbul Technical University campus. Future researches drew a roadmap for the study to create a Software Development Kit (SDK) for mobile applications, which will help interested parties to develop augmented reality application with minimum software development skills.

Keywords: Augmented reality map, Campus assistant, 3D, Geographical database

CITIZEN BASED TREE INVENTORY USING MOBILE DATA COLLECTOR AND QUICK RESPONSE CODE

Nurul Hawani Idris (1), Mohd Farid Fauzi (1), Nurul Hazrina Idris (1), Mohamad Hafis Izran Ishak (2)

[1] Department of Geoinformation, Faculty of Built Environment and Surveying,
Universiti Teknologi Malaysia 81310 UTM Skudai Johor, Malaysia
[2] School of Electrical Engineering, Faculty of Engineering,
Universiti Teknologi Malaysia 81310 UTM Skudai Johor, Malaysia
Email: hawani@utm.my; m.farid85@live.utm.my; hafis@utm.my

Abstract: A lot of studies have reaffirmed that the idea of living near nature is good for human health, reduce air pollution and can result in cooler temperatures. Due to this, various campaigns to support this notion including tree planting by the local authorities, corporate companies, non-governmental organizations and school children have been actively implemented. However, due to limited resources to conduct a tree inventory after planting events have led to difficulty in monitoring the trees that have been planted, such as tracking a tree survival and growth. Therefore, the purpose of this paper is to present the approach of using the Geotrees system, an integrated mobile data collector that embedded with Quick Response (QR) code technology to support a citizen based tree inventory. This system offers a low cost solution in tree inventory where any mobile-enabled citizens could participate in tagging trees using their own smartphone. End users are able to record basic tree data including species name, diameter and height after tagging a tree with QR code. The system is also providing a tool to report post event activities such as tree watering and pruning. As a conclusion, engaging citizen in tree inventory using digital mobile technology could offer as an alternative way to support in providing supplementary data towards a comprehensive database for monitoring the sustainability of urban green space and forest in Malaysia.

Keywords: Tree inventory, volunteered geographic information, citizen science, QR code, Mobile GIS

DEVELOPMENT OF REAL TIME CROP REAL TIME CROP FIRE ALERT SYSTEM

Nidhi Kundu (1), R.S. Hooda (1), Manoj Yadav (1)

[1] Haryana Space Applications Centre (HARSAC), CCS HAU Campus, Hisar-125004, Haryana, India
Email: nidhi.ghanghas@gmail.com; hoodars@yahoo.com; manojyadav60@rediffmail.com

Abstract: Burning of crop stubble has emerged as a major problem in the northern India causing severe environmental problems. As the government has declared this an illegal activity, real time monitoring of such incidences has become inevitable to facilitate the enforcement agencies in knowing their locations. We developed a mobile based 'Real Time Crop Fire Alert System' through which the daily crop stubble fire locations captured through the SUOMI satellite are being sent to various enforcement officers at the state and district level through SMS alert. The crop fire location map indicates district, block and village name along with the latitude and longitudes of the point. The mobile application developed for this purpose can help in navigation by indicating the shortest/ optimum route from the current location of the official to any fire location in the state to enable enforcement agencies to reach at the exact location. Daily Crop residue burning incidences for the year 2017 and 2018 have been provided using SUOMI National Polar-Orbiting Partnership (NPP) Visible Infrared Imaging Radiometer (Suomi NPP-VIIRS) active fire products with spatial resolution of 375x375 m available at the NASA Website. Though it is a course resolution data, yet because of its daily repeat cycle it can indicate major crop fire points on daily basis. As the spatial resolution of these satellite sensors is very course, it can't capture only large crop stubble burning sites. During the wheat harvesting season in 2018, 5925 crop stubble fire points were observed as compared to 4747 for the year 2017, indicating an increase of 24.8% compared to 2017. Maximum number of 713 and 811 crop stubble incidences were recorded in Karnal district both during 2017 and 2018, respectively followed by Jind 528 and 736, Sonipat 561 and 576. Kaithal and Panipat districts recorded an increase from 322 to 513 and 343 to 420, respectively.

Keywords: Crop Burning, SUOMI, NPP –VIIRS, Mobile App

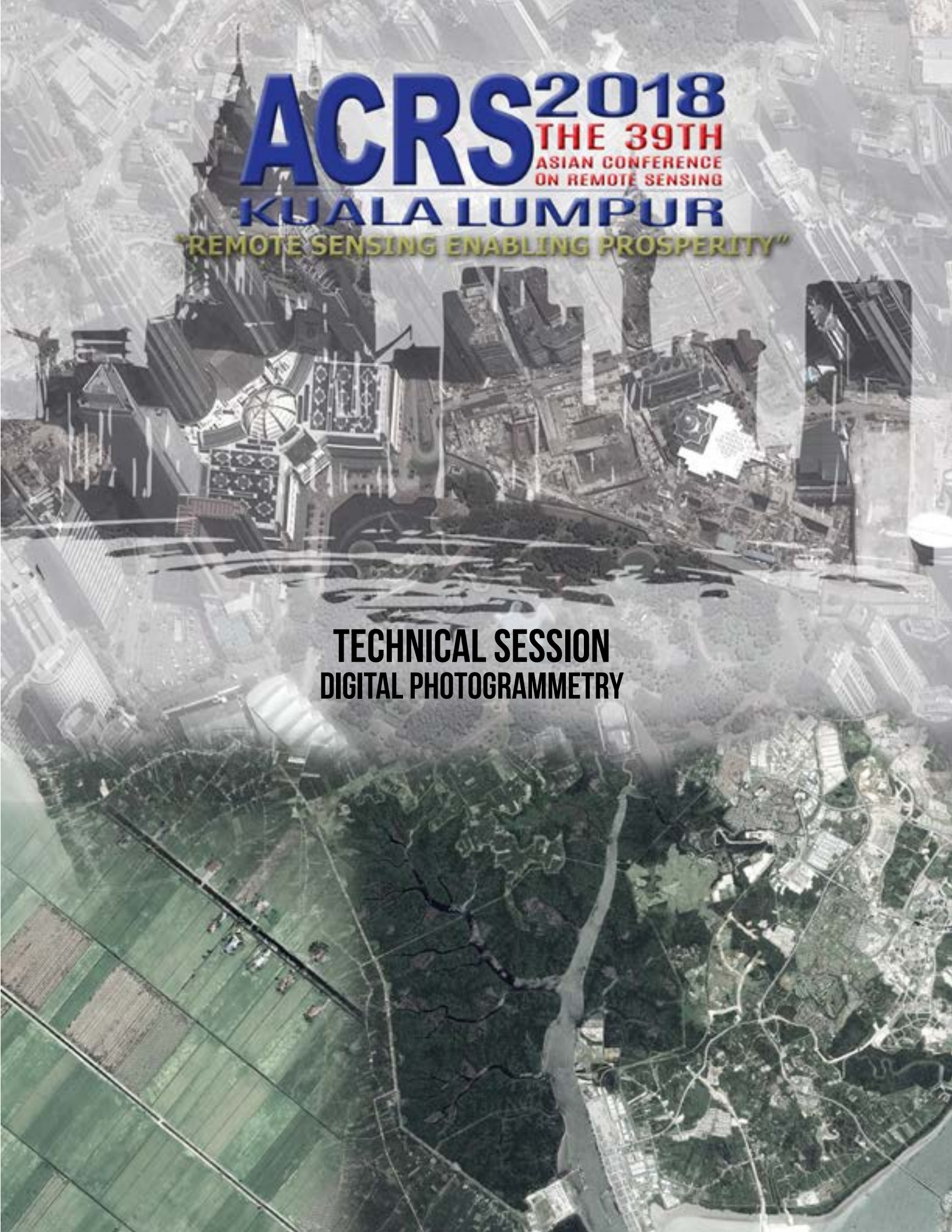
MOBILE APPLICATION FOR OPERATIONS AND MAINTENANCE MONITORING OF IRRIGATION AND WATER ALLOCATION STRUCTURES AT CHAO PHRAYA RIVER BASIN, THAILAND

Frank Yrle (1), Kasem Pinthong (2), Kavinda Gunasekara (1), Surachat Malasri (3), Nearamit Thepnok (3)

[1]Asian Institute of Technology, GeoInformatics Center, Pathum Thani, Thailand, 12120
[2]Sensorsoft Co. Ltd., Bangkok, Thailand, 10230
[3]Thai Royal Irrigation Department, Regional Irrigation Office 12, Chainat, Thailand, 17150

Abstract: Thailand's Royal Irrigation Department delegates maintenance of its irrigation and water allocation structures to seventeen Regional Irrigation Offices (RIO). Each RIO must assign a portion of its limited budget for structure maintenance, but lacks operations and maintenance data to base that decision on. We are presenting a participatory approach for operations and maintenance monitoring of Thai irrigation and water allocation structures. The Water Management System is composed of a mobile application and a web portal. The android-based application features an intuitive interface in which users enter descriptions of the incidents they encounter; descriptions are typed into the application, while image, video, and audio media can be uploaded for supplemental depiction. Additionally, the application employs smart phone internal GNSS devices to record location information. Irrigation officers then access a web portal to assess incident reports through an operational management interface. Each incident is visualized on a map of the regional district with an assigned severity level to improve RIO response coordination. A live chat component facilitates direct communication between irrigation officers and users for further engagement. The Water Monitoring System is initially being instituted in central Thailand's RIO 12, located in the Chao Phraya River Basin. RIO 12 spans five provinces including Chainat, Uthai Thani, Suphanburi, Ang Tong, and Singhburi. There are currently seventeen ongoing irrigation projects in RIO 12, underlining the need for such a monitoring system. Utilizing a participatory approach to operations and maintenance monitoring will allow RIOs to accurately apportion budget for maintenance, have structures in good operating condition for potential flood events, and increase coordination for response time efficiency.

Keywords: Participatory GIS Application, Irrigation, Thailand



TECHNICAL SESSION
DIGITAL PHOTOGRAMMETRY

POSITIONING ACCURACY IMPROVEMENT OF TERRESTRIAL MOBILE MAPPING SYSTEMS USING A BUNDLE BLOCK ADJUSTMENT

Su Wei Lin (1), Rey Jer You (1)

[1]Geomatics Department, National Cheng Kung University, No.1, University Road, Tainan City 701, Taiwan, R.O.C.
Email: kammy60132@gmail.com; rjyou01@gmail.com

Abstract: Recently, low-cost terrestrial Mobile Mapping Systems (MMSs) have been developed for the construction of the 3D city models and mapping. A terrestrial MMS combining GPSs and an IMU can perform the direct geo-referencing and then use forward intersections to determine many ground coordinates of points. However, according to many experiments, it is well known the accuracy of positioning results using a low cost terrestrial MMS using the direct geo-referencing and forward intersection only is neither stable nor reliable because of the bad base-depth ratio, the GNSS signal obstruction in city regions, and less redundancy for extra examination. This research adopts the exterior orientation obtained from a terrestrial MMS with the help of ground control points and introduce them into bundle block adjustment in order to improve the positioning accuracy. A bundle block adjustment using an exterior orientation from a terrestrial MMS can raise the positioning accuracy from 499cm to 244cm in a real MMS data. Additionally, adding some pairs of ground control points extra can improve the accuracy even to 16cm. This result has no significant differences comparing to the positioning accuracy using high precise MMSs. Our experiments have shown that adding few control points and using bundle block adjustment can improve the positioning accuracy.

Keywords: Terrestrial Mobile Mapping System, Direct geo-referencing, close range Photogrammetry, Bundle block adjustment

ESTIMATING VOLUMES AND SPATIOTEMPORAL PATTERNS OF MUD VOLCANO ERUPTION IN THE WANDAN REGION BY USING UAV PHOTOGRAMMETRY

Chia-Ying Liu (1), Ray Y. Chuang (1), Horng-Yue Chen (2), Shih-Jung Lin (3)

[1] National Taiwan University, Department of Geography, No. 1, Sec. 4, Roosevelt Road, Taipei 10617, Taiwan.
[2] Academia Sinica, Institute of Earth Sciences, No. 128, Sec. 2, Academia Road, Nangang, Taipei 11529, Taiwan
[3] National Center for Research on Earthquake Engineering, No. 200, Sec. 3, HsinHai Rd., Taipei 106, Taiwan
Email: r05228011@ntu.edu.tw; raychuang@ntu.edu.tw; chenhy@earth.sinica.edu.tw; sjlin@ncree.narl.org.tw

Abstract: Mud volcanoes are special geologic features occurred in tectonic areas with horizontal compression. Complete research for mud volcanos can help us to know the Earth interior interaction. In Taiwan, mud volcanoes are present on-land and off-shore southwestern Taiwan around the transitional area from subduction to orogeny. Among all mud volcanoes in Taiwan, the Wandan mud volcano erupts sporadically with large amount of effluent mud. However, few studies focused on the Wandan mud volcano and the mechanism of its eruption remains unclear because we lack fundamental information such as eruptive volumes, duration of mud eruption, impact factors and recurrence intervals. Therefore, it is important to estimate the eruptive volumes and further to examine the spatiotemporal pattern of the mud volcano eruption in Wandan. We first compile literature and newspapers for historic eruption events to estimate eruptive magnitude and recurrence intervals. Our preliminary result shows that the recurrence interval roughly can be classified into two groups, 150-180 days for highly active period and 300-600 days for less active period. In recent years, surveying techniques and their applications in geomorphologic studies develop rapidly. Therefore, we estimate the eruptive volumes of recent eruptions for the Wandan mud volcano by using aerial photos taken from unmanned aerial vehicles (UAV), and the structure- from-motion (SfM) photogrammetry techniques. We use RTK-GPS and leveling for horizontal and vertical measurements of ground control point, respectively. We can use a SfM software to generate DSMs, point clouds, and orthophotos with cm-level accuracy. We estimate the eruptive volume by subtracting the pre-eruption DSM from the post-eruption DSM. Our results shows that for the event on 15 May, 2018, the eruptive area is 12,761 m^2 and the volume is 15,284 m^3.

Keywords: UAV, GNSS, digital surface modeling, control survey

COMPARISON AND USAGE OF LOCAL FEATURE BASED ALGORITHMS FOR 3D FACE RECOGNITION

Muhammed Enes Atik (1), Zaide Duran (1), Bülent Bayram (2)

[1] Istanbul Technical University, Department of Geomatics Engineering, 34469 Maslak Istanbul, Turkey
[2] Yildiz Technical University, Department of Geomatic Engineering, Division of Photogrammetry, Davutpasa Campus, Esenler, 34210, Istanbul, TR
Email: atikm@itu.edu.tr; duranza@itu.edu.tr; bayram@yildiz.edu.tr

Abstract: With the development of laser scanning technology, 3D point clouds have become easy to obtain. Thus, facial recognition has become a popular field of study by using a three-dimensional point cloud against the constraints of automatic face recognition using two-dimensional images. The aim of the study is to approach 3D face recognition processes from a different dimension. In this context, the facilities of using automatic 3D local keypoint detector algorithms in face recognition are being investigated. In the scope of the thesis, face recognition algorithm was developed using 3D keypoint based methods. As an application data, face data belonging to 10 people were modeled in 3D by using a laser scanner. The algorithm consists of three steps. In the first step, 3D points are defined on the point clouds using Instrinsic Shape Signature (ISS) method. In the second step, key points are defined using Point Feature Histograms (PFH) and Fast Point Feature Histograms (FPFH) histogram methods. In the third step, the keypoints in different point clouds are matched using the feature histograms obtained. As a results, in the natural face expression, ISS-PFH algorithm, 9 out of 10 people; 7 out of 10 people with ISS-FPFH algorithm are correctly defined. When the cases where different face expressions are given to the system are examined, the ISS-PFH algorithm has 5 out of 10 persons; The ISS-FPFH algorithm has 3 out of 10 people correctly identified. The positional accuracy of the matched points has been examined. ICP was applied to the matching point clouds for this purpose. Euclidean distance between corresponding keypoints in the two point cloud is calculated. It has been accepted that the points are shorter than 10 mm. When root mean square errors of correct point matches are examined, there is no significant difference between the methods. In all methods a root mean square error of about 3 mm was determined with an accuracy of 10 mm. The difference between keypoint descriptor algorithms has been determined. The correct matching rate for PFH is up to 60% with 10 mm error, while FPFH histograms are around 25% - 30%.

Keywords: 3D model, Face recognition, Keypoint, ICP, Local feature

CONTRIBUTION OF SMARTPHONES FOR DOCUMENTATION OF CULTURAL HERITAGE: A CASE STUDY OF ZILKALE

Ozan Ozturk (1), Batuhan Sariturk (1), Abdullah Harun Incekara (2), Dursun Zafer Seker (1), Bulent Bayram (3), Zaide Duran (1)

[1] Istanbul Technical University, Faculty of Civil Engineering, Deparment of Geomatics Engineering, Ayazaga Campus, 34469 Maslak, Istanbul, Turkey
[2] Gaziosmanpasa University, Faculty of Engineering and Natural Sciences, Deparment of Geomatics Engineering Ayazaga Campus, 60150, Tokat, Turkey
[3] Yıldız Technical University, Faculty of Civil Engineering, Deparment of Geomatics Engineering, Davutpasa Campus, 34220 Esenler, Istanbul, Turkey
Email: oozturk16@itu.edu.tr; sariturkb@itu.edu.tr; abdullah.incekara@gop.edu.tr; seker@itu.edu.tr; bayram@yildiz.edu.tr; duranza@itu.edu.tr

Abstract: Due to the high complex image scene using only aerial images for 3D documentation of historical sites is challenging. Most existing documentation methods from aerial images still suffer from the abrupt irregular geometric deformations and radiometric changes due to material change, shadows of trees and invisible areas etc. In contrast to displays, it can be said that there are palpable benefits in having high resolution cameras on smartphones. Some benefits of high resolution cameras on smartphones are more detailed captured, sharper images and the more room for digital zooming with less detail loss etc. They may not be perfect that there are perceivable advantages to derive from the higher MP ratings. In this study Zilkale historical sites which is located in the Rize Province was selected as the study area. This study focuses on the 3D documentation of Zilkale, which is a medieval castle consists of outer walls, middle walls and inner castle dated back to 14th and 15th century. In the area 692 high resolution images were taken using by an Unmanned Aerial Vehicle (UAV) and a smartphone as a terrestrial camera. To demonstrate the importance of the terrestrial photographs for documentation wo different 3D models of Zilkale historical monument were produced using the computer vision based photogrammetric software from aerial images and combined of aerial and terrestrial images. Produce models were examined both visually and using some basic metrics for the 3D spatial and image matching accuracy. Study resulted with the success of the combination of terrestrial and aerial images based 3D models especially in the visibility of façades with higher accuracy. Produced models without terrestrial photographs cannot be considered as a reliable product for the 3D documentation of historical monuments or cultural heritage sites.

Keywords: Image Fusion, Unmanned Aerial Vehicle, Digital Photogrammetry, Cultural Heritage, Documentation, Computer Vision

IMAGE- AND RANGE-BASED 3D RECORDING OF MULTI LEVEL OF DETAIL SOLITARY VEGETATION OBJECT FOR LANDSCAPE AND CITY MODELING

Deni Suwardhi (1), Widiatmoko Azis Fadilah (1), Agung Budi Harto (1),
Shafarina Wahyu Trisyanti (1), Irwan Gumilar (2)

[1] Remote Sensing and Geographic Information Science Research Group, Insitute of Technology Bandung, No. 10, Jalan Ganesa, 40123 Bandung, Indonesia
[2] Survey and Mapping Laboratory, No. 10, Jalan Ganesa, 40123 Bandung, Indonesia
Email: deni@gd.itb.ac.id; widiatmokoazis@gmail.com; agung@gd.itb.ac.id;
shafarina.wahyu@student.itb.ac.id; igumilar@gd.itb.ac.id;

Abstract: A landscape/city consist of man-made objects (e.g., buildings), natural objects (e.g., vegetation), and terrain. Currently, 3D landscape/city modeling, such as CityGML, still focus on the representation of building geometry. However, In fact, vegetation is also important to be modeled as it can be used as a visualization and analysis tool for some applications. This paper describe research that have objectives are recording tree size parameters and generating 3D tree models that can be used for industrial forestry, landscape/city planning, and entertainment (game, cinema, Virtual/augmented Reality). The used methods in this research are Close Range Photogrammetry (CRP), Terrestrial Laser Scanner (TLS), Unmanned Aerial Vehicle (UAV) Photogrammetry, and combined methods, which produce data in the form of point cloud. The point cloud then extracted to obtain the tree size parameters, which can be used as the input data for 3D tree modeling LoD 1-4. The tree size parameters are position, trunk and crown diameter, height of crown, tree height, and geometry model with the most appropriate level of detail. Based on the comparison of acquisition methods that have been done in this research, it is concluded that CRP can replace TLS role to obtain position, height, canopy diameter and tree type parameters, and 3D tree model used for 3D landscape modeling. The results of this research are the 3D tree models which have different information based on the appearance, geometry, semantic, and topology aspects of CityGML.

Keywords: Photogrammetry, Laser Scanner, UAV, CityGML, Tree

ANIWATCH: CAMERA TRAP DATA PROCESSOR FOR DEEP LEARNING-BASED AUTOMATIC IDENTIFICATION OF WILDLIFE SPECIES

Byeong-Hyeok Yu (1)(2), Moonhee Kang (1)

[1] Sobaeksan National Park Northern Office, Korea National Park Service, 494, Namhangang-ro, Gagok-myeon, Danyang-gun, Chungcheongbuk-do, Republic of Korea
[2] Open Source Geospatial Foundation (OSGeo)
Email: bhyu@knps.or.kr; rkdansgml524@knps.or.kr

Abstract: Camera trap equipment is mainly used to monitor the status of wildlife in protected areas. The existing data survey identifies wild animals through visual interpretation. This process not only requires a long time, but also has the problem that the expertise of the investigator determines the reliability of the data. Recently, deep Learning in the field of image recognition has been detecting the object identification, object count, and the image description in the image with high accuracy. In this paper, we introduce the camera trap data processor (AniWatch) which can automatically database wildlife identification, animal count, and motion information by deep learning. To test the software performance, the Sobaeksan national park's Jukryong eco-corridor was selected as a study area. First, we collected the camera trap data in the area. Since we need to detect moving objects in a fixed position, we performed data preprocessing through computer vision algorithms. Through the image tracking algorithm, the minimum bounding rectangle of the wild animal object was detected and each frame was saved as an image. Because each image is of different size and resolution, we adjusted it to 100 × 100-pixel size to recognize it as training data. For deep learning, we applied a convolutional neural network (CNN) technique which is used in image recognition field. Open source libraries (OpenCV, TensorFlow, and Keras) were used to implement the model, and the software was developed as a GUI application through Python. In the test results, AniWatch confirmed that it can reduce the time required for visual interpretation and minimize human errors. In the future, we will provide an automatic calculator of monitoring statistics by inputting camera trap data.

Keywords: AniWatch, camera trap data processor, deep learning, species identification, convolutional neural network

UTILIZATION OF *UNMANNED AERIAL VEHICLE (UAV)* FOR ACCELERATION LAND REGISTRATION

Dhiky Hartono (1), Soni Darmawan (1)

[1] Institut Teknologi Nasional, Geodesy Engineering Department,
Faculty of Civil Engineering and Planning Jalan PKH. Mustopha, No. 23, 40124 Bandung, Indonesia
Email: dhiecky.hrt@gmail.com; soni_darmawan@yahoo.com

Abstract: Starting in 2016 and through the National Land Agency (NLA) the Indonesian government conducted a program of land registration simultaneously throughout Indonesia named after the Complete Systematic Land Registry (CSLR), where the program is specialized to work on land registration throughout Indonesia targeted for completion by 2025. Technology that can speed up this CSLR program one of them use drone aircraft (Drone). The purpose of this research is to know the extent of Unmanned Aerial Vehicle (UAV) capability of Quadcopter type for mapping of plot of land in terms of accuracy, speed, and economics. The area to be studied is the area that is being implemented the program is located in the village of Solokan Jeruk Solokan District of Orange Regency Bandung. The research methodology consists of data acquisition using quadcopter type drones, processing photo using Agisoft Photoscan software that will be tied to the Ground Control Point (GCP) that is obtained from the GPS Real Time Kinematic recording using the Stop and Go method, so that the photo map will have ground coordinates that are georeferenced. The results of this research are Unmanned Aerial Vehicle (UAV) type Quadcopter capable of providing good accuracy, efficient cost savings and speed of providing work maps / base maps on programs CSLR. The conclusions obtained in this study are that Unmanned Aerial Vehicle (UAV) types of Quadcopter are very helpful for CSLR programs in terms of the accuracy of the maps entered into class 3 in the ratio of 1: 2,500 based on RBI Map Geometry Accuracy, the speed produced by UAV types of Quadcopter is proven faster if Compared with recording satellite imagery and seen from the cost of much more efficient 42.87% to 61.16% when compared with High Resolution Satellite Imagery or equivalent to Rp. 9,454,500 to Rp. 20,962,500 with an exchange rate of Rp. 14,385.00.

Keywords: CSLR, Drone, Ground Control Point

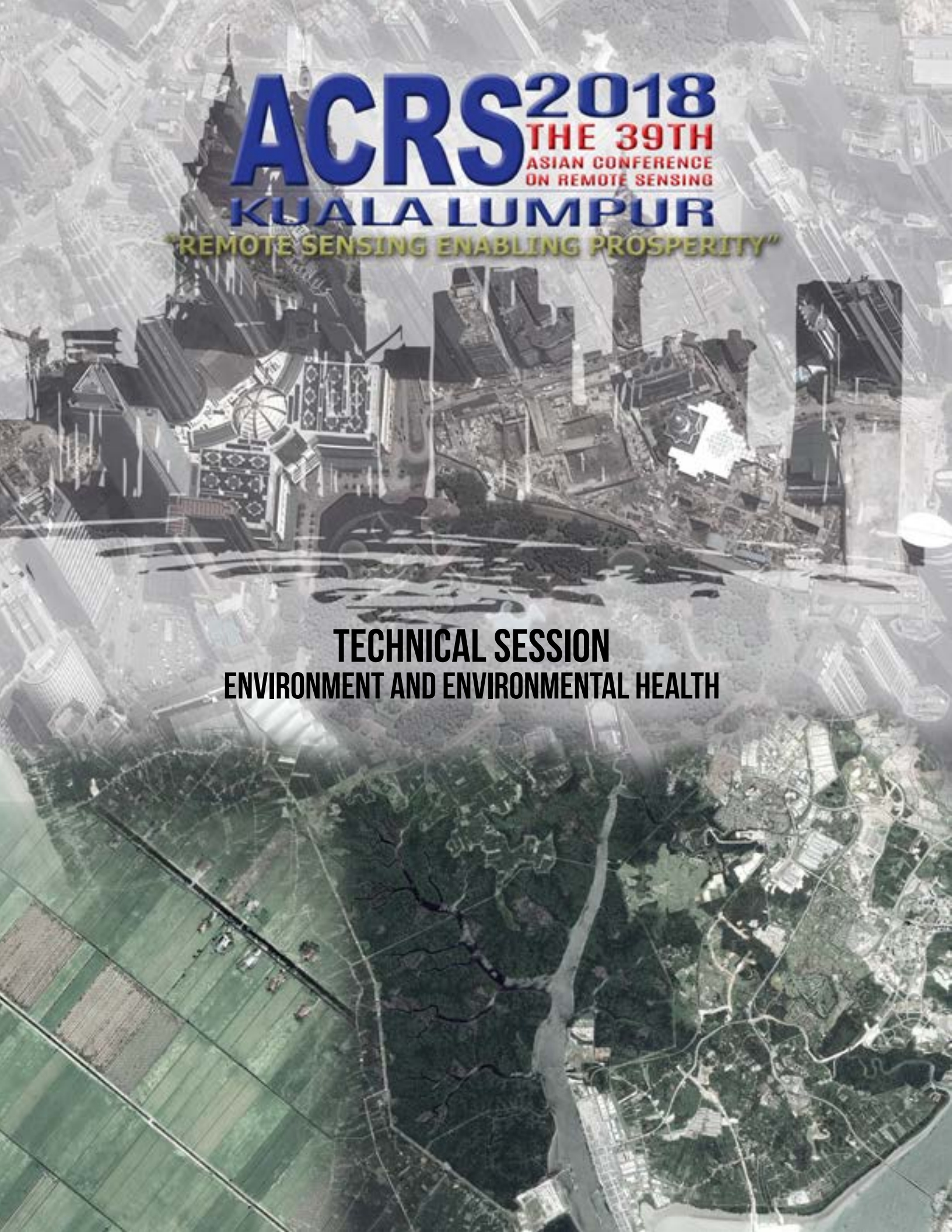
EVALUATION OF THE POSITIONAL ACCURACIES FROM UNMANNED AERIAL SYSTEM WITH PPK CAPABILITY

Ariel C. Blanco (1)(2), Louie P. Balicanta (1)(2), Yvan F. Pagdonsolan (2), Dexter Lozano (3)

[1] Department of Geodetic Engineering, University of the Philippines Diliman, Quezon City 1101
[2] Training Center for Applied Geodesy and Photogrammetry
University of the Philippines Diliman, Quezon City 1101
[3] Sitech Philippines, E. Rodriguez Jr. Avenue, Quezon City 1102
Email: acblanco@up.edu.ph

Abstract: Positional accuracy achievable from products generated by unmanned aerial systems (UAS) is largely dependent on the accuracy of the exterior orientation parameters (i.e., image station coordinates ISC and orientation angles) and the ground controls points. Depending on the UAS GNSS receiver and method, the accuracy of the ISC ranges from a few centimeters to several meters. This study is aims determine whether UAS-generated products, including orthomosaics, would be able to satisfy the 10-cm (or better) accuracy requirement in tertiary surveys. Aerial images were acquired covering FVR village, Poblacion, and Tigbe in Norzagary, Bulacan, Philippines using Trimble UX5 HP (with PPK capability). For the case of Tigbe, the nominal accuracy of UX5 HP PPK ISC were set to 5 cm (xy) and 10 cm (z). Using ISCs only, the following were obtained based on 9 checkpoints: 0.070 m RMSEx, 0.054 m RMSEy, 0.138 m RMSEz. Note that this satisfied the planimetric accuracy requirement but not the vertical accuracy. Using 6 corner GCPs, the adjustment RMSEs in the x, y, and z are 0.029 m, 0.029 m, 0.012 m, respectively. Corresponding checkpoint RMSEs are 0.074 m, 0.011 m, 0.112 m using three (3) checkpoints. With 4 corner GCPs (one at each corner) and 5 checkpoints, adjustment RMSEs (0.041 m, 0.039 m, 0.038 m) and checkpoint RMSEs (0.055 m, 0.027 m, 0.101 m) indicate that the planimetric accuracy requirement is met. It has been shown that the use of GCPs significantly improve the positional accuracies as expected. Further reducing the GCPs to three (which is the minimum required number of GCPs) yielded varying results depending on the location of the three GCPs forming a triangle. The accuracy requirement can be met if the GCPs are located at the corners and around the perimeters, especially in locations where the strength of linkages across image has been weakened relatively due to the deviations from flight lines. It was noted that, in areas outside the coverage of the GCPs, the error may increase beyond the acceptable RMSE unless the ISC are accurate to the level which is equal or better than that of the GCPs.

Keywords: UAS, Accuracy Assessment, PPK, Position



TECHNICAL SESSION
ENVIRONMENT AND ENVIRONMENTAL HEALTH

ESTIMATION OF ENVIRONMENTAL IMPACT TO HUMAN HEALTH BY ASSOCIATING GREENNESS AND CANCER

Jiyoon Moon (1), Tae-byeong Chae (1)

[1] Korea Aerospace Research Institute, Satellite Operation & Application Center, 169-84, Gwahak-ro, Yuseong-gu, Daejeon, 34133, S. Korea
Email: jymoon@kari.re.kr; tbchae@kari.re.kr

Abstract: It has been constantly increased to estimate the impact of natural environment to human health and welfare, and suggested that the proportion of complex disease risk would be resulted from differences of environmental exposures. On recent study, the exposure of neighbourhood greenness may impact health and reduce diseases by illustrating the relation between the greenness and various diseases. Thus, in this study, we tried to figure out the relation between the greenness and different cancer and investigate a relevant correlation with specific cancer type. Study area is Seoul city, which is the capital of S. Korea. Multiple Landsat 8 images were used to calculate NDVI and statistical data of the number of cancer patients in 2009-2013 was used. In addition, other social statistics such as population, gender, age, and educational level were also combined to analyze the complex relation. Then we found out whether NDVI shows the strong relation with cancer among other social variables. Furthermore, the relation between NDVI and other social variables was also analyzed as well as cancer. The result of this study enables to estimate the impact of environment to human health, and it is expected to be used as a fundamental information for the policy to improve the quality of life.

Keywords: greenness, NDVI, satellite images, human health, cancer

HIGH RESOLUTION AIR POLLUTION ASSESSMENT FOR ROAD TRANSPORT IN YANGON, MYANMAR

Tkakashi Misumi (1), Wataru Takeuchi (1)

[1]Institute of Industrial Science, The University of Tokyo, Meguro 4-6-1 Tokyo 153-8505, Japan
Email: tmisumi@iis.u-tokyo.ac.jp; WATARU@iis.u-tokyo.ac.jp

Abstract: Air pollution is one of the most serious issues around the world. After the evolution in the England, large amount of toxic gasses have been emitted in the air in exchange for our convenient life and affected our health. According to the Health Effect Institute, it was estimated that 6 million people were dead because of longtime absorption of polluted air. In order to reduce the risk, prompt response to tackle the problem is necessary. To solve air pollution problem, we estimated traffic flow. It is considered that the main cause of air pollution is emission of nitrogen oxide and suspended particle matter. Those toxic substances are discharged from cars and plants. Therefore, the estimation of traffic flow is indispensable for mitigation of the air pollution. We attempted to estimate the traffic flow by using traffic data of google map. Google provides the currently traffic congestion map, which shows the traffic speed on each road section. Processing the information, the volume of traffic could be measured and forecasted. Combining it with hazardous gas emission data and atmospheric circulation model, the distribution of noxious gas in a town was estimated. This study will contribute to the simplification of the noxious gas observation. Various studies related to traffic flow and air pollution have been conducted. For example, "High Resolution Air Pollution Assessment System for Road Transport Policy Evaluation" conducted by Kuwahara. However, there is no method which observes the large scale toxic gas distribution at short interval because the manually counted traffic data or traffic video data are indispensable for their study. Thus, this evaluation method will enable burden reduction and the periodic observation.

Keywords: Air Pollution, Traffic, Myanmar

THE EVOLUTION OF MESOSCALE CONVECTIVE SYSTEM (MCS) AROUND THE GREATER JAKARTA AREA ON 9 FEBRUARY 2015 USING MTSAT SATELLITE

Danang Eko Nuryanto (1)(2), Rahmat Hidayat (1), Hidayat Pawitan (1), Edvin Aldrian (3)

[1] Department of Geophysics and Meteorology, FMIPA Bogor Agricultural University, Kampus IPB Darmaga, Bogor 16680, West Java, Indonesia
[2] Research and Development Center, Indonesian Agency for Meteorology Climatology and Geophysics, Jl Angkasa I No 2 Kemayoran Jakarta Pusat 10720, Indonesia
[3] Agency for The Assessment and Application of Technology, Jl MH Thamrin No 8 Jakarta 10340, Indonesia
Email: danang.eko @bmkg.go.id

Abstract: The Greater Jakarta (GJ) area received serious attention from the government in the last 10 years due to the frequent occurrence of flood problems during the rainy season. Extreme rain events which leads to flooding often associated with highly convective cloud systems. One of the phenomena describes the presence of a broad convective cloud system known as a mesoscale convective system (MCS). The objective of this study is to describe the MCS evolution during heavy rainfall event on February 9, 2015. The Multi-functional Transport Satellite (MTSAT) imagery data was used for identified the MCS. The system developed from morning of February 9, 2015 until the daytime. The results showed that there was a concentration of convective clouds around GJ area. Although the convective cloud area tends to be small (<50,000 km2), heavy rainfall was observed in the study area. This shows that the rain that occurred was quite heavy and may be the cause of the flooding in the study area.

Keywords: heavy rainfall, mesoscale convective system, the Greater Jakarta

A STATISTICAL TEST OF EROSION PIN MEASUREMENTS

Walter Chen (1), Allison Chen (2)

[1] Department of Civil Engineering, National Taipei University of Technology,
1 Sec. 3 Chung-Hsiao E. Rd., Taipei 106, Taiwan
[2] Department of Management Science, National Chiao Tung University,
1001 University Road, Hsinchu 300, Taiwan
Email: waltchen@ntut.edu.tw; allison.nctu@gmail.com

Abstract: Soil erosion modelling at the watershed scale has gained increasing importance in the last few years. To validate soil erosion models, installing erosion pins in the watershed is the most direct method to determine erosion rates. In this study, we examined the measurements of 550 erosion pins installed at 55 locations throughout the five sub-watersheds of the Shihmen reservoir watershed in northern Taiwan. Then, we used the Mann-Whitney U-test to determine if the erosion pin measurements from different sub-watersheds are statistically different.

Keywords: Shihmen reservoir watershed, erosion pin, Mann-Whitney U-test

SPATIOTEMPORAL DISTRIBUTION OF WILDFIRE IN SOUTHEAST ASIA USING REMOTE SENSING DATA

Shiro Ochi (1)(2), Wataru Takeuchi (3)

[1] Geoinformatics Center, Asian Institute of Technology, PO Box.4 Klong Luang, Pathumthani, 12120, Thailand
[2] Japan Aerospace Exploration Agency, Tokyo, Japan
[3] Institute of Industrial Science, University of Tokyo, Tokyo, Japan
Email: ochi@ait.ac.th; ochi.shiro@jaxa.jp; wataru@iis.u-tokyo.ac.jp

Abstract: Forest fire and slash-and-burn farming are recognized as not only the causes of deforestation and land use change, but also the sources of air pollution and greenhouse gases(GHG). In Southeast Asia, more people are recently concerning about the health issue due to the air pollution and particle matters(PM). Wildfire including forest fire is assumes to be an important source of the pollution, and Remote Sensing is expected to be used for providing the information about the wildfire in regional scale on real-time basis. In this research, the spatial and temporal distribution of hotspots(active fires) was analyzed by using 10 years' data from 2008 to 2017 of MODIS Active Fire Product(MOD 14) . The main part of Southeast Asia was divided into 10 regions, and the frequency of occurrence of hotspots in each region and the characteristics of the fire radiation power(FRP) of hotspots were analyzed to characterize the hotspots in each region. Himawari 8 data was also used to evaluate the power of fire detection by using its high temporal resolution, then the feasibility of real-time basis monitoring is discussed.

Keywords: hostspot, wildfore, MODIS, MOD14, Himawari

BUILDING ENVELOPE HEAT LOSS MAPPING USING INFRARED THERMOGRAPHY

Nursyahidah Fathihah Binti Ishak (1), Siow Wei Jaw (1)(2), Kam Fei Tong (3), Hwai Jiun Ong (3)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia.
[2] Geoscience & Digital Earth Centre (INSTeG), Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia.
[3] Andes Consultant Pte Ltd, 18 Boon Lay Way, #03-122 TradeHub 21, Singapore 609966.
Email: idaishak1212@gmail.com; swjaw@utm.my, tongkf@andesconsultants.com, jerryong@andesconsultants.com

Abstract: Infrared thermography (IRT) is a well-known non-destructive measurement tool for identifying the problems of the building envelope which hardly seen by naked eye. It has been widely used to pinpoint moisture intrusion, particularly leaks within the walls and determine the potential spot for electrical overheating. Therefore, this study aims to locate the heat loss in building envelope (i.e. physical separator between the conditioned and unconditioned environment of a building), including walls, floors, roofs and doors. In doing this, infrared thermal camera was used to scan over the selected buildings. The thermography captured the temperature differences on the walls, slabs and others part of the building envelope. Thereafter, the "hot" spot (i.e. thermal induced-anomalies) of heat loss was identified from the processed thermography. These "hot" spot denoted the areas of heat loss, which might not be noticeable until permanent damage of the building envelope occurs. Results of this study, allows us to assess the performance of the building envelope. This can avoid heat loss from defective building envelope as the unseen heat loss due to defective building envelope will cause increase of utility bill and building operating costs. Apart from that, by locating the areas of heat loss, it can reduce the emission of Greenhouse gas (GHG) in a cost effective manner for combating the threat of climate change. Consequently, thermal survey is crucial in the aspect of building survey. It can monitor and assess the building envelope performance in order to locate the structural defects and rectify them before it gets serious.

Keywords: Infrared thermography, building envelope, heat loss, green building

ENVIRONMENTAL IMPLICATIONS OF WHEAT RESIDUE BURNING: A CASE STUDY OF HARYANA STATE, INDIA

R.S. Hooda, Nidhi Kundu (1), Manoj Yadav Haryana (1)

[1]Space Applications Centre (HARSAC), CCS HAU Campus, Hisar-125004, India
Email: hoodars@yahoo.com; nidhi.ghanghas@gmail.com; manojyadav60@rediffmail.com

Abstract: The menace of crop residue burning in the Indo-Gangatic plains of India, has acquired colossal proportions due to mechanized harvesting, creating environmental emergencies in the northern states of Punjab, Haryana, Uttar Pradesh and Delhi. Satellite data has been put to operational use for monitoring wheat residue burning and studying its implications.Wheat stubble burning areas in the 12 major wheat growing districts of Haryana were studied for 2017 and for all 22 districts for the year 2018 using Resourcesat AWIFS satellite data which provides information at 5 days interval. The area under crop stubble burning in 12 major growing districts for the years 2017 and 2018 was observed as 292.8 and 294.6 thousand ha., respectively, which comes to about 14.6% of wheat area in both the years. Thus there is hardly any change in the area in the two years. The total wheat stubble burning area in all the 22 districts of Haryana mapped for the year 2018, however, was 308.5 thousand ha., which is 12 % of total wheat cropped area in the state. During both the years major wheat stubble burning was observed in Jind, Fatehabad, Kaithal and Karnal districts, moderate in Rohtak, Hisar, Sonipat, Sirsa, Panipat and Kurukshetra districts and very less in rest of the districts of the state. Total biomass burnt each year in each district and potential emission of polluting gases like CO_2, SO_2, NO_x and $PM_{2.5}$ etc. from the burning of this crop biomass is also being computed. Besides, the power generation potential from the burning of such huge amount of crop biomass through biomass based power plants is also being estimated.

Keywords: Crop Burning, Resourcesat, AWiFS, Biomass, Emissions

ANALYZING RELATIONSHIP BETWEEN PARTICULATE MATTER (PM10), FINE PARTICULATE MATTER (PM2.5) AND OZONE (O3) USING CORRELATION

Urvi Shroff (1), Shaily Gandhi(1), Felix Emeka Anyia(2), Vikram Sorathia(3)

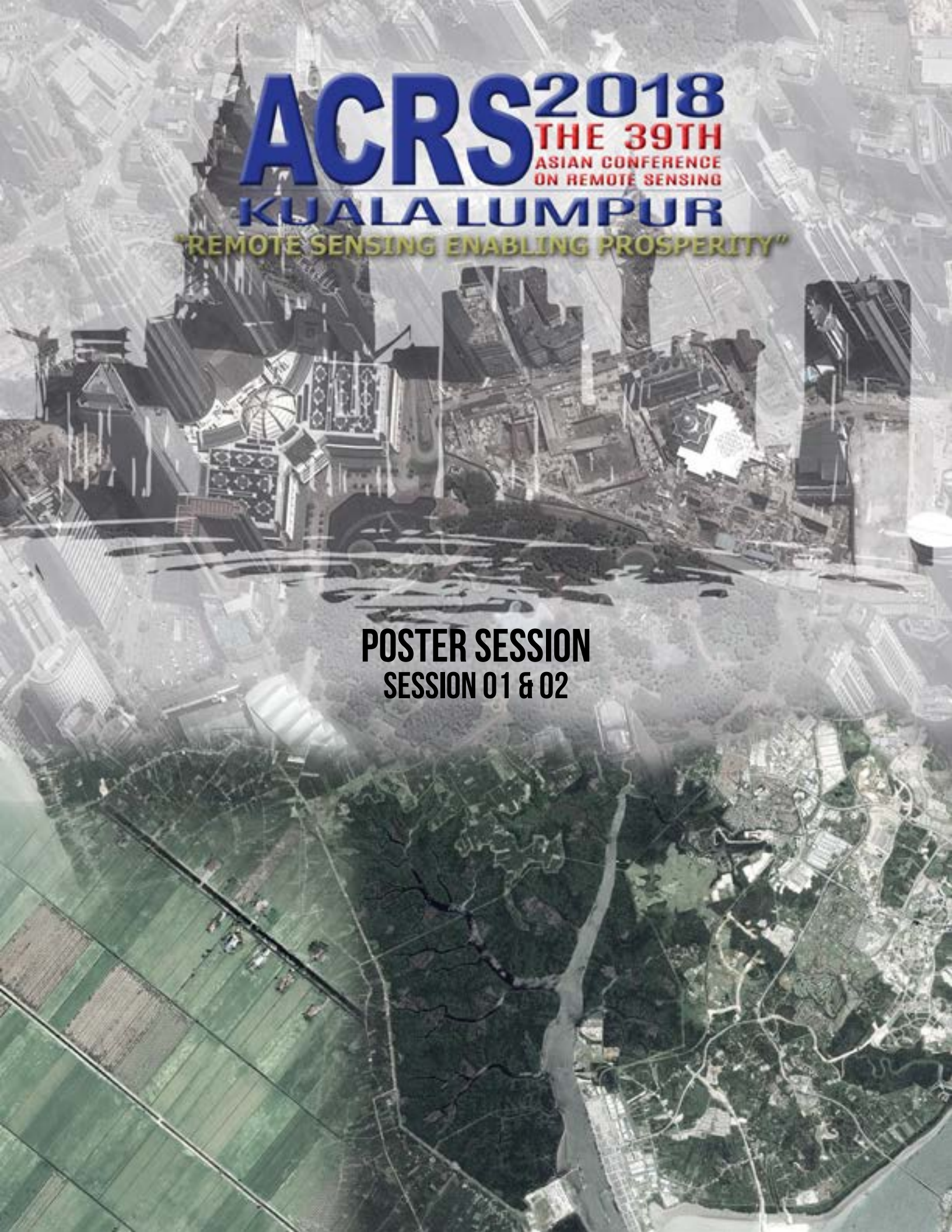
[1]Faculty of Technology, CEPT University, Ahmedabad-380009, Gujarat, India;
[2] Centre for Health and Development (CHD), University of Port Harcourt, Nigeria;
[3] Kemsemble Tech Labs LLP, Gandhinagar, Gujarat, India;
Email: urvi.shroff.mgeo17@cept.ac.in; shaily.gandhi@cept.ac.in; felix.emeka.anyiam@gmail.com; vsorathia@gmail.com

Abstract: The correlation between ozone and particulate matter is essential for air pollution analysis. According to World Health Organization, In 2012, ambient air pollution from particulate matter was responsible for about 3 million deaths. Ozone and particulate matter are amongst top two air pollutants in United States (World Health Organization, 2016). Impact of ozone and fine particulate matter on pollution are projected to be especially significant for densely-populated areas. In a study it has been found that the correlation coefficients between major atmospheric compound pollutants PM2.5 and O3 were respectively 0.40 in hot season (June, July and August) and 0.16 in cold season (December, January and February) with both passing the confidence level of 99%. (Jia et al., 2017). This paper aims to study Pearson correlation using spatial data from 51 States having 276 counties in United States to test a hypothesis: "There is no variation in Ozone due to particulate matter". Analysing data of air quality measurement for 2008 from US Environmental protection Agency, Air Quality System, the correlation coefficient between major atmospheric pollutants:

i. PM2.5 and Ozone resulted in 0. 2976791 [95% CI: 0.294-0.300]; t = 167.55, df = 288730, p-value < 2.2e-16
ii. PM10 and Ozone resulted in 0. 2437678 [95% CI: 0.241-0.246]; t = 178.51, df = 504400, p-value < 2.2e-16 (0.00000000000000022)
iii. PM2.5 and PM10 resulted in 0. 4268498 [95% CI: 0.423-0.430]; t = 228.72, df = 234810, p-value < 2.2e-16.

The result implies that the correlation was statistically significant, indicating that alternative hypothesis is true as correlation is not equal to 0. This study might attempt to establish association between PM2.5 and PM10 using temporal variation from 2008 to 2017 in major urban cities of United States will provide insightful result which can be used for modelling environmental parameters.

Keywords: Ozone, Particulate Matter, Air Pollution, Correlation



POSTER SESSION

SESSION 01 & 02

TRANSITION IN NDVI OF FORCIBLY WITHERING POTTED TREES

Kousuke Hida (1), Mitsuharu Tokunaga (1)

[1] Kanazawa Institute of Technology, Civil and Environmental Engineering,
7-1 Ougigaoka, Nonoichi, Ishikawa 921-8501, Japan
Email: b1444953@planet.kanazawa-it.ac.jp; mtoku@neptune.kanazawa-it.ac.jp

Abstract: In order to judge trees with risk of collapse, we observed and compared healthy potted trees and unhealthy potted trees with near infrared camera. In Japan, the health conditions of trees have been judged by visual diagnosis by experts but it is inefficient. Hence, a system of efficient and make quantitative judgement is urged. Therefore, in this study, even if the phenomenon of potted trees deterioration can't be confirmed by visual we verified whether it can be confirmed by decrease in NDVI. In addition, we verified whether health condition such as withering leaves and discoloration of leaves can be confirmed by comparing visible image and NDVI transition. Two similar potted Conifers were observed with near infrared camera a day. In order to clarify healthy and unhealthy subjects, one subject was forced to deteriorate with two patterns. The first pattern is sprinkling herbicide on the soil. Second, the trunk was scratched and it was applied herbicide. As results, NDVI transition of the first pattern showed a similar trend to healthy subject for several days. After that, leaves of unhealthy subjects withered, discoloration of leaves, NDVI transition tended to gradually decrease. This result showed phenomenon that the object deteriorated by sprinkled herbicide. The NDVI transition of the second pattern tended to decrease, the phenomenon of deterioration can be confirmed. In this study, the phenomenon of deterioration of potted trees could be confirmed by comparing NDVI transition of healthy potted trees and unhealthy trees which was forced to deteriorate. Also, difference in NDVI between healthy and unhealthy subjects could be shown as difference in health condition by comparing NDVI and visually images.

Keywords: NIR, NDVI, withering evaluation of tree

RENEWABLE ENERGY CROP RECOGNITION BASED ON OBJECTED-BASED CLASSIFICATION USING MEMBERSHIP FUNCTION

Maytavee Tuathong (1), Kamolratn Chureesampant (1), Sasikan Yaemyim (1)

[1] Electricity Generating Authority of Thailand, Survey Division, Map and Geographic Information System Department, Photogrametry and Remote Sensing Section, No. 53 Moo 2, Charunsanitwong Road, Bang Krui, 11130, Nonthaburi, Thailand
Email: maytavee.t@egat.co.th; kamolratn.c@egat.co.th; sasikan.y@egat.co.th

Abstract: Recently, the renewable energy trend continues to remarkable progress. The analysis of its potential energy crops is challenge. The remote sensing also provides the opportunity to monitoring such kind of energy crops by classification. However, the pixel-based classification, is based on quantitative pixel intensities on histogram. It cannot fully utilize the spatial information. As object-based classification is attractive approach because it considers more others attributes e.g., shape, size, colour, texture and etc. Therefore, this paper addresses recognition capabilities of LANDSAT 8 Earth-observation satellite in comparison with fuzzy logic membership function (MF) and Nearest Neighbour (NN) algorithms and combination of MF and NN based on object-based classification. LANDSAT 8 satellite is used as input data as it has many effective bands that can distinguish the difference of any land use with support the object-based classification. The recognition results were generated by taking Tham Charoen sub district, So Phisai district, Bueng Kan province in north-eastern Thailand, as the study area. The selected major classes were pará rubber trees, oil palm trees, eucalyptus trees, paddy fields, mixed forests, water bodies, and build up areas. Experiment results reveal that the most suitable recognition is the MF and NN combination because the supplement of an excellent mapping of linear segment for hypersurface model with small amount of data to define in the MF and the robust to noisy training data for the NN. Moreover, the assigned membership function can be applied to other region of interest areas.

Keywords: Renewable Energy Crops, Object Based Classification, Membership Function (MF), Nearest Neighbour (NN)

UTLIZING UNMANNED AERIAL VEHICLE TO IDENTIFY THE RICE LODGING AREA

Li-Chi Wang (1), Re-Yang Lee (1), Tsai-Chin Chao (1), Xin-Zhan Peng (1)
Yu-Kun Zheng (1)

[1] Department of Land Management, Feng-Chia University
NO. 100, Wenhwa Rd., Seatwen, Taichung, 40724 Taiwan (R.O.C.)
Email: lichi92321@gmail.com; rylee@fcu.edu.tw; v45837153@gmail.com; p9603200@gmail.com; a852456cheng@gmail.com

Abstract: Because of frequent natural disasters in Taiwan, farmers often suffer from huge losses. Thus, The Council of Agriculture enacted "Implementation Rules of Agricultural Natural Disaster Relief" in 1990 in order to help the farmers maintain the livelihood. This act will first evaluate the damage to the agriculture and then provide assists: reimbursements, loans with low interest or money assist. However, the government evaluates the damage only by their eyes, without any supporting data. This has been controversial. It not only takes a lot of time, resources and budget but also occurs doubtful accuracy of the damage. As a result of executing inappropriate techniques to measure the damage, the Taiwanese government often has disagreements with the farmers regarding to the reimbursement. This essay targets Yuli Township in Hualian, Taiwan, which suffers from typhoon frequently. The main crop in Yuli, Hualian is rice, the study area we selected is about 500 hectares of rice field. In the beginning, this study uses Unmanned Aerial Vehicle (UAV) to get RGB color images of rice lodging. With these images, we apply Maximum Likelihood (ML) and Random Forest (RF) to identify the lodging. Secondly, we compare classification accuracies by employing two classifiers to find out the better method. Lastly, the higher accuracy will be a reference for the government to evaluate the lodging. This thesis will contribute to decreasing the conflict between farmers and Taiwanese government as well as the expense on the assessment.

Keywords: Rice Lodging, UAV, Random Forest

THE EFFECT OF TEMPERATURE AND RAINFALL VARIATION ON PHENOLOGY AND PRODUCTION OF OIL PALM IN JOHOR

Amirah Audadi Madzen (1)

[1] Social Environmental and Development Sustainability (SEEDS) Research Centre, Faculty of Social Science and Humanities, Universiti Kebangsaan Malaysia, Selangor, Malaysia
Email: amirahaudadimadzen@gmail.com

Abstract: World climate has changed significantly over recent decades and altering earth system. Temperature in Southeast Asia has grown at a rate of 0.14°C to 0.20°C every decade since the 1960s. The IPCC Fifth Assessment Report also projected that global warming and climate change will occur more drastically in the last three decades of the 21st century and temperatures in that region is expected to increase about 1.5°C to 2.0°C in the mid-century (2046-2065). Therefore, the method of tracking and evaluating changes in ecosystems is important in assessing the effects of climate change. Land Surface Phenology (LSP) is a study on plant growth patterns and observed using remote sensing technologies. Variety temporal and spatial resolutions data from remote sensing technologies allow the changes and conditions of vegetation to be studied and monitored in various spatial and time scales. Global climate change is one of the threats to the oil palm industry in Malaysia which plays a major role in the Malaysia's economic development. Therefore, this research is conducted to identify the relationship of climate change on oil palm phenology and productivity in Johor in a period of 11 years (2000 to 2010). Remote sensing data which is Enhanced Vegetation Index (EVI) time series from MODIS-Aqua (product MYD13-Q1), rainfall, temperature and Fresh Fruit Bunch data is use to assess phenological and productivity patterns of oil palm throughout year 2000-2010.

Keywords: *EVI*, Oil Palm, *MODIS*, Production, Vegetation Phenology

LANDSAT 8 SATELLITE DATA-BASED HIGH-RESOLUTION VEGETATION MAPPING IN THE ISLAND OF HOKKAIDO, JAPAN

Ram C. Sharma (1), Hidetake Hirayama (2), Keitarou Hara (1)

[1] Department of Informatics, Tokyo University of Information Sciences, 4-1 Onaridai, Wakaba-ku, Chiba 265-8501, Japan
[2] Graduate School of Tokyo University of Information Sciences, 4-1 Onaridai, Wakaba-ku, Chiba 265-8501, Japan
Email: sharma@rsch.tuis.ac.jp; h17002hh@edu.tuis.ac.jp; hara@rsch.tuis.ac.jp

Abstract: High resolution satellite data are important sources of information for assessing and monitoring of vegetation conditions. This research assesses the potential of image compositing techniques for classification and mapping of vegetation types in the island of Hokkaido, Japan. The island of Hokkaido, Japan's coldest region, is located at the north end of Japanese archipelago. It is one of the most affected region by the effect of global warming in Japan. Compared to the national average of 1.09°C, the average winter temperatures have risen by 1.33°C over the last century. It represents a transitional zone between cool temperate forests, consisting of oaks, ashes, and conifers to the south, and the sub-arctic ecosystems to the north. In the context of global warming, study of distribution and mapping of vegetation is relevant in the region which is dominated by subarctic climate. Different composite images generated from all multi-spectral scenes available from Landsat 8 satellite over the study area in 2017. This research deals with classification of three vegetation types: forests, shrubs, and grasses; and non-vegetation (urban, water, and barren). Ground truth data are prepared with reference to Google Earth imagery. Four machine learning classifiers, k-Nearest Neighbors (KNN), Random Forests (RF), Support Vector Machines (SVM), and Neural Networks (NN), are employed with the support of ground truth data. Confusion matrix, overall accuracy, and kappa coefficient calculated with validation data are used as the metrics for quantitative evaluation. The best performed classifier is employed for the production of vegetation map in the study area. The methodology and the results presented in the research are expected to contribute to vegetation mapping activities in other regions as well.

Keywords: Vegetation, Mapping, Image composites, Landsat 8, Machine learning, Hokkaido

SUSTAINABLE WATER MANAGEMENT FOR ELECTRICAL ENERGY MICROHYDRO IN BANJARNEGARA REGENCY CENTRAL JAVA PROVINCE INDONESIA

Jaka Suryanta (1), Tia Rizka N. Rachma (1), Yatin Suwarno (1), Irmadi Nahib (1), Nursugi (1)

[1] Badan Informasi Geospasial (BIG) Jalan Raya Jakarta – Bogor KM 46 Cibinong Bogor, Indonesia
Email: jakaeriko@gmail.com

Abstract: There are 94 points of licensing of micro hydro power plants (PLTHM) in Banjar Negara district from 100 KW to thousands of KW, both operational and non-operational, excluding larger ones such as those in the Mrica reservoir. This hydroelectricity principle are requires adequate and stable water flow throughout the year and possible altitudes. Water supply depends heavily on land management and its watershed. This study aims to calculate the availability of surface water in several rivers in supporting the potential of micro hydro power energy by taking into account the management of the Upper Serayu basin area. The method used is to calculate the run off of the rainfall input as well as the type of vegetation, slope and soil type. To know the type of vegetation done with satellite imagery observation. From the existing model of Wanatani management, strict supervision is required where a large slope above 40% is not recommended for potato plantations. Meanwhile, the area under it can be processed with the principle of agroforestry that is to blend potato plantations with other perennials.

Keywords: PLTHM, DAS, Wanatani, potatoe

SIMPLE ALGORITHM FOR LAND COVER CLASSIFICATION USING OPTICAL-BIOPHYSICAL RELATIONSHIPS OF VEGETATION SPECTRAL

Yudi Setiawan (1), Kustiyo (2), Lilik Budi Prasetyo (1), Wim Ikbal Nursal (3), Sahid Hudjimartsu (3)

[1] Department of Forest Conservation and Ecotourism, Faculty of Forestry, Kampus IPB Darmaga, Bogor 16680, Indonesia
[2] Deputy for Remote Sensing Affair, Indonesian National Institute of Aeronautics and Space (LAPAN), Pekayon Pasar Rebo, Jakarta, 13710, Indonesia
[3] Forests 2020 International Partnership Programme, Faculty of Forestry, Bogor Agricultural University, Kampus IPB Darmaga, Bogor 16680, Indonesia
Email: setiawan.yudi@apps.ipb.ac.id; kuslapan@yahoo.com; lbprastdp@apps.ipb.ac.id; bangwim@gmail.com; shudjimartsu@gmail.com

Abstract: This study was conducted to find out the usefulness of significant band combinations of Landsat 8 OLI/TIRS, for the discrimination of different land cover types in tropical landscape of Indonesia. Four dates multi-spectral Landsat 8 data during the period from 2015 to 2016 were used. The analysis was carried out using various multivariate statistics and classification approaches. The Jeffries-Matsushita (J-M) Distance Separability Index were used for selection of best bands for land cover discrimination. The analysis showed that, for discrimination of the vegetation in the study area, NIR was found to be the best band, followed by SWIR and Red. The results of classification showed that inclusion of SWIR band increased the overall accuracy and kappa coefficient. The 'Two Band Ratio' index, which incorporated Red, NIR and SWIR bands, showed improved discrimination in the multi-date dataset classification, compared to other SWIR based indices.

Keywords: spectral feature, distance separability index, land cover

SEASONALITY TRENDS OF RUBBER TREE CANOPY OBSERVED BY X-BAND SYNTHETIC APERTURE RADAR

Bambang H. Trisasongko (1)(2), David J. Paull (1), Dyah R. Panuju (1)(2)

[1] School of Physical, Environmental and Mathematical Sciences, UNSW Canberra, Northcott Drive, Campbell ACT 2600, Australia
[2] Department of Soil Science and Land Resources, Bogor Agricultural University, Jalan Meranti, Bogor 16680, Indonesia
Email: trisasongko@apps.ipb.ac.id

Abstract: Understanding seasonality is critical for many remote sensing applications since the role of local weather events associated with particular seasons may impact information retrieval. Unfortunately, the issue has been inadequately assessed; hence, various outcomes could be expected when a single date of observation is employed for a specific task. This article considers seasonal discrepancies in SAR data backscatters returned by different ages of rubber trees. We selected Jalupang rubber plantation situated in Subang, Indonesia to illustrate the problem using dense multi-temporal Cosmo/SkyMed X-band SAR data. Large variation occurs amongst young trees of 1–4 years age indicating a strong contribution of non-tree scatterers. Mature stands < 20 years act as stable scattering objects, which could serve as a potential natural entity for SAR calibration. Backscatter from old growth > 25 years appears less stable, perhaps due to increasing canopy gaps. Extreme variation due to season was observed in young trees, with the discrepancy being about 4 db in HH polarization between observations in wet and dry seasons. The ambiguity tends to be lower for maturing trees (6–20 years) to ca. 1.5 db. The research suggests that variations due to associated seasonal events could be significant in X-band, which is an important issue for long-term monitoring of tropical woodlands.

Keywords: canopy, Cosmo/SkyMed, rubber plantation, seasonality, X-band

EARTHQUAKE-INDUCED BUILDING DAMAGE ASSESSMENT BASED ON SAR CORRELATION AND TEXTURE

Gong Lixia (1), Wu Fan (2), Li Qiang (1), Zhang Jingfa (1)

[1] Institute of Crustal Dynamics, China Earthquake Administration,
No. 7, Anningzhuang Road, Haidian District, Beijing, 100085 China
[2] Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, No. 9, Dengzhuangnan Road, Haidian District, Beijing, 100094 China
Email: xiaolongzhu1900@hotmail.com; wufan@radi.ac.cn; liqiang08@163.com; zhangjingfa@hotmail.com

Abstract: SAR remote sensing has shown its excellence in providing important information for damage mapping in a large area. SAR change detection is a fast and efficient way to identify damaged buildings by comparing post-seismic to pre-seismic images. When a building collapses after an earthquake, the corresponding SAR signal could be stronger or weaker. So it is hard to decide whether a target is damaged by simple intensity difference or ratio. In this paper SAR correlation and texture are combined to explore the function between building damage degree and SAR intensity change. ENVISAT ASAR dataset of Dujiangyan City in Wenchuan Earthquake are selected as training data. Field survey after the shock recorded structure and damage information of 10254 buildings in this area. All the buildings are classified into 3 classes by damage degree, intact, moderately damaged and damaged. According to the results of field survey, 1113 building samples are evenly selected to calculate the function which discriminate the building damage degree on the basis of SAR correlation and intensity difference. Buildings are classified by the function and the accuracy is about 70%. A discrimination model is proposed by using texture features of SAR. Second-moment texture parameters which can characterize earthquake damage are selected to calculate correlation and feature difference, and a discrimination function is constructed using the above samples. The building damage recognition accuracy is improved from 70% to 79%, which can effectively meet the needs of earthquake damage evaluation in earthquake emergency period. ALOS PALSAR dataset of the same test area are processed to validate the method and to analyze the effect of working band on the accuracy. It turns out that SAR discrimination effect of L-band is similar to that of C-band, and that L-band is more efficient in identifying moderately damaged buildings.

Keywords: Earthquake Building Damage SAR Texture

BI-TEMPORAL ANALYSIS OF VEGETATIVE COVER USING ALOS PALSAR: HALIMUN SALAK NATIONAL PARK, INDONESIA

Dyah R. Panuju (1)(2), David J. Paull (1), Bambang H. Trisasongko (1)(2)

[1] School of Physical, Environmental and Mathematical Sciences, UNSW Canberra, Northcott Dr, Campbell ACT 2612, Australia
[2] Department of Soil Science and Land Resource, Bogor Agricultural University, Jalan Meranti, Kampus IPB Darmaga, Bogor, 16680, Indonesia
Email: panuju@apps.ipb.ac.id

Abstract: The implementation of bi-temporal change analysis using optical and microwave datasets has assisted management of rural and urban land use, including forest areas. Forests in tropical regions such as Indonesia are often situated in mountainous terrain and their monitoring needs to cope with persistent cloud cover. This research applied an iteratively reweighted multivariate alteration detection (IRMAD) and post-classification change analysis on a pair of dual polarimetric ALOS PALSAR datasets to detect vegetation dynamics in the vicinity of Taman Nasional Gunung Halimun Salak for the years 2007 and 2010. Employing Gamma Map filtering for the second MAD variate, the dual polarimetric data of the pair was able to detect changes due to maturing oil palm plantations as well as land clearing and replanting rubber at the site. The result indicated successful detection of typical dynamic change of vegetated areas like maturing vegetation or temporary clearing as well as discrimination of vegetated and non-vegetated areas. By comparing combinations of the datasets, it appears that data injection may improve the capability of IRMAD to detect change. The accuracy of classification may also be improved by additional synthetic data. When examining four pixel-based classifiers for pre-change detection, a gradient boosting tree of datasets injected with texture components yielded the highest accuracy at 71%.

Keywords: ALOS PALSAR, change detection, Halimun Salak, IRMAD, post classification

SOIL HYPERTROPHICATION OF MUNG BEAN MORPHOLOGY USING RGB ANALYSIS AND CANNY EDGE DETECTION

Jennifer Dela Cruz (1), Jessie R. Balbin (1), Julius T. Sese (1), Ivan Jason A. Inmenzo (1), Jean Rene D. Kalaw (1), Ryann David C. Paglinawan (1), Ian Gabriel W. Sumague (1)

[1] School of Electrical Electronics and Computer Engineering, Mapua University, Murall St. Intramuros Manila, Philippines
Email: jcdelacruz@mapua.edu.ph

Abstract: The study utilized image processing in assessing the effects of soil hypertrophication on Mung Bean Plants. Canny Edge detection and RGB analysis were used in analyzing the morphology of the plant. Rapitest Soil Test Kit was conducted to determine the nutrient levels, specifically, the Nitrogen Phosphorous and Potassium (NPK) levels present in the soil. The study shows that NPK Hypertrophication results in smaller morphology and slower growth as compared to the recommended set-up. Nutrients were varied to assess the effects of specific nutrients on the plant morphology. With the results, other studies will be able to make use of the data and find ways to improve the situation in the plantations and farmlands. The study will also be useful for agriculture students who wish to conduct research regarding plant morphology.

Keywords: hypertrophication, plant morphology, Mung Bean, RGB analysis, Canny Edge

THE RICE FIELDS ANALYSIS BY THE SEASONAL VARIATION TENDENCY

Seiji Ito (1), Yoshinari Oguro (1), Tomohisa Konishi (1), Jukkrit Mahujchariyawong (2)

[1] Department of Global Environment Studies, Faculty of Environmental Studies, Hiroshima Institute of Technology, 2-1-1 Miyake, Saeki-ku, Hiroshima, Hiroshima, 731-5193, Japan
[2] Forestry Department of Environmental Technology and Management, Faculty of Environment, Kasetsart University, P.O. 1072 Kasetsart, Chatuchak, Bangkok 10903, Thailand
Email: seiji@cc.it-hiroshima.ac.jp; y.oguro.yx@it-hiroshima.ac.jp; t.konishi.vd@it-hiroshima.ac.jp; mjukkrit@hotmail.com

Abstract: In order to estimate the yield quantity of rice or to manage water resources at Thailand, it is necessary to know not only the rice field area but also the number of harvest times in each rice fields. The aim of this study is to obtain the number of rice crop times per a year from the Sentinel-2/MSI data. The study area is around the Chao Phraya river in the north area of Bangkok, Thailand. At first, we have obtained the Sentinel-2/MSI data set for a year and divided the data set into the several seasons. In the next, Normalized Difference Vegetation Index (NDVI) have been obtained by the MSI images, NDVI data without cloud has been obtained by the seasonal data set. We have estimated the number of harvests by counting where the NDVI suddenly changes from the seasonal data set of one year. At the same time, if the NDVI has not changed throughout the year or NDVI has tended to be low, it has been excluded from the target for being regarded as another area (trees, building, and so on).

Keywords: Rice field, NDVI, Sentinel-2/MSI

RETRIEVING NITROGEN CONCENTRATION WITH HYPERSPECTRAL DATA AND LONG SHORT-TERM MEMORY MODEL

Senlin Tang (1)(2), Xia Zhang (1), Mao Zhang (1)(2), Wenchao Qi (1)(2)

[1] Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, 100101, China
[2] University of Chinese Academy of Sciences, Beijing, 100049, China
Email: tangsl2016@radi.ac.cn; zhangxia@radi.ac.cn; zhangmao@radi.ac.cn; qiwc@radi.ac.cn

Abstract: Nitrogen is one of the key nutrient elements in growth of crops. Quantitative retrieval of nitrogen by hyperspectral remote sensing data provides technical guidance for irrigation and fertilizer management of crops, and is of great significance to China's digital agriculture strategy. In this paper, nitrogen retrieval experiments were carried out by a deep learning model of long short-term memory (LSTM), and the partial least squares regression (PLSR) and support vector machine (SVM) algorithms were also conducted to make comparative analysis. The 248 samples of canopy spectra and corresponding leaf nitrogen contents, covering the whole growth period of winter wheat and under different coverage levels, were collected and used to validate the algorithms. The samples were allocated to calibration and validation data sets according to Nitrogen concentration values. Three groups of spectral features were extracted by successive projections algorithm from original and transform spectra, spectral position selection and vegetation indices. The correlation coefficient of each feature group was calculated to select the optimal features. Then the unoptimized and optimized spectral features were fed respectively into LSTM model to retrieve nitrogen concentration. Based on the optimized features, the R^2 and RPD were improved from 0.7077 and 1.6776 to 0.8927 and 3.2598 by LSTM model. The R2 and RPD were 0.8475 and 2.7887 for PLSR, and 0.7903 and 2.6253 for SVM. The retrieval accuracy of Nitrogen concentration using feature optimized LSTM algorithm was superior to those of PLSR and SVM algorithms. The results demonstrate that LSTM model is able to retrieve nitrogen concentration of winter wheat effectively and has the potential to predict biophysical and biochemical parameters of other crops.

Keywords: nitrogen retrieval, winter wheat, feature selection, hyperspectral remote sensing long-short term memory model

WATER PRODUCTIVITY ASSESSMENT USING REMOTELY SENSED DATA FOR WHEAT IN THE JIROFT PALAIN, IRAN

Saeid Hamzeh (1), Seyed Karim Afsharipour (1), Seyed Kazem Alavipanah (1), Ismail Moghbeli Damaneh (2)

[1] Department of Remote Sensing and GIS, Faculty of Geography, University of Tehran, P.O. Box 14155-6465 Tehran, Iran
[2] Agricultural engineering research department, South Kerman Agricultural and Natural Resources, Kerman, Iran
Email: saeid.hamzeh@ut.ac.ir

Abstract: In recent years, climate change and rising global water demand as a result of population growth has caused water scarcity. In this regard, calculation of agricultural water productivity in order to optimize the management of water resources and reduce the water consumption to sustain and improve food security for the coming generations is essential. Due to the limited availability of field data, spatial and temporal quantification of water productivity is very time and cost consuming, especially at regional scale. In this context remotely sensed satellite data are a valuable and promising source of information for quantify the water productivity. The main goal of this paper is to estimation and assessment of wheat water productivity in the Jiroft plain watershed located in south of Iran. For this purpose Landsat 8 satellite imagery and the WATPRO model were used for direct estimation of water productivity during the growing season of wheat in the study area. The deployment peak, cultivation and harvesting time for six divided field were determined by using the time series of Normalized Deference Vegetation Index (NDVI) extracted from satellite imagery. Then wheat water productivity was calculated and the results were evaluated with ground control points. The results shows that the highest and lowest water productivity for wheat in this area is 0.4 and 0.8 kg m^{-3}, respectively and the average of water productivity in the study area was estimated around 0.5 kg m^{-3}. It was found that the type of irrigation system (drip, sprinkler and surface systems) and different amount of salinity of irrigation water are important factors affection on water productivity. Assessing the accuracy of the WATPRO model with the measured water productivity at field show that this model perform well for estimation and mapping water productivity with an RMSE and correlation coefficient of 0.16 kg m-3 and 85% respectively. Also the correlation coefficient of 76.5% was found between average NDVI and water productivity in this area. This research shows the operational ability and power of satellite based observation for estimating water productivity and water resource management.

Keywords: Water productivity, Evapotranspiration, Crop Yield, Remote Sensing

TREETOP DETECTION FROM LIDAR DATA USING LOCAL MAXIMA ALGORITHM

Lindah Roziani Jamru (1), Mazlan Hashim (1), Mui How Phua (2)

[1] Geosciences & Digital Earth Centre (INSTeG), Research Institute of Sustainable Environment
Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
[2] Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS 88400
Kota Kinabalu, Sabah, Malaysia
Email: lroziani2@liveutm.my

Abstract: Light Detection and Ranging (LiDAR) sensing produce three dimensional of point cloud that can generate Canopy Height Model (CHM) precisely. This sensor capable to extract the vertical biophysical of forest structure at different level of spatial resolution. For the tree counting, CHM has been used for tree top detection. This work infrequently published for the tropical forest because of the complexity of the forest becomes an obstacle for structural analysis. In this study, we applied local maxima algorithm with 16 combination of CHM filters (mean, median and Gaussian) and window size (3x3, 5x5, 7x7 and 9x9) for treetop detection. The results reveal the best combination between filters and window size for treetops detection were; (a) -9.79 (7x7; mean and 258 trees), (b) 57.69% (9x9; Gaussian and 451 trees) and (c) 63.98% (9x9; mean and 469 trees).

Keywords: Forest structure, LiDAR, Tropical forest, Treetop detection

MAPPING LAND DEGRADATION IN NUWARA ELIYA DISTRICT USING MULTI-TEMPORAL SATELLITE IMAGES AND SPECTRAL MIXTURE ANALYSIS METHOD

C.M.Weththasinghe Arachchige (1), G.S.N. Perera (1)

[1] Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, 70140, Sri Lanka.
Email: chathumal93@gmail.com; sanka@geo.sab.ac.lk

Abstract: One of the major problem facing Asia as well as Sri Lanka is the threat of land degradation due to climatic factors and human influences. The process of land degradation in Sri Lanka has increased rapidly specially in districts like Nuwara Eliya. Taking advantages of the hyperspectral imagery and developing methods such as spectral mixture analysis (SMA) are recently much recommended methods for vegetation studies in arid, semiarid as well as tropical lands. Three cloud free Landsat TM, ETM+ and OLI-TIRS scenes covering Nuwara Eliya district were selected for the study. Imageries were acquired in dry season in the study area (January and February) in years 2001, 2007 and 2016, respectively. The three imageries were radiometrically and atmospherically calibrated and then converted from digital number (DN) into at-satellite reflectance. Flash atmospheric correction was used for this process. Shade, green vegetation, and soil were the three endmembers selected for the analysis. A linear mixture model (LMM) was adopted using the endmembers derived from the image. Principle component analysis (PCA) was applied to identify the dimensionality of the data and to derive three pure endmembers Fraction images of endmembers and RMS error for each fraction image were obtained. Change detection of the vegetation and soil fraction images were used to identify the areas with changes of soil and vegetation in order to classify areas as regrowing and degraded areas. It was done by the visual interpretation and secondly change vector analysis (CVA) was applied to determine and analyse land cover change map and evaluate the degradation process in the study area. The CVA result shows that there is 500.98 km^2 area under regrowing class and 110.27 km^2 area under degraded class in the period of 2001 to 2007. In the period of 2007 to 2016 there is 153.82 km^2 area under regrowing class and 343.80 km^2 area under degraded class and clearly shows the degradation process undergoing in the study area.

Keywords: Remote Sensing, SMA, Land Degradation

HIGH TEMPORAL RESOLUTION OF SENTINEL-1A DATA FOR PADDY FIELD IDENTIFICATION BASED ON CHANGE DETECTION METHOD

Agustan (1), Swasetyo Yulianto (1), Anisah (1), Budi Heru Santosa (1)

[1] Center for Regional Resources Development (PTPSW), Agency for the Assessment and Application of Technology (BPPT), Jalan M.H. Thamrin No. 8, Jakarta, Indonesia
Email: agustan@bppt.go.id

Abstract: Sentinel satellite imagery with radar sensors for one particular area with the same orbit can be compared every 6 days and freely available to be downloaded. This advantage can be exploited to identify land cover changes in a region regularly. Paddy is fast-growing crop with approximately 120 days life cycles. Hence, paddy growth stage can be monitored with this radar sentinel satellite. In addition, radar satellite is also cloud free and therefore it is suitable for tropical region such as Indonesia. This paper describes a study of paddy field identification based on the change detection method of paddy growth stage. Sentinel-1A images for Indramayu region in West Java from January 2018 to July 2018 are downloaded and processed using SNAP software. It is found that there are certain regions that show rapid changes over this time period including inundated, growing and harvested stages. That rapid changes area can be indicated as paddy fields. In addition, by validating the images with regular field observations every month from Area Frame Sampling campaign, it is found that the accuracy of paddy field identification is around 95%. By examining the relationship of backscatter value of the images to a complete paddy growth stage, it is found that the VH polarization gives a narrower range compare to VV polarization. The backscatter range for land preparation is approximately 0.073 to 0.0389, for early vegetative is approximately 0.0030 to 0.0114, for late vegetative is approximately 0.0113 to 0.0245, generative is approximately 0.0160 to 0.0337; and for harvesting is approximately 0.0096 to 0.0377 respectively.

Keywords: Change Detection, Sentinel-1A, Image Classification, Paddy Growth Stage

INVESTIGATING THE POSSIBILITY OF MONITORING THE RECOVERY OF TSUNAMI DAMAGED PADDY FIELDS USING MODIS 16 DAYS COMPOSED NDVI

Ryota Uemachi (1), Kazuhiro Naoki (1), Kohei Cho (1)

[1] Tokai University, 4-1-1 Kitakaname Hiratsuka, Kanagawa 259-1292, Japan
Email: kohei.cho@tokai-u.jp

Abstract: On March 11, 2011, Tohoku Area of Japan was seriously damaged by the Japan Earthquake. At that time, a large-scale tsunami associated with the earthquake hit the large area along the coast of Tohoku Area including many paddy fields. In this study, the authors have investigated the possibility of using MODIS 16 days composed NDVI for monitoring the recovery condition of the tsunami damaged paddy fields. The authors have selected a number of test sites for normal paddy fields, inundated inshore paddy fields, and inundated inland paddy fields. Usually, the NDVI of typical paddy field gradually increase from May to August and suddenly decreases in September to October due to harvesting. As for the year 2011, the NDVI of the inundated paddy fields in March by the tsunami did not increase much even in the summer time. However, in inundated inland paddy fields which were suffered by the tsunami in 2011, the NDVI variability became almost the same as that of normal paddy field in 2012.This means, that those inland paddy fields were recovered within one year. On the other hand, the inundated inshore paddy fields did not show such clear recovery. The results well matched with the paddy recovery report provided from the local government. However, in some areas, the 16 days composed NDVI showed abnormally low values mainly due to clouds. These abnormal data makes it difficult to identify the recovery condition of the paddy fields. The authors have identified the appropriate threshold level of NDVI for identifying the abnormal NDVI and interpolate the value with the NDVI of before and after the event.

Keywords: Disaster, Great East Japan Earthquake, Tohoku, Aqua, Terra

HOW THE STRONGEST LA-NINA AFFECTED THE EQUATORIAL TROPICS? GLOBAL ANALYSIS IN 2010 WITH TRMM SATELLITE

Muhamad Afifi Md Yatim (1), Nur Fathiera Mansor (1), Aina Afifah bt. Mohd Yusof (1), Mohd. Nadzri Mohd. Reba (1)(2), Mohd. Rizaludin Mahmud (1)(2)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
[2] Geoscience & Digital Earth Centre (InsTeG), Faculty of Geoinformation & Real Estate, Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
Email: afie0913@gmail.com; firamansor888@gmail.com; ainayusof@gmail.com; rizaludin@utm.my; nadzri@utm.my

Abstract: This study analyzed the rainfall pattern changes in humid tropics at 3-hourly scale during the strongest La-Nina event ever using Tropical Rainfall Measuring Mission (TRMM) satellite. At present the evidences had showed that the rainfall are changing and increasing in general in the tropics. However, specific characteristics of change including rate, quantity, and pattern was less elaborated. This parameters are critical to us in understand the changes, the cause, and most importantly figure out an appropriate method to adapt for the future scenarios. To anticipate the aforementioned issue, we had initiated the analysis to determine; 1) the trend of rainfall changes (events, quantity and spatial size) and 2) the rate of rainfall changes. The number of different rainfall events are determined to inform us the trend of impact of the La-Nina. On the other hand, the changes of rainfall quantity and spatial size primarily the increment cases would provide us with quantitative information how much the changes had occurred in specific areas and how large is the extent; whether it is a synoptic scale event or it was the aftermath effect at microscale. Finally, the rate of rainfall changes informed us how quick is the changes happen. The output from all the analyses will be used to classify types of impact that experienced by different parts of humid tropics; the most affected region by this La-Nina event.

Keywords: Climate Change, Big Geodata, Space Precipitation, GIS based analysis, Anomalies

CHANGES OF RAINFALL ZONE IN MALAYSIAN METROPOLITAN: SATELLITE REVEALED THE EMERGING INFLUENCED OF NIGHT TIME URBAN HEAT ISLAND & OROGRAPHY

Abd. Ramlizauyahhuddin Mahli (1), Fatin Haziqah Jumaat (1), M. Nadzri M. Reba (1), Jaw Siow Wei (1), Mazlan Hashim (1)

[1] Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
Email: ramli.mahli@gmail.com

Abstract: This study analyzed the changes of annual rainfall climate zone in Malaysian metropolitan region, the Klang Valley and its surrounding areas for 35 years (1980-2015) and investigated the plausible driving factors using satellite data. The annual rainfall climate zone analysis was conducted at microscale (0.01 deg., @ ~2km) resolution using 385 rain gauge network across the metropolitan region. Four satellite variables referred as explanatory factors; daytime and night time temperature, both from Moderate Resolution Imaging Spectrometer (MODIS) satellite data, elevation data from newly released 30-meter resolution of Shuttle Imaging Radar Topography (SRTM), and built up areas from Landsat multi temporal images were used. The results showed two prominent changes; first was the annual rainfall reduction in the intense urbanized region and second is the increased rainfall in the higher elevated areas. The remaining rainfall zones were unchanged. Correlation between the annual rainfall and elevation showed an increasing relationship with 1998-2015 dataset compared with 1980-1997 dataset. Analysis with the surface temperature, a variable that associated with the urban heat island showed that the night time condition had higher influenced to the spatial rainfall distribution pattern. We hypothesized that the changes of the rainfall zones were largely contributed by local effects from urbanization. The shorter min-max daily temperature and increased aerosols signified the condition of very active convective heating, evaporation and evapotranspiration which contributes to more clouds being formed. This mechanism however was not applicable in the intense urbanized areas where the evapotranspiration was decreasing due to the removal of vegetation. The clouds were then lifted adiabatically due to the increase elevation. Because those higher elevated areas were covered by vegetation (forest, crops, etc.) and relatively having lower surface temperature, the dew point were lower and easily achieved; constitutes to frequent rainfall. This study showed that in the long term, the deforestation and vegetation removal may lead to climate change at micro-scale level; which is a hotter and drier environment for urban areas and wetter forest.

Keywords: Climate Change, Urbanization, Tropics

CLIMATOLOGICAL ANALYSIS OF VARIATIONS IN THERMAL COMFORT AND UHI OVER THE PUNE METROPOLITAN REGION

Vinayak B. (1), Shirishkumar Gedam (1)

[1] CSRE, Indian Institute of Technology- Bombay, Powai, Mumbai 400076
Email: vinayakbhanage@iitb.ac.in; shirish@iitb.ac.in

Abstract: This study investigates the seasonal and diurnal variation of Urban Heat Island (UHI) over Pune Metropolitan Region (PMR) of Maharashtra, India. The measurements of Land Surface Temperature (LST) were derived from the day and night time datasets available from MODIS satellite for the period of 2006-2016. This eleven years data were processed and climatological averaged LST data were obtained for the seasonal and diurnal scale. The method of fringe analysis was used to estimate the phenomenon of Urban Heat Island (UHI). The large variations in the seasonal and diurnal pattern of UHI have been observed over PMR. To assess the impact of UHI on the quality of urban life, Urban Thermal Field Variance Index (UTFVI) is calculated on a diurnal and seasonal scale. Our analysis shows that during the daytime of the summer season densely populated southern part of the region shows the strongest UHI (3.10°c) while in the night northeastern part of the PMR experiences the higher magnitude of UHI (5.81°c). In a winter spell, extremely small variation is noticed on a diurnal scale, whereas in general, it shows the highest intensity of UHI over Northeastern parts of the PMR. An analysis of UTFVI emphasizes that 80% of the area of PMR has good to excellent conditions for urban living on both seasonal and diurnal scale. The combined analysis of UTFVI and UHI explains that in most of the part of PMR have suitable urban living conditions but an intensity of UHI is ranging from -3.73°c to 5.81°c which indicates the necessity to apply area wise proper mitigation strategies in order to reduce the intracity effect of the UHI.

Keywords: MODIS, Seasonal and Diurnal Variation, Urban Heat Island, Urban Thermal Field Variance Index

FIRE ACTIVITY AND SMOKE POLLUTION IN INDONESIA UNDER THE INFLUENCE OF DROUGHT INDUCED BY 2015 EL-NIÑO EPISODE

Radyan Putra Pradana (1), Tomonori Sato (2)

[1] Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG).
Jl. Angkasa I No. 2, Kemayoran, Jakarta 10720, Indonesia.
[2] Faculty of Environmental Earth Science, Hokkaido University. Kita 10 Nishi 5,
Sapporo 060-0810, Japan
Email: radyan.putrapradana@bmkg.go.id; t_sato@ees.hokudai.ac.jp

Abstract: During the 2015 dry season, there were massive forest fire events in Indonesia associated with the extremely dry condition due to the El-Niño event. Therefore, the synthetic study of fire events has collected global attention in recent years, especially after 1997/1998 El-Niño event brought considerable environmental and economic damages. This study aims to evaluate the impact of the latest strong El-Niño episode in 2015 in comparison to past events to understand the drought and fire conditions under which they occurred. For this purpose, a long-term reanalysis dataset, MERRA2, provided by NASA was utilized to examine the relationship between aerosol optical depth (AOD) and meteorological parameters during 1980-2015. This study also used the Global Fire Emission Dataset version 4.1 (GFED4s) to examine the biomass burning carbon emissions during 1997-2015. The fire and smoke pollution in 2015 had occurred repeatedly in southern Sumatra and south-central Kalimantan and the most severe drought and forest fires during 2015 occurred in September and October. The results indicate that fire activity in Sumatra and Kalimantan can be realistically predicted by ENSO indices. The difference in fire environments between Sumatra and Kalimantan may be partly attributed to different patterns of human activity and government policy. This study analyzed the drought as the preconditioning of the fire occurrence. Further studies will be needed to clarify the contribution of local human activity as a trigger of fires.

Keywords: El-Niño 2015, forest fire, biomass burning emission, aerosol optical depth

TIME-SERIES ANALYSIS OF ASIAN ELEPHANT HABITAT CHANGE AND IMPACT ON ITS POPULATION DYNAMIC AT REGIONAL SCALE

Nuntikorn Kitratporn (1), Wataru Takeuchi (1)

[1] Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo, 153-8505, Japan
Email: tita@iis.u-tokyo.ac.jp

Abstract: Asian elephant (Elephas Maximus) is not only ingrained in South and Southeast Asia culture, but also environmentally important as a keystone and umbrella species. Nevertheless, its overall population has continued to decline and spatially restrained which resulted in the species being designated as endangered since 1980s. Despite the overall population reduction, the census at country-level showed an increasing trend in some countries, such as in Sri Lanka and India. However, temporal and cross-countries research on elements impacting population dynamic remain limited. This study is aimed at identifying land cover and landscape changes and their relationship to Asian elephant population dynamic across all 13 range states over 1990, 2003, and 2015. The study area is based on confirmed home range of wild Asian elephants from International Union for Conservation of Nature (IUCN). We identified candidate factors potentially impact Asian elephant population which included food and refuge (forest, shrub, grassland, agriculture), physical landscape fragmentation (Patch Density and Largest Patch Index), landscape heterogeneity (Shannon Diversity Index) and human settlement. Integrating of satellite remote sensing and GIS data, we investigated the change of candidate drivers and applied logistic regression to the country-level population data available at each epoch. We identified that forest and largest patch of forest is crucial for large elephant population but should not be singlehandedly used to predict population change. Additionally, we also observed that large elephant population is likely occurs where there are high human presence and activities. This reflects the potential conflict between elephants and human. Through mapping the spatial changes and identifying drivers of Asian elephant population, our study is expected to help regional conservation to understand and incorporate the situation and needs of endangered elephants.

Keywords: Asian Elephant, Conservation, Landscape Metrices, Land Cover Change

RESTORATION INFORMATION EXTRACTION FROM THANGKA PAINTING USING HYPERSPECTRAL IMAGING TECHNOLOGY

Cen Yi (1), Sun Xue-jian (1)

[1] Institute of Remote Sensing and Digital Earth, CAS, Beijing 100101, China
Email: cenyi@radi.ac.cn; sunxj@radi.ac.cn

Abstract: Thangka is a unique art form of painting in Tibetan culture, which has important historical, artistic and cultural value. Imaging spectrometer technologies can obtain large-scale image and reflectance at the same time, which is one of the newest non-destructive testing and analysis techniques of cultural relics which are currently safest and not easily to be affected by detection objects and detection environment. However, due to the lack of hardware devices and the difficulties of faint information extraction, the studies of the restoration information extraction of Thangka using spectral techniques are limited. For this reason, hyperspectral images of Thangka were obtained, the spectral feature mechanism of pigments was thoroughly studied, and post-restoration information of Thangka was extracted using spectral matching algorithms in this study. The result shows that the extraction accuracy of the restoration area is 85.6%. This study shows that hyperspectral remote sensing technology can be used in the restoration information extraction and identification of Thangka, and has a broad application prospect in the field of cultural relics identification.

Keywords: Hyperspectral Remote Sensing, Thangka, Non-Destructive, Restoration

ANALYSIS OF MENTAL IMPACT BY DISASTERS USING TWEET DATA

Min Song Seo (1), Hwan Hee Yoo (1)

[1] Gyeongsang National University, Department of Urban Engineering, Gyeongsang National University, Building 406, Office 310, 501 Jinju-daero Jinju Gyeongsangnam-do 660-701, South Korea, 52828.
Email: alsthd7938@gmail.com; hhyoo@gnu.ac.kr

Abstract: Recently, in Korea, the frequency of different disasters has increased, which has also raised the concern about the mental health problems that each citizen will have. Therefore, in this study, we analyzed previous disasters occurred in the Republic of Korea, that produced a big shock and fear to the citizen and became an issue, “Do not ask crime" like a social disaster and "Gyeongju earthquake" as a natural disaster incident. We used two methods; first, by tweet data focused on disasters we analyze the mental impact due to this issue. Second, we assess surveys and questionnaires. The results of both methods were compared and analyzed too. Besides, in order to analyze the degree of impact of the indirect trauma caused by the disaster, three types of scales were evaluated. The survey was conducted using the Likert scale method, and the tweet data were quantified by levels of emotion by applying the text clustering and opinion mining analysis techniques to the mental impacts of the citizens. For comparison and analysis of the survey and tweet data, the emotion analysis was conducted by classifying the tweet data that includes the keywords of each question in the survey. As a result, the scale of the impact level using the questionnaire and tweet data was the same. The analysis method using the tweet data can overcome limitations of the topics and periods of the survey, and confirm that it is an effective method to obtain the same analysis results as the survey. The results of this study are expected to be used as an advantageous tool to identify and manage the degree of impact on the trauma experience of the citizens due to the disasters.

Keywords: Disasters, Tweet Data, Indirect Trauma, Survey, Opinion Mining

SIMULATION OF FLOOD DISASTER RISK FOR PREVENTION ACTIVITIES IN URBAN AREAS

Ever Enrique Castillo Osorio (1), Hwan Hee Yoo (1)

[1] Gyeongsang National University, Department of Urban Engineering, Gyeongsang National University, Building 406, Office 310, 501 Jinju-daero Jinju Gyeongsangnam-do 660-701, 52828, South Korea.
Email: ever.castillo.osorio@gmail.com; hhyoo@gnu.ac.kr

Abstract: In recent years the number of natural disasters has increased due to flooding in urban areas around the world. For this reason, in order to conduct risk prevention activities, it is necessary to know in advance the levels of vulnerability in urban areas exposed to floods. Geographic data are valuable to improve these activities, because they show the spatial location of the elements in the vulnerable area. In the same way, hydrological modelling provides a simulation with different degrees of probability of the occurrence of flood events and their location in the vulnerable areas. In order to achieve the improvement of the prevention activities, we propose a methodology for the hydrological simulation of flood disasters scenarios using HecRAS tool. In this methodology we define the geometrical and topological conditions of the cartographic data, use Gumbel's distribution method for the processing of hydrological data, and develop the simulation of flood disasters using geomorphological and fluid mechanics parameters of the rivers. The results of the hydrological simulation are stored in a geodatabase designed by us, using standards and protocols based on open source, which allows their collection, processing and dissemination. We apply the proposed methodology to a case study and develop the hydrological modelling of floods for three simulation scenarios, to calculate the vulnerable flooding urban areas as part of the prevention activities in Chaclacayo district located in Peru.

Keywords: Hydrological Modelling, Flood Simulation, Disaster Risk Prevention, Spatial Database, Urban Vulnerability

ASSESSMENT OF DROUGHT IMPACTS BY MEASURING DIFFERENT REMOTE SENSING INDICES: A CASE STUDY IN DAEGU, S. KOREA

Yun-Jae Choung (1), Seung-Hyeon Lee (1), Hyun-Ji Jo (1), Hyeon-Cheol Park (1)

[1] Research Institute of Spatial Information Technology, Geo C&I Co. Ltd., Junmyung Bldg., 435, Hwarang-ro, Dong-gu, Daegu, 41165, Republic of Korea
Email: chyj@geocni.com; shlee@geocni.com; hjcho@geocni.com; hcpark@geocni.com

Abstract: Assessment of drought impacts in the urban areas is an important task for assessing the urban vulnerability by droughts. This research assesses the drought impacts in Daegu city, S. Korea by measuring the various remote sensing indices such as the normalized difference vegetation index (NDVI) and the normalized difference moisture index (NDMI) derived from the multi-temporal Landsat images as follows. First, the different three remote sensing indices (NDVI and NDMI) were derived from the Landsat images acquired in Daegu, S. Korea. Then, the changes of the NDVI and NDMI in Daegu city are measured during the drought period. Finally, the correlation between the total drought period and the NDVI/NDMI values are measured for assessing the drought impacts in Daegu city during the drought period.

Keywords: Drought, NDVI, NDMI, Landsat

THE COMPOSITING OF 16-DAY UNVI IN CHINA IN 2017 USING MODIS SATELLITE DATA

Lifu Zhang (1), Tao Zhong (2), Xuejian Sun (1), Nan Wang (1)

[1] No. 20, Datun Road, Chaoyang District, 100101 Beijing, China
[2] Institute of Remote Sensing and Digital Earth, University of Chinese Academy of Sciences, No. 20, Datun Road, Chaoyang District, 100101 Beijing, China
Email: zhanglf@radi.ac.cn; zhongtao@radi.ac.cn; sunxj@radi.ac.cn; wangnan@radi.ac.cn

Abstract: UNVI (Universal Normalized Vegetation Index) is a kind of vegetation index that can reflect the characteristics of vegetation well. At present, there is no complete method of UNVI calculation and product composition in the world. The objective of this research is to develop a method for mass production of UNVI composited product data. In this research, based on MODIS data of the whole 2017 in China, an UNVI composition scheme is developed with using the Angle-Normalized Vegetation Index Composite as the main algorithm, using the CV-MVC (Constrained-View angle-Maximum Value Composite) and the MVC (Maximum Value Composite) as auxiliary algorithms. Moreover, the UNVI composition scheme is programmed with IDL (Interface Description Language). As a result, the research reaches the goal of developing a complete method of UNVI calculation and product composition, and produces a UNVI composited product data of the whole 2017 in China. At the end of this research, through comparison and analysis between the UNVI composited data and NDVI product data at the same time and place, it can be preliminarily verified that the UNVI composition data is reliable. But there may be several abnormal value pixels in the UNVI composited data sometimes, which leaves a problem to be solved in the next research.

Keywords: UNVI, MODIS, Vegetation Index Composition

EXAMINING THE EFFECTS OF GREEN REVOLUTION LED AGRICULTURAL EXPANSION ON NET ECOSYSTEM SERVICE VALUES IN INDIA USING MULTIPLE VALUATION APPROACHES

Srikanta Sannigrahi (1), Shahid Rahmat (1), Sandeep Bhatt (2), Shouvik Jha (3), Suman Chakraborti (4), Saikat Kumar Paul (1), Somnath Sen (1)

[1] Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur, West Bengal 721302, India
[2] Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, West Bengal 721302, India
[3] Indian Centre for Climate and Societal Impacts Research (ICCSIR), Kachchh-370 465, Gujarat, India
[4] Centre for the Study of Regional Development,School of Social Sciences, Jawaharlal Nehru University, New Delhi 110 067
Email: srikanta.arp.iitkgp@gmail.com

Abstract: Ecosystem services are the bundle of natural processes and functions which are crucial for human well-being, subsistence, and livelihood. The unusual changes of land use are primarily responsible for the losses of global and regional ecosystem services at any given ecosystem. This modification has destabilized the core ecological functions and ecosystem resilience and undermines the ability of an ecosystem to maintain the natural flow of ecosystem services. India is an agriculture-based economy which significantly determines the formation of country's natural capital. The present study explicitly quantifies the ecosystem service values (ESV) (Billion US$) of India from 1985 to 2005 for eight ecoregions using several value transfer approaches (Costanza 1997a, b, Costanza, 2011, de Groot, 2012, and Xie 2008. Total five explanatory factors, i.e., total crop area (TCA), crop production (CP), crop yield (CY), net irrigated area (NIA), and cropping intensity (CI) were incorporated in constructing local Geographical Weighted Regression (GWR) to explore the cumulative and individual effects of the green revolution led agricultural expansion on ESV. Analysis of Variance (ANOVA), Pearson's correlation coefficient test (r), Student's "t" test was performed to analyze the method wise, year wise, and biome specific variances and sensitivities of different ecosystem services to land use changes. A Multi-Layer Perceptron (MLP) based Artificial Neural Network (ANN) algorithm was employed to predict timely ESV and estimate the normalized importance of the explanatory factors. During the observation period, the cropland, forestland, water bodies have contributed the most significant proportion (80% – 90%) of ESV's, followed by grassland, mangrove, wetland and urban built-up. ANOVA reveals that effect of time on ESV is insignificant. Tukey's post hoc test was done for the time as a factor, and the result shows that the value of ESV does not change significantly for any of the given pairs of years. Additionally, both ANOVA and Tukey's Honest Significant Difference (HSD) test proved that all unit values incorporated in this research are exhibiting statistically significant ESV. In all three years (1985, 1995, and 2005), among the nine ecological functions, the highest ESV accounts for water regulation, followed by soil formation and retention, biodiversity maintenance, waste treatment, climate regulation, and gas regulation, respectively. However, the total ESV's for all nine functions were reduced from 244.843 Billion US$ in 1985 to 241.59 Billion US$ in 2005. The results of this study comprehend the inevitability of conserving the productive land (forest) for the improvement of different supporting, regulating, provisioning, and cultural ecosystem services for the present and future generations through a vigorous ecosystem management policies and strategies.

Keywords: Ecosystem Service Value, Land Use Change, Ecology, Value Transfer, Biodiversity, Gas Regulation

EXAMINING THE SPATIOTEMPORAL VARIATIONS AND HOTSPOTS OF VALUED ECOSYSTEM SERVICES IN INDIA DURING 1985 – 2005

Srikanta Sannigrahi (1), Shahid Rahmat (1), Sandeep Bhatt (2), Shouvik Jha (3), Suman Chakraborti (4), Saikat Kumar Paul (1), Somnath Sen(1)

[1] Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur, West Bengal 721302, India
[2] Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, West Bengal 721302, India
[3] Indian Centre for Climate and Societal Impacts Research (ICCSIR), Kachchh-370 465, Gujarat, India
[4] Centre for the Study of Regional Development, School of Social Sciences, Jawaharlal Nehru University, New Delhi 110 067
Email: shahidrahmat82@gmail.com

Abstract: Ecosystem services can be defined as the processes and functions of the natural ecosystem through which the basic needs and demands of human well-being are sustained and fulfilled. In this study, the spatiotemporal variation and clusters of ESV are analyzed during 1985 – 2005 using benefits transfer approach. The spatial heterogeneity of ESV was assessed through Local Morans I, Getis-Ord-Gi hotspot, and Geary's I statistics, respectively. The temporal uncertainty of ESV was estimated through Ecosystem Service Change Index (ESCI), Ecosystem Service Status Index (ESSI). The sensitivity of ESV to land use/land cover changes were estimated using the Coefficient of Elasticity (CE) and Coefficient of Sensitivity (CS) approach. We have examined the variability of ESV in different land-use categories through Coefficient of Variation (CV), Theil Index (TI), Ginni Coefficient and Entropy method. The contribution of ESV to GDP was quantified using the percent of ESV (%ESV) approach. Total eight ecoregions were considered for estimating the changing dynamics of high and low ESV clusters during 1985 – 2005. Among the eight ecoregions, grassland shows the minimum CV of ESV (1.15) during 1985 – 2005, indicating the most stable and undisturbed eco-regions in India during this study period, followed by cropland (CV= 2.0), forest land (2.32), water bodies (3.27), mangrove (3.5) respectively. While, the urban built-up (CV = 15.89) and wetland (CV = 10.91) exhibits the highest CV during 1985 – 2005. The ESCI was found highly negative (-0.05) over forested region, and negative (-0.02) for water bodies, while a very highly positive (0.38), highly positive (0.24), moderate positive (0.06), weakly positive (0.03) and very weak positive (0.02) values have quantified for urban built-up, wetland, mangrove, cropland and, grassland, respectively. The overall ESSI was very good for urban built-up categories (0.24), followed by wetland (0.15), mangrove (0.04), cropland (0.02) and, grassland (0.01), respectively. The correlation estimation between the ESV of different land use categories has shown that the ESV's of urban built-up regions is most negatively correlated (r = -0.99) with forest ESV's. The net gain of ESV due the expansion of urban areas is quantified as 8.6 Billion US$ year-1, while the net loss of ESV due to the destruction of forest cover was approximated around 18.50 Billion US$ year-1.

Keywords: Ecosystem Service, Sensitivity, Elasticity, Ginni Coefficient, Theil Index

APPLICATION OF WRF-CHEM MODEL TO SIMULATE AIR POLLUTION OVER HO CHI MINH CITY, VIETNAM

Nguyen Thi Quynh Trang (1), Wataru Takeuchi (1)

[1] W.Takeuchi lab, Institute of Industial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
Email: qtrang@iis.u-tokyo.ac.jp

Abstract: The online meteorological and chemical transport Weather Research and Forecasting with Chemistry (WRF-Chem) model exhibits high skill in air pollution monitoring and forecasting recently because of its outstanding improvement in compare with the "offline" one: meteorological and chemical processes are solved together on the same grid and with the same physical parameterizations. The main goal of the present study is to simulate the meteorological variables as well as PM2.5 concentration with high temporal and spatial resolution over Ho Chi Minh city, Vietnam where air quality is considered among the worst in the world. WRF-Chem was conducted at a resolution of 3 km and 3-hour time interval from 6th to 9th February, 2018, applying different Gas Phase Chemical Mechanisms. Supplementedly, the output of model was validated against ground-based observations for both meteorological components and PM2.5 values. Overall, this present case research shows that the WRF-Chem model has an acceptable performance for meteorological variables as well as air pollution situation within study area. It provides a general overview of WRF-Chem simulations and can serve as a reference for future air quality modelling, that benefits both the researchers and the decision making communities.

Keywords: WRF-Chem, PM2.5, Air quality modeling, Hochiminh city

APPLICATION OF GEO-INFORMATICS FOR ENVIRONMENTAL HEALTH ASSESSMENT (EHA) ON IRON-ORE MINES AREA, NOAMUNDI BLOCK, JHARKHAND, INDIA

Kunal Kanti Maiti (1), Jatisankar Bandyopadhyay (1), Debashish Chakravarty (2), Sonjay Mondal (1)

[1] Department of Remote Sensing and GIS, Vidyasagar University, Midnapore-721102, West Bengal, India
[2] Department of Mining Engineering, Indian Institute of Technology Kharagpur, 721302, West Bengal, India
Email: kunal.rs.gis@gmail.com; jatib@mail.vidyasagar.ac.in; dc@mining.iitkgp.ernet.in; sonjaymondal@gmail.com

Abstract: Mining health issues is the most variable in our world which we faced in daily life. The mining impact and mineral extraction activities are very significant role for land, air and water bodies in any operational mines surrounding area. Multispectral satellite data have demonstrated its ability to detect, monitoring of geo-environmental change based on remote sensing applications. The Noamundi iron-mine in the Paschim Singhbhum district of Jharkhand is one of the important mining areas since the eighteenth century. The Principle iron-ore in this area is hematite. The use of Normalized Difference Vegetation Index (NDVI), measures the amount of greenery/ vegetation in the area. At the present time, it has become obligatory to study and analyze the impacts of mining on its surrounding area with the use of remote sensing (RS) and geo-spatial information system (GIS) to generate thematic maps for Environmental impact assessment (EIA) over the mining affected area. Therefore, it can be concluded that increase in mining activities is damaging the vegetation, land, and Environment. The present study can be useful to identify the degraded area due to mining activity and necessary environmental management plan (EMP) with their societal aspects can be taken up to mitigate the problem.

Keywords: Iron-Ore, NDVI, GIS, EIA, EMP

USING REMOTE SENSING TECHNIQUES TO IDENTIFY SOIL SALINITY IN RABIGH CITY, SAUDI ARABIA

Ahmad A. Ashi (1), Fahad M. Harbi (1), Saleh M. Harbi (1), Hassan A. Garni (1), Mohammed A. Hakami (1)

[1] Remote Sensing Department, Saudi Geological Survey, Saudi Arabia
Email: Ashi.aa@sgs.org.sa

Abstract: Salt mobilization is largely due to increased temperature creates an imbalance in the hydrology of the landscape resulting in water table rise. The salts and waterlogging associated with urban salinity may damage infrastructure, reduce water quality as salts wash into waterways and increase the cost of urban construction and maintenance. Normalized Differential Salinity Index (NDSI) applied on LANDSAT 7 ETM+ (2000) and LANDSAT 8 OLI (2017) to identify soil salinity affected area. Change detection shows that increase ≈ 48%. Overall Ground validating of 48 sample shows moderate to high accuracy assessment by 81%. In conclusion, the study have indicated that a serious salinity problem R2≈0.89 exists in relationship between NDSI and Electrical Conductivity field test based on the visible spectral bands are more sensitive to changes of the EC against those based on near-infrared and midinfrared.

Keywords: Soil Salinity, Remote Sensing, Saudi Arabia, LANDSAT, NDSI

WATER CLARITY ASSESSMENT OF FEWA LAKE USING SATELLITE REMOTE SENSING

Nishan Pravat Adhikari (1)

[1] Tribhuwan University, Institute Of Engineering Paschimanchal Campus Lamachaur, Pokhara, Nepal.
Email: 71bge522@wrc.edu.np

Abstract: Satellite imagery has been used effectively to estimate water clarity levels. Improving the application of satellite data for analyzing water quality is an important issue because it would reduce the cost of gathering on site data in remote locations, and allow for the analysis of water quality from historical images when field data is not available. Water clarity can be analyzed from satellite by measuring how much light in reflected in different bands. Water reflects a small range of light compared to most surfaces, but good data can still be acquired by comparing the return in different parts of the spectrum. The most reflection occurs near the blue end of the visible spectrum, while less light is reflected near the red portion of the spectrum. Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key of water quality. Water clarity is an important measure of water quality. Measures of water clarity are often included in the standards for safe drinking water. There are several ways of measuring water clarity, one method is to measure turbidity. Turbidity can be measured in Nephelometric Turbidity Units (NTU), by using a nephelometer which measures the amount of light reaching a detector after passing through the water. In this way the amount of suspended particles scattering the light can be found. Clear water will have a low NTU, while murky water will have a high NTU. In lakes, the turbidity is measured with a secchi disk. This is a black and white disk that is dropped in the water attached to a rope. The depth that the disk reaches before it disappears from sight is recorded. This provides an estimation of the turbidity level in the lake.

Keywords: Turbidity, Satellite imagery, Fewa Lake, water clarity, Sechhi depth

CARBON STOCK ESTIMATION IN TONGKE-TONGKE MANGROVE FOREST, SOUTH SULAWESI, INDONESIA

Vina Nurul Husna (1), Nurul Ihsan Fawzi (2)

[1] Environmental Research Center, Bogor Agricultural University, Bogor, Indonesia
[2] Conservation Program, Alam Sehat Lestari, Sukadana, West Kalimantan, Indonesia 75582
Email: vinahusna@gmail.com; nurul.ihsan.f@mail.ugm.ac.id

Abstract: Mangrove ecosystem have a role as carbon sequestration and carbon circle in the world. This ecosystem also facing deforestation and degradation same as tropical rainforest. The aim of this research is to obtain Tongke-Tongke mangrove forest using remote sensing. The method was used SPOT 7 imagery to found tree species and its diameter. To estimate carbon stock, we using NDVI and ground-truthing data. The result, correlation between NDVI and carbon stock is 92.28%. Tongke-Tongke mangrove ecosystem reserve 23,239 Mg C ha-1, with total area 100.5 ha. We estimate, mangrove ecosystem has 231.2 Mg C ha-1, which is only a half of default carbon stocks of mangroves forest by IPCC Tier 1 in the Asia-Pacific (511 Mg C ha-1). This is because Tongke-Tongke mangrove forest is successfully planting forest and become secondary mangrove forest. This study provides data reference how carbon stock in reforested area and will increasing C storage in this area.

Keywords: Tongke-Tongke mangrove forest, Coastal carbon, Mangrove, Potential carbon storage

VISUALIZATION OF DEFORESTATION IN PARAGUAYAN CHACO USING GOOGLE EARTH ENGINE

Maria Leticia Cardozo (1), Shou-Hao Chiang (2)

[1] International Environmental Sustainable Development Program, National Central University, No. 300, Zhongda Rd., Zhongli District, Taoyuan City 32001, Taiwan
[2] Center for Space and Remote Sensing Research, National Central University, No. 300, Zhongda Rd., Zhongli District, Taoyuan City 32001, Taiwan
Email: lesocardozo@gmail.com; gilbert@csrsr.ncu.edu.tw

Abstract: Forests act as a reservoir of biodiversity, shelter to wildlife and carbon sinks, and mitigates climate change. Despite their importance, they have been threatened by human activities such as unsustainable logging, agricultural expansion, cattle ranching, fuel wood collection and others, which are the main drivers of deforestation. The objective of this study is to visualize and describe the deforestation process of the Chaco, in Paraguay, South America, by means of remote sensing analysis through the cloud-based Google Earth Engine (GEE) platform. The study area is part of the second largest forest area in South America, it has a great biodiversity, with two marked Eco-region in it, the Dry Chaco and the Wet Chaco. According to the United States Agency for International Development (USAID) in 2017, the Paraguayan Chaco has experienced a lot of land use changes and deforestation. Landsat images from the whole year of 2013 and 2017 were collected, and since the study area is covered by multiple Landsat's scenes and the process of image collecting and pre-processing would take a lot of time and storage, the usefulness of GEE to reduce the task is remarkable and will be introduced. In GEE, the integrated development environment (IDE) for the rapid creation of prototypes using JavaScript API is able to define the study area, pre-process the images, including the elimination of cloud pixels of the scenes, composite and evaluate the changes of study area. Following the above functionalities embedded in GEE, the visualization and interpretation of the deforestation in the Paraguayan Chaco were performed. The results show that deforestation in the study area increase from the year of 2013 to 2017, and is clearly visualized and interpreted with rectangular geometric features of forest clearance. This study suggests that GEE is an effective tool for rapid image processing and land monitoring.

Keywords: Deforestation, Google Earth Engine, Landsat, Chaco, Paraguay

CONSTRUCTION OF CORRELATION MODEL OF REGIONAL *PHYLLOSTACHYS EDULIS*'S AGE AND TLS INTENSITY

Xu Wenbing (1)(2), Cheng Xiaojun (1), Li Quan (1)

[1] College of Surveying and Geo-informatics, Tongji University, Shanghai 200092, China
[2] F School of Environment & Resource, Zhejiang A&F University, Hangzhou, Zhejiang 311300, China
Email: xuwb97@163.com; cxj@tongji.edu.cn; 815644889@qq.com

Abstract: In this paper, a correlation model of regional *Phyllostachys Edulis*'s age and Terrestrial Laser Scanning (TLS) intensity is proposed. A 10m*10m sample plot of *Phyllostachys edulis* is scanned by a Leica ScanStation C05 Terrestrial Laser Scanner. Then the point cloud of the *Phyllostachys edulis* is extracted. Moreover, the intensity data of the extracted point cloud is analyzed and the original intensity is corrected through a polynomial model. The relationship between the ages of *Phyllostachys edulis* and corrected intensity data is then investigated and a correlation model is constructed. The experiment results show that the correlation coefficient between the actual surveyed age data and the age data estimated by the proposed model are relatively high, which demonstrates the accuracy of the proposed model.

Keywords: *Phyllostachys edulis*, terrestrial laser scanning technology, laser intensity, polynomial model

AN APPROACH FOR TROPICAL PEATLAND EXTRACTION FROM SENTINEL-1A SAR IMAGERY

Fiolenta Marpaung (1), Sepanie Putiamini (1), Doni Fernando (1), Lena Sumargana (1)

[1] Centre for Regional Resources Development (PTPSW), Agency for the Assessment and Application of Technology (BPPT), Jakarta, 10340, Indonesia
Email: fiolenta.marpaung@bppt.go.id

Abstract: Tropical peatland in Indonesia have been rapidly devastated by a repeatable large-scale fire as a result of land clearing, and a lower ground water levels in the late dry season, especially when the strong El Nino droughts arise. The disturbances including climate change, deforestation, peatland drainage, forest and peatland fires, and land conversion provoke changes in carbon balance and then affect CO2 ecosystem. Various initiatives have been developed in studying the characteristics of peat to gain knowledge and knowledge for the best practice management in peatlands. However, accessing the spatial variation of tropical peatland in Indonesia is quite limited, difficult and laborious. Therefore, we investigated the existence of tropical peatland in South Sumatera, Indonesia at three different types of land cover (namely; forest, acacia, and shrubs) along with two types of peat conditions. Here, an algorithm providing an automatic tropical peatland detection based on synthetic aperture radar images is described that can be applied to a wide range of Sentinel-1 scenes. We used both the VH and the VV channels with Interferometry Wide (IW) swath mode of to classify more tropical peatland correctly. The peatland extraction algorithm is based on polarimetric features and textural features derived from the grey-level co-occurrence matrix. Polarimetric features are used as the initial identification of the distribution of peat, while the textural features are implemented as methods of supervised pixel image classification. The algorithm was tested on several SAR images. The results indicate that peat with land cover of acacia has a low of textural with a ratio of polarimetric features (δVH/δVV) between 1.3 and 1.6, whereas the peat with land cover of shrubs or woods have a low textural homogeneity with a ratio of polarimetric features (δVH/δVV) between 1.7 and 2.0.

Keywords: backscattering, texture analysis, Sentinel-1A, peatland, Indonesia

ANALYSIS OF VEGETATION INDICES USING METRIC LANDSAT-8 DATA TO IDENTIFY LANDCOVER CHANGE IN RIAU PROVINCE

Tatik Kartika (1), Kustiyo (2), Ita Carolita (1), Samsul Arifin (1), Inggit Lolita Sari (2), Anna Tosiani, (3), Andi France Daryanto (3), Rizky Firmansyah (4), Zuraida (4)

[1] Remote Sensing Application Center, LAPAN
[2] Remote Sensing Data and Technology Center, LAPAN
[3] IPSDH, KLHK
[4] WRI Indonesia
Email: tatikkartika@yahoo.com; tatik.kartika@lapan.go.id; tatikkartika17@gmail.com

Abstract: Landsat-8 has various channels that function to identify an object. The vegetation index algorithm which is based on remote sensing involves several bands and can describe the percentage of canopy and density of vegetation. More than 100 vegetation index algorithms and each can be used in accordance with the research objectives. In this paper we will discuss the utilization of Landsat-8 metric data with the parameters of Normalized Difference Vegetation Index (NDVI) and Normalized Burn Ratio (NBR) and with various features to produce indications of rapid land change, especially to detect changes in areas from vegetation to not and as appropriate. For this purpose the annual Landsat-8 metrics data is located in Riau Province. To compare both NDVI and NBR parameters, the trial and error method is used and the results are compared visually to the two different images of the year. The results obtained that NBR with maximum features and threshold for each year more than 90 gives tangible results in seeing changes in land cover in Riau Province. In the analysis, other information is needed, for example a map of the Forest Area to see further whether the changes that occur are in the forest area or not, which will certainly provide different treatment.

Keywords: data metric, landsat, vegetation index, land cover change

COMPUTING THE HOURLY CO-EFFICIENT FOR DOWNSCALING THE SATELLITE PRECIPITATION DATA IN MOUNTAINOUS TROPICAL CATCHMENT

Aina Afifah bt. Mohd Yusof (1), Muhamad Afifi Md Yatim (1), Nur Fathiera Mansor (1), Mohd. Rizaludin Mahmud (1)(2), Mohd. Nadzri Mohd. Reba (1)(2)

[1] Department of Geoinformation, Faculty of Geoinformation & Real Estate, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
[2] Geoscience & Digital Earth Centre (INSteG), Faculty of Geoinformation & Real Estate, Research Institute for Sustainable Environment, Universiti Teknologi Malaysia, 81310, Johor Bharu, Malaysia
Email: ainayusof208@gmail.com; firamansor888@gmail.com; afie0913@gmail.com; rizaludin@utm.my; nadzri@utm.my

Abstract: This study compute the co-efficient to downscale the satellite precipitation data at hourly scale in the mountainous tropical catchment. Mountainous tropical catchments which played a vital role in securing primary resources for the reservoirs and sustaining agriculture on the downstream require consistent and effective monitoring. Using satellite precipitation data as an alternative was novel however, it was constraint by the conflict of spatial resolution and size of the sub-catchments. At present, even the satellite precipitation data at the most advanced of 0.1° was having limitation to represent the local rainfall variation especially in humid tropics in Southeast Asia. By far, most of the downscaling approach were limited to monthly rainfall downscaling at larger temporal scale. As the rainfall was temporally very dynamics which varied at hourly scale, it is crucial to made the high resolution of satellite precipitation available at this scale. In order to solve that gap, we initiate the downscaling procedures by incorporating the orographic factors and wind intensity and direction with hourly scale at 200 meter resolution. The satellite precipitation data from Global Precipitation Mission (GPM) is used as sample. The output of this study would be useful to produce high resolution satellite precipitation in the mountainous humid tropics; critical inputs for high spatial and temporal hydrologic applications on the sub-catchments of the mountainous watershed.

Keywords: Rainfall, Orographic, Digital Elevation Model, Sub-Catchments

IDENTIFYING THE RELATIONSHIPS BETWEEN WATER QUALITY AND LAND COVER CHANGES IN ANGKE RIVER, INDONESIA

Prita Ayu Permatasari (1), Hefni Effendi (1)(2), Luisa Febrina Amalo (1)

[1] Environmental Research Center, Bogor Agricultural University
PPLH Building, Jalan Lingkar Akademik, IPB Dramaga Campus, 16680 Bogor, West Java, Indonesia
[2] Department of Water Resource Management, Faculty of Fisheries and Marine Science, Bogor Agricultural University,Jalan Agatis, IPB Dramaga Campus, 16680 Bogor, West Java, Indonesia
Email: pritapermatasari@gmail.com; hefni_effendi@yahoo.com; luisafebrina@gmail.com

Abstract: River is an important element in human life that can be used to meet daily needs. The high level of urbanization in big cities causes the quality of the river to decline due to industrialization and pollution. Angke River is one of the rivers that flows in Jakarta Megacity and is often used by local people for transportation and irrigation. Fine resolution satellite imagery provides opportunities for land cover monitoring and assessment. By using NDVI data, land cover changes can be identified and correlated with some water quality parameters. The results show that from 2014 to 2016 the parameters of BOD, COD, and TSS are negatively correlated with the average NDVI in the entire watershed.

Keywords: Angke River, NDVI, Water Quality, Land Use, Land Cover

GNSS-PWV VARIABILITY DURING INTENSE RAIN EVENTS IN DAVAO CITY, PHILIPPINES

Kristine Mae R. Carnicer (1)(2), Edgar A. Vallar (1), Maria Cecilia D. Galvez (1)

[1] Environment and RemoTe Sensing ResearcH (EARTH) Laboratory, Physics Department, De La Salle University, 2401 Taft Avenue, Manila, Philippines
[2] Physics Department, Ateneo de Davao University, 8000 E. Jacinot Street, Davao City, Philippines
Email: kristine_carnicer@dlsu.edu.ph

Abstract: Several studies have supported the existence of the positive correlation between atmospheric water vapor and precipitation. In this study, the temporal behavior of precipitable water vapor (PWV) was analysed in Davao City, Philippines (7o4'N, 125o36'E) for three years (2013-2015) to monitor its variability during intense rain events. The PWV measures were derived from the data sets retrieved from the Global Navigation Satellite System (GNSS) receivers of Jet Propulsion laboratory (JPL) and the National Mapping and Resource Information Agency (NAMRIA). The two GNSS receivers are only around 7.7 km apart and their measured PWV values showed strong correlation with a calculated r value of r = 0.948. The study aims to find a relationship between the time evolution of GNSS PWV derived from these pair of receivers during intense rain events (rain rate of 7.5 mm/h or higher). Time series plots made between the PWV measures and rain showed that a gradual build-up of atmospheric water vapor is observed prior to most intense rains. A time difference of around 5– 10 hours is also measured between the peak in PWV to the onset of rain. This is usually followed by a decrease in the PWV value that ranges from 5-15 mm. However, the maximum PWV value that precedes each rain event varies depending on the season and no cut-off value of PWV had been noted that predicts the occurrence of intense rain events. In addition, the study also presented the annual variability of GNSS-PWV which is characterized by a clear annual cycle dependent on the local climate.

Keywords: GNSS Precipitable Water Vapor (PWV), Intense Rain Events, Atmospheric Water Vapor

RESPONSE RELATIONSHIP RESEARCH BETWEEN LAND USE AND WATER QUALITY IN BAIYANGDIAN LAKE BASED ON GF-2

Liu Ke (1)(2), Guo Chang(1), An Zhiyuan (1)(2)

[1] North China Institute of Aerospace Engineering, Langfang 065000, China
[2] Collaborative Innovation Center of Aerospace Remote Sensing Information Processing and Application of Hebei Province, Langfang 065000, China
Email: liuke1176@163.com; 351893272@qq.com; azy01@263.net

Abstract: Many researchers find that the type of land use can affect the water quality to some extent. Baiyangdian Lake is selected as the study area. Taking the image of GF-2 on March 22, 2018 and the water quality parameters of sixteen monitoring points, which are as the same period as the image of GF-2, as the data source. Through analysis on present condition and characteristics of the land use of Baiyangdian, the study area can be divided into 8 kinds of land use types using maximum likelihood method. The study utilizes the technique of spatial analysis of GIS to obtain buffer of 100m, 300m and 500m as well as obtaining the area proportion of land use types in each buffer. Pearson correlation analysis is used to explore the relationship between area proportion of land use types and water quality parameters. The results indicate that the water and reed land are the main land use types. Instead, bare land and cultivated land occupy insignificant proportion of the area. Commercial & tourism land, living land and bare land are the main sources of pollution, which are positively correlated with TP and TN, while these three land-use types have negatives on SD. Reed land has significant positive correlation with TP and TN. At the buffer of 300m, the correlation can reach the maximum value, indicating that reed land can purify water quality. Positive correlation is observed between living land, bare land, TP and TN. At the buffer of 500m, the correlation can reach the maximum value. The correlation between living land, bare land and TP, TN is positive. The correlation between living land, bare land and NH4+-N, COD are not significant. From the result we can know that living land and bare land are essential sources of pollution for TP and TN. Economic aquatic plants have the ability to purify the quality of water. Aquaculture can contribute to the contamination of nitrogen and phosphorus and make water muddy. Replies show that compared with other land use, the water of low vegetation coverage is more likely to have positive correlation with NH4+-N and COD.

Keywords: Baiyangdian Lake, Land Use, Water Quality Parameter, Correlation analysis

CORRELATION OF DESERTIFICATION WITH LAND AND WATER USE IN TURKEY

Gaye Onursal Denli (1), Hayri Hakan Denli (1)

[1] Istanbul Technical University, Civil Engineering Faculty, Geomatics Department, Maslak, 34469 Istanbul, Turkiye
Email: onursal@itu.edu.tr; denli@itu.edu.tr

Abstract: Drought is defined as a natural event that occurs when the amount of precipitation is significantly less than normal, causing severe hydrological imbalances that negatively affect land resources and production systems. Majority of Turkey is located in the Mediterranean Climate Zone where significant differences in seasonal rainfall can be observed. Since one of the characteristics of the Mediterranean Climate Zone is the periodic variations of rainfall amounts, drought episodes are inevitable. As a result, drought is one of the climate-related problems that Turkey experiences and likely to encounter frequently. Along with that, incorrect use of land, wrong agricultural policy and the wastage of water added to the drought will have a very serious problem. Turkey experienced the worst drought in last 44 years in 2017, due to a substantial decrease in rain levels. Non-sustainable agricultural practices cause pollution of freshwater resources and deterioration of arable land. Freshwater resources constitute only 2.5 percent of the world's water resources. However, less than 1 percent of all freshwater resources can be used by ecosystems and people. Turkey utilizes approximately 75% of its fresh water for the irrigation and cultivation of its crops. In the current drought, Turkish farmers now need to irrigate and use their supply of water more effectively. Up until now poor irrigation techniques have not caused serious difficulties but it will be after that. Time analysis of satellite images reveals the drought of many important water resources and agriculture regions in Turkey. Turkey Desertification Risk Map has been created based on all analysis and is of great importance for the future of the country. In this study, the impact of desertification will be emphasized, presented with maps and satellite imagery and the measures to be taken against the sensitivity of the subject will discussed.

Keywords: Climate, desertification, water, land use

SECOND ORDER INTERACTION MULTIPLE REGRESSION MODEL ON WATER QUALITY INDEX (WQI) AT MANJUNG RIVER AND ITS TRIBUTARIES

Aminatul Hawa Yahaya (1), Noorazlina Mohamid Salih (2)

[1] Technical Foundation Section, Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology, Lumut, Perak, Malaysia
[2] Marine Electrical Electronic Technology Section, Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology, Lumut, Perak, Malaysia
Email: aminatulhawa@unikl.edu.my; noorazlinams@unikl.edu.my

Abstract: This research focuses on identify the main parameter that have a significant contribution in the water quality index and to promulgate the best second order of multiple regression to predict the water quality index (WQI) at Manjung river and its tributaries which included Sungai Ayer Tawar, Sungai Sitiawan and Sungai Lumut. This research is also highlights a multi-variety technique to examine the relationship between dependent and independent variables. There are six independent variables which are the water quality parameters and water quality index as the independent variable were included in this data set. The Multiple Regression (MR) models were involved is the second-order interaction with 42 possible models were considered. The elimination of variables with was employed to get the selected model. The best model includes used the second order interaction with variables of (DO, COD, BOD, TSS, AN and pH). The best model obtains then being verified by the Mean Absolute Percentage Error (MAPE) calculation to measure the models' relative overall fit.

Keywords: Water Quality Index (WQI), Second Order Interaction, Multiple Regression (MR) Model, Mean Absolute Percentage Error (MAPE), Best Model

A STUDY ON DEVELOPMENT OF RADAR DATA 3D PROFILE TECHNIQUE USING UNITY ENGINE

Seung-hyeon Lee (1), Hyeoung-wook Choi (1), Yu-yeon Lee (1), Yong-chel Seo (2)

[1] Institute of Spatial Information Technology Research, GEO C&I Co., Ltd,
435 Hwarang-ro, dong-gu, Daegu, Republic of Korea
[2] Department of Civil Engineering, Pukyoung National University, 365 Sinseon-ro,
Nam-Gu, Busan, Republic of Korea
Email: shlee@geocni.com; hwchoi@geocni.com; yylee@geocni.com; suk@pknu.ac.kr

Abstract: This study deals with the vertical profile analysis function using the Unity engine on the basis of 3D modeling of rainfall radar observation information. To develop the rainfall radar observation data 3D profile visualization technique, a 3D cumulative rainfall model enabling a 3D analysis was first created. The cumulative rainfall model was converted into the grid-based rainfall distribution of real-time-created rainfall distribution data so as to superimpose the grid data, thus creating the rainfall accumulated at points according to time changes. In addition, to display the cumulative rainfall data in 3D, [Z]-value data raw file, which provides 3D high values by matching the grid data according to the legend table, was separately created. The profile function designed for the visual analysis of the created 3D cumulative rainfall model was developed using the Unity 3D platform, and the visualization display tool enabling diverse analyses through 3D rendering tool was constructed. Furthermore, the 3D cumulative rainfall model, which was created to provide the proposed profile technique-based user service, was linked with Google Open Map so as to spatially display the rainfall distribution, and by applying the profile module, a function was implemented to quantitatively analyze the sectional distribution in 3D model. As a result using the developed 3D profile tool, it is deemed to be possible to conduct a quantitative analysis of 3D display.

Keywords: Rainfall Radar, 3D Profile, Unity 3D, Open Map, User-intuitive

RESEARCH ON EFFECTS OF MICROBIAL RECLAMATION ON SPECTRAL FEATURES OF VEGETATION IN COAL MINING AREA

ZHAO Heng-qian (1)(2), BI Yin-li (2), ZHAO Xue-sheng (2)

[1] State Key Laboratory of Coal Resources and Safe Mining (China University of Mining and Technology), 100083 Beijing, China
[2] College of Geoscience and Surveying Engineering, China University of Mining and Technology (Beijing), 100083 Beijing, China
Email: zhaohq@cumtb.edu.cn

Abstract: The land reclamation and its monitoring in coal mining area is of great significance for land use and ecological environment governance in China. However, the monitoring of land reclamation through remote sensing is in serious shortage of related research at present, still staying at the level of leaf spectral analysis in laboratory. This research performed field experiment of vegetation canopy spectral observation in the microbial reclamation basement of coal mining area, and analyzed the effects of land reclamation on the spectral features of local vegetation. Results show that land reclamation can reduce the canopy spectral difference between plants and strengthen the diagnostic vegetation spectral features, among which green peak and red valley were most sensible to land reclamation; as for specific canopy spectral feature parameters, the wavelengths of green peak, red valley and red edge tend to shift to longer wavelengths significantly under the function of land reclamation, which can be used as effective indication signs of land reclamation monitoring in coal mining area.

Keywords: hyperspectral remote sensing, microbial reclamation, coal mining area, vegetation canopy, spectral feature

EXAMINING LANDSCAPE CAPACITY TO PROVIDE SPATIALLY EXPLICIT VALUED ECOSYSTEM SERVICES FOR SUSTAINABLE COASTAL RESOURCE MANAGEMENT: THE CASE OF INDIAN SUNDARBAN

Srikanta Sannigrahi (1), Saikat Kumar Paul (1), Somnath Sen (1)

[1] Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur, India
Email: srikanta.arp.iitkgp@gmail.com

Abstract: Ecosystem services are the direct and indirect services that human obtained from their native ecosystem. Several studies have demonstrated the effectiveness of the time series satellite remote sensing products for estimating spatially explicit valued blue ecosystem services for sustainable coastal resource management. This study thoroughly evaluated the landscape capacity to provide multiple key ecosystem services in a tropical coastal ecosystem (Sundarban Biodiversity region, India) using Landsat time series data started from 1973 to 2018. Several machine learning algorithm, including support vector machine (SVM), random forest (RF), naïve Bayes, decision tree, etc. are employed to classify the regions into several major landscape zone. Expert opinion survey was conducted to assign the capacity code for each eco-region. The basic benefit transfer approach was used to aggregate the values of each ecosystem services. Research results have indicated that the water bodies are the most relevant to provide the necessary regulatory, supporting, provisioning, and cultural ecosystem services. Almost half of the total ecosystem service values (ESV's) are supplied by water bodies (very high relevant - VHR) (53.01% to 55.45%), followed by mangrove forest (high relevant - HR) (30.63% to 33.56%), cropland (moderate relevant - MR) (6.42% to 10.86%), and mixed vegetation (low relevant - LR) (2.57% to 7.92%), respectively. For regulating and cultural ecosystem services, the water bodies and mangrove eco-regions are the most important in order to provide the valued regulatory services, i.e., carbon sequestration, oxygen production, regulating global, regional warming, water regulation by attenuating surface runoff, regulating soil quality, waste treatments. The water regulation (WR), waste treatment (WT), aesthetic, recreation, and cultural (ARC), and climate regulation (CR) are the main ecosystem services of Sundarban ecosystem region. These services are immensely important for not only the coastal communities who entirely rely on these services, but also for the climatic and environmental suitability of Kolkata urban region, the 3rd largest urban metropolitan region of India.

Keywords: Ecosystem Services, Landscape Capacity, Gas Regulation, Climate Regulation, SVM, RF

3D MODELLING AND DEPTH ESTIMATION OF SHALLOW WATER ENVIRONMENTS USING A CUSTOMIZED UNMANNED SURFACE VEHICLE

Trizia Mae A. Badong (1), Reena Louise E. Manalac (1), Ayin M. Tamondong (1), Patrick Joseph M.Ostrea (2)

[1] University of the Philippines Diliman, Department of Geodetic Engineering, University of the Philippines Diliman Campus, 1101 Quezon City, Philippines
[2] Eisenpatt Industrial Engineering Services, 50 Lalaine Bennet st. BF Resort Village, Las Pinas City,Philippines
Email: tabadong1@up.edu.ph; remanalac@up.edu.ph; amtamondong@up.edu.ph; patrick.ostrea@eisenpatt.com

Abstract: Modelling and mapping of shallow (less than 20 meters) water environments are vital in sustaining and maintaining ecosystems under water, yet it is one of the constraints of conventional hydrographic survey methods which uses large and heavy vessels, which harms both itself and the ecosystems involved. The aim of this research is to test an alternative way to address this problem through the use of a customized Unmanned Surface Vehicle (USV) that is equipped with a Global Navigation Satellite System (GNSS) receiver, echo sounder, video recording device, and motion corrector. The designed USV costs lower compared to the commercialized vehicles. A bathymetric survey was done using a GNSS receiver and a measuring rod on the chosen study area which consists of different seabed types such as corals, rocks, and sand, before the deployment of the USV for the establishment of control points under water. The depth of different seabed types was determined using an echo sounder which was normalized using tide corrections and then verified using points from the bathymetric survey. The extracted data was used to produce a bathymetric map of the area which resulted to an average residual of approximately 0.164 meters. The acquired images from the USV were used to produce a 3D model of the area which was then compared to the previously produced surface. The produced bathymetric map and 3D model evidently show that the use of the customized USV is an effective alternative to the conventional hydrographic survey methods in sustaining and maintaining shallow environments as it dealt minimal damage to the environments.

Keywords: Unmanned Surface Vehicle, Echo Sounder, Global Navigation Satellite System, Bathymetric Survey

EVALUATING THE PERFORMANCE OF LANDSAT 8 IMAGERY FOR INDONESIA NAUTICAL CHART UPDATING

Fadilah, ND. (1), Luthfiana, RF. (1), Manessa, MDM. (2)

[1] Sensing Technology Studies Program, Faculty of Defense Technology, Indonesia Defense University, Sentul, West Java, Indonesia
[2] Applied Geographical Research Centre, University of Indonesia, Depok, West Java, Indonesia
Email: deandrafadilah@gmail.com; fatihrahmaluthfiana94@gmail.com; m.manessa@outlook.com

Abstract: Indonesia is one of the maritime countries in the word. The extent of the water makes the difficult updating process especially the shallow region and full of the coral barrier reef. Satellite-derived bathymetry is one of alternatives method for rapid mapping with a less survey. This study tested the performance of Landsat 8 Imagery to identify shallow water. This study uses an-linear multiple (Manessa, 2016). The output from this study show prediction accurate depth until 14 m but, this accurate, not appropriate with standard based on IHO. The cause might due tue the resolution that relatively small. So, raises much of topography generalisation undersurface.

Keywords: Evaluating, Landsat 8 Imagery, Indonesia Nautical

COASTAL AND SHALLOW WATER SEA BED MAPPING USING IMAGERY-DERIVED BATHYMETRIC APPROACH

Kelvin Kang Wee, Tang (1)(2), Mohd Razali Mahmud (1)

[1] GeoCoastal Research Unit, Geospatial Imaging and Information Research Group (GI2RG), Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia
[2] Department of Survey and Mapping Johor, Department of Survey and Mapping Malaysia, Wisma Persekutuan Johor Bahru, 80000 Johor Bahru, Malaysia
Email: tkwkelvin2@live.utm.my; kelvin@jupem.gov.my

Abstract: Bathymetric mapping over coastal and shallow water region using vessel-based acoustic system is sometime hostile and inaccessible. It requires extensive amount of effort, time and money when it comes to the near shore and coastal region. Today, imagery-derived bathymetry has becoming popular and provides an alternative data gathering technique in particular the extremely shallow water environment. Indeed, numerous attempts of using radiometric technique to estimate water depth from remotely sensed data had been developed since the past two decades. A wide variety of bathymetry retrieval and empirical models have been established to form statistical relationship between image pixel values and water depth values. This paper deliberates the ratio transform attempt proposed by Stumpf et al. to extract bathymetric information along the northeast coastal region of Penang Island, Malaysia via Landsat-8 medium- (30m) resolution images. The average uncertainties achieved is 0.655 m, where the highest RMSE witnessed is 2.401 m, whilst the lowest RMSE is 0.005 m. Conversely, multispectral imageries offer safe, time- and cost-effective solution to precisely map the sea bed topography over broad areas. The high refresh rate of imaging satellite data recorded every place on earth in high frequency rate has make it possible to distinguish the sea bed topography changes with periodic calculation of coastal bathymetries.

Keywords: Imagery-derived bathymetry, Sea bed mapping, Coastal and shallow water

RETRIEVAL OF SUBMARINE GROUNDWATER DISCHARGE FLOW RATES USING AIRBORNE THERMAL INFRARED DATA ACQUIRED AT TWO DIFFERENT TIDAL HEIGHTS

Ki-mook Kang (1), Duk-jin Kim (1), Bong-Gwan Kim (1), Eunhee Lee (2), Seung Hee Kim (1), Yunjee Kim (1), Kyoochul Ha (2), Dong-Chan Koh (2), Yang-Ki Cho (1), Guebuem Kim (1)

[1] School of Earth and Environmental Sciences, Seoul National University, Republic of Korea
[2] Groundwater & Ecohydrology Research Center, Geologic Environment Division, Korea Institute of Geoscience and Mineral Resources (KIGAM), Republic of Korea
Email: mook0416@snu.ac.kr; djkim@snu.ac.kr; bongan@snu.ac.kr; eunheelee@kigam.re.kr; dalcomeboy@snu.ac.kr; yunjee0531@snu.ac.kr; hasife@kigam.re.kr; chankoh@kigam.re.kr; gkim@snu.ac.kr; choyk@snu.ac.kr

Abstract: Submarine groundwater discharge (SGD) plays an important role in coastal biogeochemical processes and hydrological cycles, particularly off volcanic islands standing in oligotrophic oceans. However, limited access of SGD measurements over a large scale prevents from fully understanding the spatio-temporal variations. This study tries to quantify the temporal and spatial variations of SGD using four airborne thermal infrared (TIR) surveys over the entire coast of Jeju Island, Korea. The surveys were done twice, each during high and low tide, and the data showed a linear correlation between the temperature anomaly and squares of groundwater velocity and a negative exponential correlation between the anomaly and depth (included tide height and bathymetry). Using these relationships, a new analytic equation for estimating the SGD flow rates using temperature anomaly at any tide height was derived. The method was validated using the measured SGD flow rates with in-situ measurement using a current meter at Gongcheonpo Beach. Despite difficulty of the on-site observation of SGD flow rates, the SGD flow rates were directly retrieved using the temperature anomaly in combination with high-resolution coastal bathymetry map and tide height. This approach is expected to be applied to rapid and efficient estimation of SGD over coastal areas off oceanic islands where fresh groundwater discharge is significant and results in great impact on coastal ecosystems.

Keywords: Submarine groundwater discharge (SGD), thermal infrared (TIR) remote sensing, Jeju Island, sea surface temperature (SST), temperature anomaly

ESTIMATION OF THREE DIMENSIONAL SHORELINE USING TERRESTRIAL LASER SCANNING DATA: CASE STUDY AT BANGAMEORI BEACH

Kong-Hyun Yun (1), Yeong Sun Song (2), Gihong Kim (3)

[1] Institute of Engineering Research, Yonsei University, South Korea
[2] Dept. of Aerial Geoinformatics, Inha Technical College, South Korea
[3] Dept. of Civil Engineering, Gangneung-Wonju National University, South Korea
Email: ykh120@yonsei.ac.kr; point196@inhatc.ac.kr; ghkim@gwnu.ac.kr

Abstract: In the coasts of western South Korea, the problem of coastal erosions is a serious social issue for the local residents in that area. Also these phenomena are regarded as potential threat to the existing buildings on the coastal zone. Global warming and human activities for the social infrastructure developments are the assumed causes for the coastal erosions. In this paper, we estimated the shoreline changes using existing two dimensional shorelines digital map which was published in the 2013 by KHOA (Korea Hydrographic and Oceanographic Agency) and recently acquired terrestrial laser canning data at Bangameori beach in the west coast of South Korea during roughly 15 years. In this research, we collected existing two dimensional shorelines published by KHOA in the year 2013. However, unfortunately we cannot obtain AHHWL (Approximately Highest High Water Level) including three dimensional position in the old years due to the data absence. So we proposed following steps for the acquisition of shorelines in the old years. First, we delineated the shoreline derived existing map in the year 2013. It contains only two dimensional position. There is no height information for AHHWL. Second, we use stereo pair of scanned images in the year 2013 After photogrammetric orientation process is accomplished using bundle adjustments We can obtain accurate height information. Last we can trace the two dimensional position on the AHHWL in the remaining year. And in the 2018, we collected and processed the laser caning data at the same area. Finally, we compare the difference between two shoreline data sets. The results show that change rates of shoreline using EPR (End Point Rate) is 0.68mm/yr. which means the retreat occurred in the research area.

Keywords: Shoreline, Laser Scanning data, Coastal Erosions, Retreat. AHHWL. Bangmoeri beach

INVESTIGATING CORAL REEF LOSS AND ITS CAUSES AROUND PANGGANG ISLAND, SERIBU ISLANDS, INDONESIA

Aulia L. Zeintrinanda (1), Susanna Nurdjaman (1)

[1] Department of Oceanography, Faculty of Earth Sciencesand Technology, Institut Teknologi Bandung (ITB) No.10, Jalan Ganeca, 40116Bandung, Jawa Barat, Indonesia
Email: aulialzein95@gmail.com; susanna@fitb.itb.ac.id

Abstract: The growth of coral reefs is influenced two factors that are anthropogenic and natural factors include salinity, temperature, light and solar radiation, nutrients, and depth. The objective of this study was to examine the changes in coral reefs area around Panggang Island and to know whether oceanographic parameters such as temperature, chlorophyll-a, salinity, pH, brightness, hotspots, thermal stress, El Niño Southern Oscillation (ENSO), and Indian Ocean Dipole (IOD) influence the change. The method used in this research is remote sensing and field data observation. The image data used comes from Landsat 7 ETM+ (2001-2003) and Landsat 8 OLI/TIRS (2013-2016) for coral reefs. Aquarius Data (2013-2016) for salinity, and Aqua MODIS data (2002-2003 and 2013-2016) for chlorophyll-a. Field data for seawater quality in April 2016 obtained from National Institute of Aeronautics and Space. The results showed that the average rate loss of coral reefs area around Panggang Island, during 2001-2016 is 10.74 ha/year. The highest coral reef loss happened in 2013-2014 (42.9 ha), this is due to the thermal stress event that occured in December 2013 to April 2014 which reached -2.25oC/week. In 2014-2015 the coral reef area was increased by 37.3 ha, this is due to the coral planting activities in the study area. During 2013-2016 there is only one hotspot event spotted, so the phenomenon did not affect the change of coral width. According to the field observation in April 2016, the parameters that meet the reef water quality standards for coral growth are chlorophyll-a and pH, while temperature, salinity, and brightness does not meet the standards.

Keywords: Coral reef, Loss, Panggang Island, Sea Water Quality, Thermal Stress

A STUDY ON EVALUATING THE ACCURACY OF SEA ICE CONCENTRATION DERIVED FROM AMSR2 DATA USING MODIS DATA

Ryohei Nagao (1), Kazuhiro Naoki (1), Kohei Cho (1)

[1] Tokai University 4-1-1 Kitakaname Hiratsuka, Kanagawa 259-1292, Japan
Email: kohei.cho@tokai-u.jp

Abstract: Passive microwave sensor AMSR2 was successfully launched by JAXA in May 2012 on-board GCOM-W satellite. The antenna diameter of AMSR2 is 2.0m which provide highest spatial resolution as a passive microwave sensor in space. The sea ice concentration images derived from AMSR2 data allow us to monitor the detailed sea ice distributions of whole globe every day. The sea ice concentration estimated from AMSR2 data were evaluated using MODIS data observed from Aqua satellite within few minutes after AMSR2 observation from GCOM- W1. The procedures of the evaluation are as follows. Firstly, MODIS ch2 data were binalyzed to discriminate sea ice from open water and sea ice concentration of each pixel size of AMSR2 were calculated. Then the AMSR2 sea ice concentration of each pixel was compared with the sea ice concentration calculated from MODIS data. The result suggested the possibility of estimating sea ice concentration from AMSR2 data with less than 10% error under good weather condition. On 16 September 2012, the minimum sea ice extent in Northern Hemisphere was recorded by AMSR2 in the history of passive microwave sensor observation from space. The annual sea ice extent graph produced from the historical passive microwave sensor data strongly suggested the trend of sea ice extent reduction in the Northern Hemisphere. The importance of sea ice monitoring with AMSR2 is increasing.

Keywords: passive microwave sensor, ice concentration, global warming, GCOM-W1

IDENTIFYING NATIONAL SECURITY THREAT BASED ON REMOTE SENSING DATA, CASE STUDY OF MOUNT AGUNG VOLCANIC ASH PLUME

Luthfiana, RF. (1), Fadilah, ND. (1), Manessa, MDM. (1)

[1] Sensing Technology Department, Defense Technology Faculty, Indonesia Defense University, Sentul, Indonesia
Email: fatihrahmaluthfiana94@gmail.com

Abstract: Indonesia one of the country with the most active volcano mountain. The numbers of an eruption were affecting the economic and national security aspect. Remote sensing technique is one of the advanced methods to observe and monitor the activity of eruption, one of it is the volcanic ash plume. A daily Modis imagery was used, then the mean of the infra-red algorithm is utilized to detect the phenomenon. This study demonstrates that volcanic ash plume identification from remote sensing based data may give a useful contribution for the operational monitoring of erupted volcanic mountain especially in Mount Agung.

Keywords: Volcanic Ash Plume, Modis Imagery, National Security

PERFORMING VISUAL ANALYSIS USING HIGH RESOLUTION IMAGES TO IDENTIFY AND ESTIMATE MILITARY ASSET CAPABILITY

Capt. Hasnul Hady Karim (1), Lt. Col. Mohamad Wasli Musa (1), Col. Abdul Rashid Modzni (1)

[1] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC), No.13 JalanTun Ismail, 50480, Kuala Lumpur, Malaysia
Email: hhady@remotesensing.gov.my; wasli@remotesensing.gov.my; rashid@remotesensing.gov.my

Abstract: Nowadays, remote sensing imagery data is an important element to provide critical information about the situation or event in earth surface. Implementation of high resolution images for visual analysis has fundamental to identify critical information needed. By utilizing high resolution images, visualization will depict features clearly to perform accurate measurement. Basic measurement will assist feature size calculation to understand the possible space for certain asset. However, understanding and knowledge about surrounding environment will guide analyst to perform information verification. By manipulating the combination of high resolution image features, high accuracy image processing and geographic information system measurement tools would be able to enhance visualisation analysis to answer critical question that needed for decision making proses consideration. In this paper, visualisation analysis is to predict amount of asset that possible to relative strength of military operation. The aim of this study is to evaluate the opportunities of high resolution imagery satellite in term to identify critical information to be manipulated into military decision process.

Keywords: Visual Analysis, High Resolution, Military Features, Estimation, Critical Geoinfo

HOW LAND USE PATTERN PLAYS AN IMPORTANT ROLE TO DETERMINE THE URBAN LAND SURFACE TEMPERATURE: A SPATIAL REGRESSION APPROACH

Suman Chakraborti (1), Anushna Banerjee (1), Srikanta Sannigrahi (2), Arabinda Maiti (3), Shouvik Jha (4)

[1] Centre for the Study of Regional Development, School of Social Sciences, Jawaharlal Nehru University, New Delhi 110 067
[2] Department of Architecture and Regional Planning, Indian Institute of Kharagpur, Kharagpur 721302
[3] Geography and Environment Management, Vidyasagar University, Midnapore 721102
[4] Indian Centre for Climate and Societal Impacts Research (ICCSIR), Kachchh-370 465, Gujarat, India
Email: srikanta.arp.iitkgp@gmail.com

Abstract: Changing land-use pattern drastically affects the surface temperature in the urban area. Increasing impervious surface is abundantly modifying the thermal structure of the city and creates the problem of urban heat island. Furthermore, the green cover has significant positive effects of reducing the temperature, forms an urban cooling effect in the city. The present study investigates impacts of the shape, pattern, and configuration of the two dominant land use/land cover classes (built-up and green surface) on the land surface temperature (LST) in Hyderabad city, the sixth largest urban agglomerations of India. Different class-level landscape metrics at neighbourhood level were employed to evaluate the spatial variation of LST. Geographical Weightage Regression (GWR), a local regression model, performed to examine the local effects of LST. Results revealed that increasing fragmentation of built-up has significant influence to enhance LST, whereas, urban green surface, the PLAND, and IJI negatively affect the LST for both the periods in which LSI significantly positively influence LST. The estimated LST is found to be highly sensitive to the changes in land-use pattern and their configuration. A Moran' I cluster value 0.399 and $P<0.01$ exhibits the spatial dependencies between LST and landscape pattern for both the reference years. The spatial regression result suggests that with the expansion of built-up in the neighbourhood, there is a discernible increase in the LST. Similarly, fragmented green cover reduces the neighbouring temperature. However, it is evident from the result that a compact growth of built-up might have reduced effect on the LST. The outcome of this study will help the planners to obtain insight on where urban management and green surface planning is necessary for mitigating the surface temperature.

Keywords: Landscape Metrics, LST, GWR, Spatial Clusters, Spatial Regression, Urban Heating

VEGETATION AND BUILT –UP AREA TRANSFORMATION ON DENSELY POPULATED ISLAND, SPERMONDE ARCHIPELAGO

Syazwi Qutbhi Al Azizi (1), Nurjannah Nurdin (2)(3), M.Akbar AS (3)

[1] Urban Planning Department, Hasanuddin University, Jl. Malino, Borongloe, Bontomarannu, Kabupaten Gowa, 92119. Indonesia.
[2] Marine Science Department, Hasanuddin University, Jl.Perintis Kemerdekaan km.10, Makassar, 90245. Indonesia.
[3] Center for Regional Development & Spatial Information (WITARIS), Hasanuddin University, Jl.Perintis Kemerdekaan km.10, Makassar, 90245. Indonesia.
Email: cicisawi@gmail.com; nurj_din@yahoo.com; akbarmuhammad.1818@yahoo.com

Abstract: The aims of this study are to dynamic change analysis of building density and vegetation transformation into buildings. This Study was used moderated spatial resolution Landsat in 1993 to 2018. Field study was conducted on Barrang Lompo island that is one of small island in Spermonde archipelago. The normalized difference built-up index and Normalized difference Vegetation Index were used for mapping urban built-up areas and vegetation area. The methods for extraction of built-up and vegetation areas using Landsat imagery comprised four major steps: pre-processing and examination of satellite data, image enhancement through resolution merging, development of the built-up area extraction method, and accuracy assessment. Barrang Lompo is a small island that has a very dense population. It has an area of 26ha and a population of around 5000 people. For 25 years, it has been undergone a very rapid change. The dynamic change from vegetation and non-built up area to dense built up area.

Keywords: built up area, vegetation, Landsat, Spermonde

DASYMETRIC MAPPING METHODS FOR IMPROVING DENSITY POPULATION IN BAC TU LIEM DISTRICT

Do Thi Phuong Thao (1), Nguyen Van Loi (1), Tran Thi Tuyet Vinh (1)

[1] Hanoi University of Mining and Geology, 18 Pho Vien, Duc Thang, Ha Noi, Viet Nam
Email: dothiphuongthao@humg.edu.vn; nguyenvanloi@humg.edu.vn; tranthituyetvinh@humg.edu.vn

Abstract: Usually, demographic statistics data is represented by a choropleth map or dot map. This type of representation has several limitations, in an administrative boundary the population is the same. Dasymetric method overcomes this disadvantage. The article mentions application of dasymetric mapping method to redistribute the block-group populations into a 30m grid, integrating land use, extracted from remote sensing data and census data in 2017.

Keywords: dasymetric, density population, Bac Tu Liem

COMPARISON OF LAND COVER CLASSIFICATIONS BASED ON OF ROUGH SET THEORY

Yoshie Ishii (1), Hasi Bagan (2), Koki Iwao (3), Tsuguki Kinoshita (4)

[1] Graduate School of Agriculture, Ibaraki University, 3-21-1 Chuuo, Ami, Inashiki, 300-0393 Ibaraki, Japan
[2] Institute of Urban Studies, Shanghai Normal University, No.100, Guilin Rd. 200234 Shanghai, China
[3] Geological Institute of Geology and Geoinformation Geological Survey of Japan, Advanced Industrial Science and Technology Central 7, 1-1-1 Higashi, Tsukuba, 305-8567 Ibaraki, Japan
[4] College of Agriculture, Ibaraki University, 3-21-1 Chuuo, Ami, Inashiki, 300-0393 Ibaraki, Japan
Email: 18am401h@vc.ibaraki.ac.jp; hasibagan@hotmail.com; iwao.koki@aist.go.jp; tsuguki.kinoshita.00@vc.ibaraki.ac.jp

Abstract: Rough set theory is applied to remote sensing such as hyperspectral band selection and object detection. This theory can also be applied for pixel-based land cover classification. Original rough set model is applied after optimization of original DN (Digital Number) in each band. Also, variable precision rough set model which allows some contradictions and graded rough set model which enables to handle original DN are proposed. However, accuracies of these proposed models have not compared each other. In this study, we first evaluated these rough set-based classification accuracies by changing parameters such as number of training data and optimization of original DN in each band. Then, we defined optimal parameters for graded rough set model. After that, we compared the accuracy with that of MLC and SVM which are traditional classification methods. Landsat 8 image were used, and the study area was chosen around Kasumigaura Lake in Ibaraki, Japan. From these experiments, we found that the classification accuracy using graded rough set with defined optimal parameters was relatively higher than that of using any other rough set model. And kappa coefficients of MLC, SVM and graded rough set classification were around 0.85. From these results, the accuracies of these three methods were statistically no difference under the significant level of 5 percent. Furthermore, from the investigation of misclassified points, we found that most of misclassified points were mixed cells. In conclusion, we could propose graded rough set with optimal pattern which showed better accuracy than that of existing methods. We also regard misclassifications are occurred not by the classification method but by mixed cells caused by the limitation of spatial resolution.

Keywords: Graded rough set, supervised classification, land cover classification, Landsat 8 (OLI)

MULTI-TEMPORAL ANALYSIS OF KOMPSAT IMAGERY FOR DETECTING PITCH CANKER DAMAGED TREES

Hwa-Seon Lee (1), YanYan Piao (1), Kyu-Sung Lee (1)

[1] Inha University, Department of Geoinformatic Engineering, 100 Inharo, Nam-gu, Incheon, S. KOREA
Email: hslee89@inha.edu; yanyan213@naver.com; ksung@inha.ac.kr

Abstract: Pine pitch canker is a relatively new tree disease found in Korea, which is caused by the fungus (Fusarium circinatum). Considering that pitch canker is mainly occurred in mild climate regions, the occurrence of pitch canker in Korea might be an exceptional case and be related to the regional climate changes. The occurrence of pitch canker in Korea is now regarded as an endemic that represents small and scattered spatial distribution and low severity. This study aims to propose a remote sensing methodology for effectively detecting infected tree caused by pitch canker considering the occurrence characteristics of spatial distribution and mild symptoms. For this, two scenes of KOMPSAT high resolution multispectral images acquired over the study area in Heanam, southern part of Korea were used. KOMPSAT-2 image was acquired on April 20, 2011 while KOMPSAT-3 image was acquired on March 15, 2015. Only forest stands of pitch pine and black pine, which are most susceptible species to pitch canker, were extracted from each image using digital forest stand map. Normalized difference vegetation indices were calculated from each images and then NDVI difference between two images was obtained. If there were no significant changes in pine forests between 2011 and 2015, the NDVI difference would be zero theoretically. The negative value of NDVI difference indicates that the decrease of foliage mass and vigor status in 2015, and therefore could be estimated as a damaged tree caused by pitch canker in 2015. To detect infested tree caused by pitch canker, optimal thresholds were selected from the scattergram showing the relationship between NDVI of 2015 and NDVI difference between 2015 and 2011. The detection result was evaluated by the field survey conducted in November 2015 with high accuracy. A false alarm was mainly observed in mixed forest consisting a healthy pine tree with deciduous. Multitemporal analysis is effective to emphasize the difference of spectral reflectance between healthy tree and damaged tree representing weak symptoms as well as mitigate back ground effects.

Keywords: pitch canker, forest disease, multi-temporal, KOMPSAT, NDVI difference

FEASIBILITY STUDY OF NORMAL HEIGHT SYSTEM IN TAIWAN

Chun-Jia Huang (1), Jen-Wei Hsu (1), Jen-Yu Han (1)

[1] Department of Civil Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan (R.O.C.)
Email: d05521008@ntu.edu.tw; r06521805@ntu.edu.tw; jyhan@ntu.edu.tw

Abstract: The normal height system is based on the quasi-geoid, which represents the vertical distance from the quasi-geoid to terrain surface. To make possible an accurate normal height system, the normal gravity should be first determined. This study aims to build the quasi-geoid by using local gravity observations and a global spherical harmonic model in Taiwan. The quasi-geoid undulation was first computed by using the global Earth Gravity Model 2008 (EGM08) with a spherical harmonic model. In addition, the influence of terrain was also considered in the residual terrain model. The hybrid method was then used to construct a high-accuracy quasi-geoid component model in conjunction with the remove-compute-restore method, which includes surface curve fitting method. Finally, the normal heights were transformed by calculating the difference between the GNSS-derived geometric heights and the results of quasi-geoid undulation model. To evaluate its practical feasibility, the estimated normal heights were compared to the orthometric heights as adopted in Taiwan's national datum. Based on the numerical results, the mean relative difference to the orthometric heights is about 1.5cm per kilometer. It reaches the accuracy level that fulfils the needs of most engineering applications, but with less cost than that of the traditional approach for maintaining the orthometric height system.

Keywords: Normal Heights, Height datum, Global Navigation Satellite System (GNSS), Earth Gravity Model

MONITORING AND MEASURING THE WATER SURFACE LEVEL AREA OF MAE KHAM DAM IN NORTHERN THAILAND USING POLARIZATION SAR IMAGES

Kamolratn Chureesampant (1), Maitree Foitong (1), Wiwat Khlairasamee (1)

[1] Electricity Generating Authority of Thailand (EGAT), Survey Division, Map and Geographic Information System Department, Photogrametry and Remote Sensing Section, No. 53 Moo 2, Charunsanitwong Road, Bang Kruai, 11130, Nonthaburi, Thailand
Email: kamolratn.c@egat.co.th; maitree.f@egat.co.th; wiwat.k@egat.co.th

Abstract: According to the traditional on-site hydrographic survey for monitoring and measuring water surface area extent is time consuming, labor-intensive and costly, while the satellite remote sensing resources that are attractive tool and provide the opportunity to monitor hydrological process. Therefore, this paper addresses the measuring surface area of Mae Kham dam in Northern Thailand from Synthetic Aperture Radar (SAR) for the Advanced Land Observing Satellite (ALOS)/Phased Array type L-band Synthetic Aperture Radar (PALSAR) in single- and dual-polarization and fully polarimetric data obtained from different temporal variation. All polarization combinations are investigated quantitatively by supervised classification in order to generate the water surface area automatically. Within this framework, the combination with gray level co-occurrence matrix (GLCM)-based mean textural measure and enhanced frost adaptive filtering is considered in order to remove multiplicative speckle noise. The fusion of measured daily data from telemetry system for water level measurement with SAR satellite imagery is taken into account. Because it corresponds to spatial change in an appropriate time interval. Classification results were generated by taking water surface level area using multi-temporal SAR data and telemetry data. The Geographic Information System (GIS) process involved in creating upper depth contour. Experimental results reveal that the combined cross-polarized (HV+VH) power data with the mean textural is the most suitable. Because the supplement of cross-polarization data used as the characteristics for the HV and VH data are mostly similar with the smoothing effect on the image of the texture. This operational approach enhances water surface area monitoring and measurement. It supports several applications e.g., hydrological modeling, drought/flood prediction, and reservoir area utilization planning.

Keywords: Synthetic Aperture Radar (SAR), Polarization Combination, Gray Level Co-occurrence Matrix (GLCM), Adaptive Filtering, Water Surface Level Area

UAV REMOTE SENSING TECHNOLOGY FOR MAPPING BIOGEOGRAPHY AND BIODIVERSITY OF PADAKEMBANG VILLAGE, WEST JAVA, INDONESIA

Lissa Fajri Yayusman (1), Muhammad Fakhriy Ramadhan (1), Deni Suwardhi (1)(2), Ketut Wikantika (1)(2)

[1] Center for Remote Sensing, Institut Teknologi Bandung, Bandung, Indonesia
[2] Remote Sensing and GIS Research Group, Institut Teknologi Bandung, Bandung, Indonesia
Email: lissafajri@gmail.com; fahriramadan2523@gmail.com; deni@gd.itb.ac.id; ketut@gd.itb.ac.id

Abstract: Padakembang Village is located at the foot of Mount Galunggung, an active stratovolcano in Tasikmalaya Regency, Indonesia. Supported by its temperature, water resource, and fertile soil, this village possesses high biodiversity of various vegetation and become a potential area of ecotourism. However, the village development and natural resource management have not been optimized because of the lack information about the biogeography and land cover condition. To support this program, Unmanned Aerial Vehicle (UAV) was used for high resolution mapping of the Padakembang Village. Aerial photos were taken using a fixed-wing UAV covering about 5 km2 area. Because of the large area coverage and hilly topography, the acquisition was performed in four blocks area based on the similar elevation to maintain the spatial resolution. Geo-referencing process was performed using fourteen Ground Control Points (GCPs) measured in rapid-static method with radial baseline. The methodologies and the obtained results are shown and discussed in this paper. The results presented as ortho-image and contour map of the village could be employed by the local government as the main reference for natural resource management, development, and monitoring of the Padakembang Village.

Keywords: UAV, Photogrammetry, Biogeography, Biodiversity

ATMOSPHERICALLY CORRECTED D-INSAR TO DETECT TIME SERIES DEFORMATION PRECURSOR AT AGUNG VOLCANO USING SENTINEL-1A SAR DATA

Dina Noviana Rahmawati (1)(2), Asep Saepuloh (1)(3), Ketut Wikantika (1)(2)

[1] Center for Remote Sensing, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[2] Remote Sensing and Geographic Information Science Research Group, Faculty of Earth Science and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
[3] Research Group of Petrology, Volcanology, and Geochemistry, Faculty of Earth Sciences and Technology, Bandung Institute of Technology, Jl. Ganesha No. 10, Bandung, Indonesia
Email: dinanovr@students.itb.ac.id; saepuloh@gc.itb.ac.id; ketut@gd.itb.ac.id

Abstract: Agung volcano located in the far east of Bali Island, Indonesia is one of the active volcanoes parts of Circum-Pacific ring of fire. Following the large eruption of 1963, the seismicity of Agung volcano increase significantly and put into alert level IV in September 2017. Then, the early eruptions have occurred in November 25th and 26th, 2017. Regarding this eruption, this research was aimed to inspect the deformation series of Agung volcano in August 2017 to January 2018 span using the atmospherically corrected Differential Interferometric Synthetic Aperture Radar (D-InSAR) of multiplatform Sentinel-1A data. The D-InSAR techniques are used commonly for surface deformation monitoring by eliminating the topographical influence of the interferogram's phase. The Pairwise Logic Technique as termed of PLT is applied following the D-InSAR processing to eliminate atmospheric phase delay. The common image selection for D- InSAR pair served as the basis of the PLT. The method was used to Sentinel-1A in ascending and descending orbits to observe the deformation due to changes in Line-of-Sight (LOS). The deformation velocity was then calculated on the daily basis to omit the different in deformation magnitude due to temporal baseline. According to the PLT in ascending orbit, the surface velocity near the summit was calculated from -4,111 mm/day to 2,875 mm/day. The velocity gained from the descending orbits is different from the ascending, ranged from -2,538 mm/day to 3,564 mm/day. The difference happens because of the different LOS orientation and an increase in seismicity of deep volcanic activities.

Keywords: Agung volcano, deformation, D-InSAR, pairwise logic technique, Sentinel-1A

TEMPORAL SURFACE TEMPERATURE OF AGUNG VOLCANO USING DAY AND NIGHTTIME OBSERVATIONS OF ASTER TIR

Adelina Nur Afiani (1)(2), Asep Saepuloh (1)(3), Ketut Wikantika (1)(2)

[1] Center for Remote Sensing, Bandung Institute of Technology (ITB), Labtek IX-C Jl. Ganesha No. 10, 40132 Bandung, West Java, Indonesia
[2] Research Group of Remote Sensing and Geographic Information Science, Faculty of Earth Sciences and Technology, Bandung Institute of Technology (ITB), Labtek IX-C Jl. Ganesha No. 10, 40132 Bandung, West Java, Indonesia
[3] Research Group of Petrology, Volcanology, and Geochemistry, Faculty of Earth Sciences and Technology, Bandung Institute of Technology (ITB), Labtek IV Gedung Teknik Geologi Jl. Ganesha No. 10, 40132 Bandung, West Java, Indonesia
Email: adelinanurafiani@students.itb.ac.id; ketut@gd.itb.ac.id; saepuloh@gl.itb.ac.id

Abstract: A research using Thermal Infrared (TIR) remote sensing have been conducted at Agung volcano to analyze the temporal thermal characteristics in the crater. We collected and identified the surface temperature of Agung volcano prolong prior and post eruptions in 2017-2018. The land surface temperature is one of the crucial parameters for observing volcanic activities by the occurrence of temperature change anomalies in the crater surface. We used the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) day and nighttime thermal infrared observations over Agung volcano for 18 years from February 2001 to July 2018. The surface temperature was obtained by Temperature and Emissivity Separation (TES) method. This method was also applied to reduce the effect of thermal inertia from the objects. According to the proposed method, the surface temperature of the ASTER nighttime observation at Agung volcano is 15 to 20°C in an intra-eruption period between 2001-2016. However, three months preceding the 21 November 2017 eruption, the maximum surface temperature at the summit increased to 34.93°C. Interestingly, the temperature decreased a week before the eruption to 28.41°C. Contrary, the highest surface temperature was obtained one day before the eruption on 28 June 2018 about 104.12°C. According to the visual interpretation of LANDSAT 8 image, a new incandescent lava extruded on 2 July 2018. Meanwhile, the ASTER daytime observed two weeks after the eruption of 25 November 2017 showed surface temperature at the summit about 105.99°C. The derived temporal surface temperature based on ASTER TIR provided prolong prior and post thermal signature to a new eruption phase of an active volcano.

Keywords: ASTER, thermal infrared, surface temperature, Agung volcano

EVALUATION OF INTENSITY AND RGB VALUES ON 3D POINT CLOUD CLASSIFICATION

Quan Li (1), Xiaojun Cheng (1)

[1] College of Surveying and Geo-Informatics, Tongji University, No. 1239, Siping Road, Shanghai 200092, China
Email: 329yvonnelee@tongji.edu.cn; cxj@tongji.edu.cn

Abstract: 3D point cloud classification has become an issue of major interest in recent years. The common workflow of 3D point cloud classification involves neighborhood selection, feature selection and extraction and the classification of points based on the respective features. The feature selection and extraction has been the focus of many studies. In most previous studies, only geometric features are used for classification and there are limited studies which have investigated the potential of both intensity and RGB values on classification using TLS (Terrestrial Laser Scanner) point cloud. Therefore, the main objective of this study is to carefully investigate the influence of intensity data and RGB values on the classification performance. Firstly, the point cloud data are over-segmented into spatially consistent supervoxels. The supervoxel based neighborhood is utilized to improve computational efficiency. Then four feature sets, namely the geometric features, the geometric features combined with the intensity based features, the geometric features combined with RGB based features and the geometric features combined with both intensity and RGB based features are extracted based on the supervoxel neighborhood. These features are then used for training four Random Forest classifiers in the training stage and for classification in the prediction stage. Finally, the recall, precision and overall accuracy are used to evaluate the classification results. The designed experiments are implemented on two real-world datasets collected by a Faro Focus3D scanner. To train the classifiers and evaluate the classification results, these two datasets are manually labelled and classified into six classes which involve ground, façades, pole-like objects, trees, vegetation and curbs. The experimental results show that the overall classification accuracy has been improved when the geometric features are combined either with intensity or RGB based features and the geometric features combined with both intensity and RGB based features achieves the highest overall accuracy. The results also indicate that with the help of intensity and RGB based features, the classification precision of pole-like objects has been greatly improved.

Keywords: Point Cloud; Classification; Supervoxel; Intensity; RGB

CLOUD SERVICE PLATFORM SYSTEM OF COUNTY-SCALE REMOTE SENSING INFORMATION PRODUCTS BASED ON HIGH-RESOLUTION SATELLITE IMAGES

Yongtao Jin (1), Longfang Duan (1), Cong Wang (1)

[1]North China Institute of Aerospace Engineering, Hebei province, China
133 Aimin East Road, Langfang, Hebei 065000, P.R.China
Email: jsj_jin@126.com; longfang0923@163.com

Abstract: The Chinese high resolution earth observation system (CHEOS) project is a major national special project. Since its implementation in 2010, it has played an important role inland-use surveys, resource comprehensive surveys, atmospheric and water environmental protection, disaster monitoring, and other application fields. Furthermore, it provides feasibility for the service of remote sensing technology in the development of regional economy and county economy. This article selects the demand for comprehensive regional management of new urbanization in the development of Beijing-Tianjin-Hebei urban-rural integration as a typical application of county-scale remote sensing in CHEOS, and completes the design and development of system technology architecture and system function on the basis of cloud service. The background service adopts ArcGIS Server to provide interface services for the front end. The front-end page uses the ArcGIS API for JavaScript to implement the functional modules, and introduces frameworks such as Bootstrap and jQuery to improve the system interface. By constructing the pivotal service components for remote sensing monitoring applications with universality and stability, the system realizes a set of refined, streamlined, and easily-expanded rapid development frameworks. And the application of products of the high-resolution remote sensing satellite images in different fields such as agriculture, forestry, environmental protection, and land resources, as well as multi-level administrative regions of cities, counties, and townships is centrally displayed and analyzed by this system. The aim of this system is to achieve an on-demand service model for multi-scale high-resolution remote sensing information products in the Beijing-Tianjin-Hebeiregion.

Keywords: CHEOS, High-resolution Satellite Images, County-scale Remote Sensing, Cloud Service Platform System

COMPARATIVE ANALYSIS OF EDGE-ASSISTED IMAGE MATCHING TECHNIQUES

Hyowon An (1), Changjae Kim (1), Hyo Sung Lee (2), Dae Sik Shin (3), Hyeon Seung Song (3)

[1] Civil & Environmental Engineering, Myong Ji University, 116, Myongji-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Republic of Korea
[2] Civil Engineering, Sunchon National University, 255, Jungang-ro, Suncheon-si, Jeollanam-do, Republic of Korea
[3] The 3rd R&D Institute, Agency for Defense Development, no.35, 51, Oncheon-ro, Yuseong-gu, Daejeon, Republic of Korea
Email: gydnjs1110@naver.com; cjkim@mju.ac.kr; hslee@scnu.ac.kr; dsshin@add.re.kr; hssong@add.re.kr

Abstract: Due to the increasing demand for 3D spatial information together with quickly improving sensor, mobile platform, and computer technologies, photogrammetry and computer vision techniques are becoming significantly important nowadays. Among such techniques, a pixel-wise stereo-matching approach (especially, Semi-Global Matching (SGM)) is focused on in many photogrammetric and computer vision applications. SGM is showing good performances in terms of 3D point cloud generation with high-density and high precision. In this research, we are dealing with the images taken over urban areas to produce Digital Surface Models (DSM). Usually, buildings in urban areas can cause various amount of x-parallax; hence, the original SGM still have high possibility of mismatching results. In this regards, strong semantic information (i.e., edge information) is introduced into the stereomatching approaches and the results are compared each other. More specifically, the traditional template and SGM matching methods are adopted and modified. Four different approaches: 1) Traditional template matching, 2) Traditional template matching + Edge information, 3) Original SGM, and 4) Original SGM + Edge information, are carried out and their matching results are compared and analyzed. In case of SGM, edge information can be injected into the matching procedure internally by considering the information when the matching cost is calculated. On the other hand, an external approach can be applied for the case of template matching. The edge-based and the original template matching approaches are implemented separately; then, the matching results are combined selectively. After the comparative analysis of these matching results, the best approach is finally selected and 3D point cloud is generated. Conclusively, strong semantic information from the edges can contribute to improving the matching results.

Keywords: Stereo Image Matching, Photogrammetry, Semi-Global Matching, Template Matching, Edge-assisted Matching

THE GUIDANCE SEEKER ONBOARD REMOTE SENSING SATELLITE TO ENHANCE MISSION EFFECTIVENESS

Pei-Hsuan Wu (1), Jer Ling (1), Po-Yen Huang (1)

[1] National Space Organization (NSPO), Hsin-Chu, Taiwan,30078
Email: phyllis@nspo.narl.org.tw; jl@nspo.narl.org.tw; mikehuang@nspo.narl.org.tw

Abstract: Nowadays, the swath has trend to get smaller with the development of high resolution satellite for fixed number of pixels. So it is getting more important to capture clear target image efficiently. Otherwise, it might be taken several times to have one because of the cloud. The object of this paper is to develop on-board guidance seeker on remote sensing instrument which is used to get wide-angle images and detect target before task target is captured. Base on wide-angle images and detected-target, the path of satellite can be fine turned to direct task target without cloud to get clear image or to find target ships and so on. The on-board guidance seeker includes a wide angle camera, an on-board machine learning unit and an on-board real time path fine-tuning unit. This kind of on board AI-driven design can enhance mission effectiveness. Also it can be used to rescue efficiently.

Keywords: AI Target-Seeking, Seeker, Machine Learning, path-corrected

COMPARISON OF LAND COVER CLASSIFICATION METHODS FOR ECONOMIC CROPS IN THAILAND

Tanakorn Sritarapipat (1), Siam Lawawirojwong (2), Panu Srestasathiern (2)

[1] School of Geoinformatics, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand
[2] GISTDA Academy, Geo-Informatics & Space Technology Development Agency, Bangkok 10210, Thailand
Email: tanakorn.s@sut.ac.th; siam@gistda.or.th; panu@gistda.or.th

Abstract: Thailand is the large exporter for agricultural products and the main economic agricultural products are rice, cassava, maize, para-rubber, sugar cane and oil palm. Updated and reliable economic crop areas in country level are necessary for planning and management for Thailand's economic growth. This research aims to find a suitable classification method for land cover types with economic crops; urban, water, forest, rice, cassava, corn, maize, para rubber, sugar cane, and oil palm in Thailand. Multiple Landsat-8 (OLI) images were used as dataset. We systematically sampled training data covering almost parts of Thailand. Supervised classification methods; maximum likelihood, support vector machine, and neural network, were employed to classify the land cover types. In the experiments, the comparisons of the results of the classification methods were described with the accuracy and time process. The results showed that neural network method with multi-layers perceptron provided the highest accuracy with the overall accuracy of 91.83%, the kappa coefficient of 0.7552, and the lowest accuracy in each class of 56% and computing time of 51 minutes. While, maximum likelihood method provided the lowest accuracy with the overall accuracy of 60.29%, the kappa coefficient of 0.3108, and the lowest accuracy in each class of 7% and computing time of 35 second.

Keywords: Land cover, Economic Crop, Maximum Likelihood, Support Vector Machine, Neural Network, Landsat 8

AUTOMATIC PADDY GROWTH STAGE IDENTIFICATION BASED ON CONVOLUTIONAL NEURAL NETWORK

Agustan (1), Swasetyo Yulianto (1), Robby Arifandri (1), Heri Sadmono (1), Yudi Anantasena (1)

[1] Center for Regional Resources Development (PTPSW), Agency for the Assessment and Application of Technology (BPPT), Jalan M.H. Thamrin No. 8, Jakarta, Indonesia
Email: agustan@bppt.go.id

Abstract: Recently, two methods have been developed for paddy growth stage monitoring which are satellite-based remote sensing and statistic-based terrestrial observation. Satellite-based remote sensing method has the advantage on area coverage and repeat observations (temporal resolution), whereas statistic-based terrestrial observation method has the advantage on actual paddy condition. One of the statistic-based terrestrial observations used is the Area Frame Sampling method. Area frame sampling method recently is assessed as paddy reporting mechanism in Indonesia that conducted on monthly basis. With this method, the observers report paddy growth stage manually by a developed mobile phone application, in the last week of each month and attach photos of paddy as evidence. Photo recording techniques are carried out with standard operating standards. Paddy conditions are reported into 5 classes, namely land preparation, early vegetative (V1), late vegetative (V2), generative, and harvesting. However, the photos are very diverse due to the observation time factor i.e. taken in the morning or afternoon or even in the evening, and also due to the specifications of camera-phone that are not the same. To mitigate the observer's subjective assessment of the paddy growth stage, a pattern recognition method will be introduced and implanted in a mobile device. Thus the application will automatically classify the recorded photos and become a reference for observers in determining the paddy growth stage. This paper discusses the process of photo classification using Convolutional Neural Network (CNN). Recently, CNN are getting used more commonly and getting better to do image classification. In this research, we utilize Tensorflow with retraining method, which gets ImageNet model that has been already trained and then create new classification layer on the final layer. With this method we can get new classifier based on 3.000 photos with accuracy around 70% with 3-5 hours training time using consumer-grade computing machine.

Keywords: Paddy, Convolutional Neural Network, Area Frame Sampling, Image Classification

QUANTITATIVE COLLIMATION MEASURING METHOD WITH MOVING THEODOLITE

Ho-Lin Tsay (1), Shenq-Tsong Chang (1), Ming-Fu Chen (1), I-Hao Lin (1)

[1] Instrument Technology Research Center, National Applied Research Laboratories, TAIWAN, ROC
Email: hltsay@itrc.narl.org.tw

Abstract: Optical collimator is a test equipment for the simulation of infinite-finite objects in the laboratory. It is used to focus and measure the remoting sensing telescope. This paper proposes a quantitative measurement method for collimation of collimator. In this method, we use theodolite to measure relative angle at different aperture positions of the collimator, which lead to collimator's quantitative collimation and its corresponding object distance.

Keywords: Collimator,Collimation,Theodolite

INVESTIGATION OF THE PARAMETER FOR SEA ICE CONCENTRATION FROM AMSR2

Ryohei Nagao (1), Kazuhiro Naoki (1), Kohei Cho (1)

[1] Tokai University Research & Information Center (TRIC), 2-28-4, Tomigaya, Shibuya-k, Tokyo 151-0063, Japan
Email: kohei.cho@tokai-u.jp

Abstract: The microwave radiometer (AMSR2) on board GCOM-W was launched on May 18, 2012. The sea ice concentration(SIC) is opened as a standard product of AMSR2. The SIC is calculated by the Bootstrap algorithm and must determine some parameters. The parameters were changed in 2016. Therefore, we examined the parameter for calculating the SIC from AMSR2. SIC was calculated based on fixed values before 2016. After the changing the parameter, SIC is calculated based on Variable value from data of the previous day. In this study, the authors have investigated the difference between before changing parameter and after changing parameter. The basic idea of evaluation of accuracy is to use data of optical sensor with higher resolution. As the result, the accuracy of estimating SIC is improving by changing parameters.

Keywords: Sea Ice, Passive Microwave Radiometer, GCOM-W, Global Warming

AN EXAMINATION OF METHODS FOR EVALUATING DIFFERENCES AMONG HIGHLY ACCURATE LAND COVER CLASSIFIERS

Hidetake Hirayama (1), Mizuki Tomita (2), Keitarou Hara (2)

[1] Graduate School of Tokyo University of Information Sciences, 4-1 Onaridai, Wakaba-ku, Chiba 265-8501, Japan
[2] Department of Informatics, Tokyo University of Information Sciences, 4-1 Onaridai, Wakaba-ku, Chiba 265-8501, Japan
Email: h17002hh@edu.tuis.ac.jp; tomita@rsch.tuis.ac.jp; hara@rsch.tuis.ac.jp

Abstract: Many researches have focused on creating land cover maps from satellite images. Recently, advanced machine learning techniques have made it possible to create classifiers that are far more accurate than the earlier methods. The Kappa coefficient has been widely used for evaluation of classification accuracy, but with the new highly accurate classifiers there is often little difference among the Kappa coefficients. As a result, the Kappa coefficient alone is no longer sufficient for comparing classification results. The purpose of this research is to examine alternative methods that can appropriately evaluate the differences among highly accurate classifiers. Recent RapidEye satellite images were analyzed using six machine learning techniques (Random Forests, Bagging, XGBoost, Support vector machine, Neural network and K-nearest neighbor). The overall results for these classifiers were then compared using Z-test based on Kappa coefficient and McNemar's test implemented on paired nominal data. For the McNemar's test, the classification results among the six classifiers were also compared pixel by pixel for each of six land cover classes to generate p-values. The results showed that the classifiers with the highest Kappa values were XGBoost (0.985), Random Forests (0.982) and Bagging (0.975). The Z-test analysis of these results showed that the scores ranged from 0.7 to 2.9, and that although Bagging exhibited a significant difference between the other classifiers, there was no significant difference between XGBoost and Random Forest. In the McNemar's test, the p-value ranged from 0.0003 to 0.31, and there was not significant overall difference between XGBoost and Random Forests. When the McNemar's test was implemented for each land cover class, however, a significant difference was confirmed between Random Forests and XGBoost. For example, in the forest land cover class, although the user accuracies were almost the same for Random Forests (0.94) and XGBoost (0.95), the McNemar's test ($p < 0.05$) showed a significant difference between the two classifiers. These results show that differences among highly accurate classifiers can be statistically confirmed by performing McNemar's test for each land cover class, even when there is almost no difference in overall or class accuracy between classifiers.

Keywords: Land cover classification, Highly accurate classifiers, Accuracy assessment, McNemar's test, RapidEye

THE ACCURACY OF EIGHT BI-TEMPORAL CHANGE DETECTIONS TO ISOLATE EXTREME VALUES RELATED TO CLOUDS: CASES OF MOUNTAINOUS AND COASTAL TROPICS

Dyah R Panuju (1)(2), David J. Paull (1), Amy L. Griffin (3)

[1] School of Physical, Environmental and Mathematical Sciences, UNSW Canberra, Northcott Dr, Campbell ACT 2612, Australia
[2] Department of Soil Science and Land Resource, Bogor Agricultural University, Jalan Meranti, Kampus IPB Darmaga, Bogor, 16680, Indonesia
[3] Geospatial Science Discipline, School of Science, Royal Melbourne Institute of Technology (RMIT) University, Melbourne City Campus, Australia
Email: panuju@apps.ipb.ac.id

Abstract: Detecting the alteration of features captured in two or more digital images is an essential step for understanding ecological process. Numerous techniques of bi-temporal analysis have been developed to detect change processes employing clear optical images. Each technique had advantages, nonetheless landscape complexity and noises affected the results. Cloud has been an important challenge of change detection in tropical regions. Selecting appropriate methods to detect change while overcoming cloud problems is the main target of this research. Another class was subsequently added to the binary map of change to isolate extreme values related to clouds. Two sites located in tropical regions representing predominated mountainous and coastal zones were selected to evaluate the performance of eight change detection procedures. The result shows that combining Iteratively Reweighted Multivariate Alteration Detection (IRMAD) with kernel clustering produced the best accuracy (92.7%) for the mountainous region while the combination of PCA of index differencing with the clustering generated the highest accuracy (95.2%) for the coastal area. The accuracy procedures with the additional class to isolate change differs by procedures and sites, resulting in either increase or decrease accuracies. A few procedures increased while others decreased in missed detections and false alarms by additional class for isolating extreme pixels related to cloud.

Keywords: Change Detections, Cloud Isolation, Tropics, IRMAD Chi-square, PCA Differencing

LAND COVER CHANGE ANALYSIS IN BRUSSELS WITH THE COMBINATION OF CHANGE DETECTION METHODS AND USING INDICES

Saziye Ozge Donmez (1)

[1] Istanbul Technical University, Faculty of Civil Engineering, Department of Geomatics Engineering, Istanbul, Turkey
Email: donmezsaz@itu.edu.tr

Abstract: Land cover and land use (LULC) changes in the crowded cities are generally more than in rural areas. Remote sensing image analysis techniques are widely used for environmental monitoring in regional or national scales. Developing technologies, urban growth, demographic increasing, industrialization and so on can count as some reasons for cities land use changes. In the study, Brussel is chosen for analysis and land cover and observing the land use changes. Brussel is the capital of Belgium and one of the most growing cities in Middle Europe. The city has many kinds of LULC classes as urban, settlement, grassland, forest etc. In remote sensing aspect, different change detection methods are used in the study. LULC maps of the last decades of selected region according to the results. Sentinel-2 images are used for image analysis and multi- temporal data are used for the study area. The total amount of class areas is calculated and evaluated scientifically. It has been described in the terms of social-economic developments, also.

Keywords: Land use and land cover, Change detection

OIL SPILL SIGNATURE VARIANTS FOR OPTIMUM DETECTION AND TRACKING WITHIN SHORTWAVE VISIBLE TO THERMAL INFRARED BANDS

Jamal Jasmi Abdulla Althawadi (1), Mazlan Hashim (1)

[1] Faculty of Built Environment & Surveying, Geoscience & Digital Earth Centre, Reasearch Institute for Sustainable Environment (RISE), Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia
Email: jamjam144@hotmail.com; mazlanhashim@utm.my

Abstract: Remarkable advances have been made on satellite-based oil spills detection and tracking. The most significant spectral regions actively engaged in these studies ranging from the shortwave visible to thermal infrared (optical), and the microwave radar bands. The key elements in detecting the spill in both optical and radar bands are the ability to characterize the uniqueness of emanating interactions of incident energy on spills against the background, respectively. Given the background settings are determined by the sea/ocean surfaces conditions and corresponding local weather systems; as such producing large variations in resultant signatures of spills. Large variants within spill signatures caused high uncertainties in delineating between spills and look-alikes. Consequently, this paper reports the vector analyses of oil spill signatures with shortwave visible to thermal infrared bands of MODIS, Landsat TM, and Sentinel sensors over Arabian Gulf area. Factors to vector variants are emphasized within the inherent scalar element of the data acquisition of the sensors systems. Feature-based detection employing both point and region-based techniques were adopted to suit the multi-sensor data spatial resolutions in detecting the spills. Sea-truths for oil spills occurrences records have been comprehensive obtained authorities. Variants between spill signatures were characterized by divergence analysis. Results indicated exposure of spills from its initial occurrence time have high Correlation ($r^2 > 0.85$, $p < 0.005$) variations in signatures; inferred to spill reactions with the background sea. It is therefore, concluded that the optimum threshold within these variants for best compromise between the period of exposed-spills could be itemized based on local-sea conditions, hence producing minimum uncertainties with look-alikes.

Keywords: Oil spills, Spectral signatures, variants, Landsat TM, Sentinel, MODIS

APPLICATION OF LANDSAT DATA FOR COASTLINE CHANGES DETECTION IN SOUTH MINAHASA REGENCY

Munawaroh Munawaroh (1), Ibnu Sofian (1), Aninda W. Rudiastuti (1)

[1] Indonesia Geospatial Information Agency, Jalan Raya Bogor Km. 46, Cibinong Jawa Barat, 16911, Indonesia
Email: munawaroh@big.go.id; ibnu.sofian@big.go.id; aninda.wisaksanti@big.go.id

Abstract: Coastal dynamics has always been an exciting topic. Coastline mapping becomes the fundamental to environmental monitoring and management of coastal areas. Utilizing satellite data and ocean models, coastline change analysis carried on. The purpose of this study is to analyze the coastline changes at South Minahasa bay, North Sulawesi Province. Simulated wave height and coastline analysis were performed using WAVEWATCH-III, SWAN and Landsat imageries. The dynamics of changes in wind patterns and their effects on significant wave heights are simulated using wave models. Then the wave height data is used to perceive the effect on the erosion and accretion patterns of the shoreline changes. Coastline mapping and its change detection were performed using Landsat data interpretation results from 1972 to 2017. Simulation results showed that significant wave heights in Amurang Bay ranged from 0.4m to 1.2m in extreme conditions, while the extreme significant wave height resulted at Tanjung Kapitu and Waeontulap reaches 2m. Thus, the Amurang Bay area is relatively safe from erosion and abrasion due to high waves, which is inversely proportional to the conditions in Tanjung Kapitu and Waeontulap which are susceptible to erosion and abrasion due to high waves. The results of the wave height simulation are also consistent with the results of the shoreline change analysis conducted using multi-temporal Landsat series (Sensor TM and OLI TRS) by Normalized Difference Water Index (NDWI) method. The result of analysis from Landsat data shows that the length of the coastline of South Minahasa Regency in 1972, 1990, 1995, 2000, 2015, and 2017 respectively are 93,156.4 meters; 95,424.83 m, 94,985.60 m; 96,360.69 m, 95,257.98 m, and 95,386.20 m. Coastline changes mostly occur in the cape region of South Minahasa Regency, while in Amurang Bay is relatively stable and seen the addition of coastline in some locations. Thus, coastal protection by mangrove reforestation becomes the best solution in maintaining coastal, to prevent erosion and abrasion in the cape and Amurang Bay.

Keywords: Landsat, WAVEWATCH-III, SWAN, Coastline, NDWI

THE EFFECT OF LAND USE CHANGE ON LAND SURFACE TEMPERATURE OF DEPOK CITY, WEST JAVA USING LANDSAT IMAGE DATA

Perlita Angelika (1), Pricilia Chika Alexandra (1), Yerisca Adriani Dethan (1)

[1] Departement of Geography, Faculty of Mathematics and Natural Science, University of Indonesia
Jl. Margonda Raya, Beji, Pondok Cina, 16424, Depok, Indonesia
Email: perlita.angelika@ui.ac.id; pricilia.chika@ui.ac.id; yerisca.adriani@ui.ac.id

Abstract: The detection of change in land use digitally by using multi-spectral satellite imagery in the form of Landsat imagery helps in understanding the dynamics of the usage of land use. Moreover, the Landsat image can also be used to detect the surface temperature or LST (Land Surface Temperature) of an area. The land used is closely related to the surface temperature or LST of a region. The development of Depok City makes the use of land that is used as constructed area become higher. It affects the surface temperature because the more constructed an area, the temperature around it will increase. The purpose of this research is to see the relation between the changes of land used in Depok City and the surface temperature of Depok City in 2005-2017. The land used data is obtained from the supervised classification of Landsat 8 OLI/TIRS imager for year 2017 and 5 TM landscapes for year 2005. The surface temperature or LST is obtained from Landsat 8 OLI/TIRS and 5 TM Landsat processing so that obtaining the surface temperature data of Depok City.

Keywords: Landsat, LST, Land Use, Supervised

ERROR-ADJUSTED POINT ESTIMATION AND CONFIDENCE INTERVALS FOR ESTIMATING AREA OF CHANGE IN A TROPICAL PROTECTED AREA

Kamlisa Uni Kamlun (1)

[1] Faculty of Science and Natural Resources (Forestry Complex), Universiti Malaysia Sabah, UMS Road, 88400 Kota Kinabalu, Sabah, Malaysia
Email: kamlisa@ums.edu.my; unikamlun@gmail.com

Abstract: In monitoring of multi-temporal series of an area using remotely sensed data, an accuracy is used to express the level of correctness of the classification and change map. Estimation area of change applied using classification can be considered as accurate if the estimation stipulate an unbiased representation of the actual land cover of the region. Accuracy assessment encompassed the divergence of the image classification to reference data that were postulated to be true. Land cover change classification are estimated using accuracy, as well as the class-specific user's and producer's accuracies derived from the confusion matrix. In this study, inclusion probabilities were used to produce the error matrix by comparing the map and reference classification at each sample unit. The accuracy assessment was conducted using references data that were collected by stratified random sampling with strata defined by land cover classes in each change period of 1985-1998, 1998-2004, and 2004-2013 in Klias Peninsula. The results for the individual class areas (ha), adjusted area (ha), and margin of error for the 95% confidence intervals rates for the three periods of land cover change investigated in the study area. Based on the map and sample-based estimates differ by less than 1%, the forest occupied 60,067ha in the 2004-2013 time period, whereas the adjusted area estimated from the error matrix suggested a forest area of 60,596ha (margin of error of ±4,840 at 95% confidence interval). This shows a reduced land area of 529ha, which lies inside the 95% confidence interval. Therefore, we suggested that the land change maps should be supplemented by an accuracy assessment that incorporate a distinct description of the sampling design, an error matrix, the area or proportion of area of each category according to the map, and descriptive accuracy measures such as user's, producer's and overall accuracy. A straightforward analysis of uncertainty based on the confidence bounds for land change area is applied to illustrate numerically that variability in the land change area estimation.

Keywords: Land cover change, Accuracy Assessment, Error Matrix, Monitoring, Supervised classification

ROLE OF REMOTE SENSING AND GIS TECHNIQUES TO DETECT BARCHANS SAND DUNE IN SOME AREAS OF DAHNA'A DESERT, SAUDI ARABIA

Fahad M. Harbi (1), Ahmad A. Ashi (1), Saleh M. Harbi (1), Hassan A. Garni (1), Mohammed A. Hakami (1)

[1] Remote Senisng Department, Saudi Geological Survey, Saudi Arabia
Email: Harbi.fm2@sgs.org.sa

Abstract: This Study aim to determine the movement rate of barchans dunes in Dahna'a desert by monitoring the dunes changes using remote sensing and geographic information systems. This study done based the dunes size and Shape changes, wind speed and direction, elevation and area slope and barchans dunes itself micro location variables. Advances numerical models, which are capable of simulating dune patterns observed in nature. LANDSAT 8 OLI used to detect barchans during 6 years (2013 – 2018).The manual extraction of dunes shape ArcGIS is the second step of this work. Four measurements was taken by create virtual benchmarks for each barchans dune ware selected for this study. According to data gathered form Global Data Assimilation System (GLDAS) to estimate wind speed that show rating 8.4±3 my^{-1}. The results show that the annual movement rate dune varying ≈ 25±5 my^{-1}.

Keywords: Sand Dune, Movement Rate, Saudi Arabia, LANDSAT, GLDAS

MULTI-TEMPORAL LAND-COVER CLASSIFICATION OF KINABALU ECO-LINC SITE AND THE SURROUNDING PROTECTED AREAS

Charmila Flora Miuse (1), Kamlisa Uni Kamlun (1)

[1] Faculty of Science and Natural Resources (Forestry Complex), Universiti Malaysia Sabah, UMS Road, 88400 Kota Kinabalu, Sabah, Malaysia
Email: charmilafloramiuse@gmail.com; kamlisa@ums.edu.my

Abstract: The Crocker Range Park and Kinabalu Park are Sabah's largest terrestrial parks physically separated by >10km distance. Both parks are involved in a set up plan of ecological linkages to connect and further strengthen the biodiversity conservation efforts in the State of Sabah. The project is officially known as Kinabalu Eco-Linc (Kinabalu Ecological Linkage). This study is designed to monitor the land use change of the area between 1991-2018 using Landsat imagery. Supervised classification via maximum likelihood classification rule was used to create the land cover change map of both protected areas. Six land cover type were identified in the area which comprises of primary forest, secondary forest, disturbed natural for est, barren land, agriculture, and water. The result illustrated a dynamic declined of primary forest and increased of disturbed natural forest over the period of 28-years assessed. Anthropogenic pressure such as illegal encroachment and continuous land cover conversion for nomadic agriculture by the local people suggests that the locals are still highly dependent on the forest resources to sustain their livelihood. It is concluded that, monitoring protected area using remote sensing technique provide useful spatiotemporal data to locate key areas that are vulnerable to threat and can be utilized for better management of both protected areas and human use resources in adjacent area.

Keywords: Land cover change, Deforestation, REDD+, Supervised classification

WETLAND CHANGE DETECTION OF LANDSAT TM USING MAXIMUM LIKELIHOOD SUPERVISED CLASSIFICATION

Maslina Mohd Natar (1), Mazlan Hashim (1)

[1]Geosciences & Digital Earth Centre (GeoDEC),
Research Institute of Sustainable Environment
Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Malaysia.
Tel.: +60-7-555-7661; Fax: +60-7-555-7662.
Email: maslinanatar@gmail.com

Abstracts: Wetlands plays significant role to sustain the natural ecosystems, control the global climate regulation and acts as natural protector from pollutants and flood events. However, rapid growth of urban planning and agricultural development has affected the wetland ecosystems distribution in this country. This study was carried out to assess the changes of wetlands area in Pahang using Landsat TM satellite images of year 2000 and 2008. Six bands were used as input data. After image pre-processing, supervised wetland classification was performed using the maximum likelihood standard algorithm to classify the images in different land cover categories. The classification accuracy was assess using the reference data by a confusion matrix technique. The change detection analysis over wetland conversion areas were successfully presented. The result shows that the wetlands area in Pahang is decreased in order to support our country's economic activity. As a conclusion, change detection technique with satellite data images perform a great result to evaluate the land use cover changes by spatial and temporal studies.

Keywords: Wetland, Change detection, Maximum likelihood, Supervised classification, Landsat TM

ANALYSIS OF HYDROCARBON SEEPAGE BASED ON SOIL SPECTRAL MEASUREMENT IN OIL AND GAS FIELD IN NORTH WEST JAVA BASIN, INDONESIA

Tri Muji Susantoro (1)(2), Ketut Wikantika (2)(3), Asep Saepuloh (2)(3),
Agus Handoyo Harsolumakso (3)

[1] Research and Developent Center for Oil and Gas Technology "LEMIGAS"
Jl. Ciledug Raya, Kav. 109, Cipulir Kebayoran Lama, Jakarta, Indonesia 12230.
[2] Center for Remote Sensing, Jl. Ganesha 10, Bandung, West Java, Indonesia 40132
[3] Faculty of Earth Sciences and Technology, Jl. Ganesha 10, Bandung, West Java, Indonesia 40132
Email: trimujis@lemigas.esdm.go.id; ketut@gd.itb.ac.id; saepuloh@gc.itb.ac.id;
agusharsolumakso@gmail.com

Abstract: This paper is aimed to analyze the potential of the microseepage on the surface of the oil and gas fields in the North West Java Basin, Indonesia. The hydrocarbon seepage can be detected in many ways. One of them is by using a hydrocarbon detection index (HDI) and hydrocarbon index (HI). HDI and HI calculated by band ratio at SWIR region at the different wavelength. HDI used for the microseepage detection, where the value more than 1 indicates the potential hydrocarbon at the soil surface and HI used for the macroseepage detection, where the value more than 0 indicates the hydrocarbon-bearing material is present at the surface. Forty-four spectral reflectance samples were measured on the soil surface in the oil and gas field at three grids that cross the field. The result showed that 25 spectral reflectance samples of the soil surface based on HDI algorithm has a value more than 1. It means HDI can detect the potential of the microseepage on the surface of the field. But all spectral reflectance calculated by HI algorithm has a value <0. It means HI cannot detect the hydrocarbon bearing in the soil surface, because there were no macroseepage seen on the surface of oil and gas.

Keywords: Microseepage, macroseepage, hydrocarbon detection index, hydrocarbon index

LOCAL STRAIN BEHAVIOR IN TAIPEI BASIN BASED ON CONTINUOUS GNSS OBSERVATIONS

Chun-Yun Chou (1), Jen-Yu Han (1)

[1]Department of Civil Engineering, National Taiwan University,
No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan (R.O.C.)
Email: d02521001@ntu.edu.tw; jyhan@ntu.edu.tw

Abstract: Taipei city is densely populated in a basin of northern Taiwan. It is not only the developing center in fields of politics, economics, and culture in Taiwan but also one of the important commercial and financial metropolis in Asia. However, the location of Taipei Basin is around several faults and the Tatun volcano group which could be active. Additionally, with the severe climate changing, earthquakes and rainstorms happen frequently. So, it is essential to monitor surface displacements immediately for protecting the life and property of the people in the metropolitan area. The general practice is to establish the GNSS (Global Navigation Satellite System) station in a monitoring area and to record positions of the station through time. Therefore, for the deformation analysis, the research will estimate the velocities of observations through the time series data of the GNSS continuously operating reference stations in Taipei Basin and interpret the corresponding strain rates in recent years. Finally, according to the obtained results, surface continuous dynamic behavior in Taipei area could be provided for monitoring and deformation analyses and even referred to concerned departments for developments, constructions, and disaster preventions.

Keywords: Surface Displacement Monitoring, Global Navigation Satellite System (GNSS), Time Series Analysis, Strain Analysis.

ONLINE GNSS SERVICE PORTAL TO PROCESS GNSS DATA AND DOWNLOAD CORS DATA

E.M.R.D Ekanayaka (1)

[1]Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, P.O Box 02, Belihuloya-70140, Sri Lanka
Email: richierde@gmail.com

Abstract: At present, Global Navigation Satellite System (GNSS) has been widely used for broad range of disciplines such as Engineering, Land administration, Archaeology, Aviation etc. For most of the applications GNSS data should be post-processed to get an accurate positioning solution. Due to lack of user friendly processing services and lack of knowledge on GNSS, users are facing difficulties to post-process GNSS data. Even though there are multiple Web-based online processing services developed by organizations, most of those systems support only precise point positioning. Although there are several GNSS data downloading options available, users have to spend a lot of time to familiar with the user interface to download data products like observations files, navigation files and meteorological files due to its complexity. The implemented system is capable of processing GNSS data in multiple processing modes including Single point positioning, Kinematic positioning, Differential GPS and Static positioning. Users can upload their observation files, navigation files and get the postprocessed positioning file. RTKLib post-processing application was used as the backend program to process GNSS data. Once user submitted the relevant information including elevation mask angle, processing mode and frequency, python script calls command prompt to run a shell command to process GNSS data using RTKLib application. As soon as data processing completed in backend, final positioning file will be emailed to user via google smtp service. Data downloading section of service portal provides a user friendly Interface to download observation files, navigation files and meteorological files in RINEX format from many worldwide CORS stations effortlessly. Once user submit the information, relevant ftp links are generated based on the user information in backend. UNAVCO GPS/GNSS FTP server layout was used as the GNSS data source in the portal. The system backend was developed using Flask, which is a micro framework for python while frontend developed with bootstrap which is an open source toolkit for frontend development.

Keywords: Online Data Processing, GNSS, CORS Data, RTKLib

LAND COVER MAPPING OF THE MEKONG DELTA WITH MULTI-TEMPORAL SENTINEL-1A SYNTHETIC APERTURE RADAR IMAGERY

Khanh Duc Ngo (1), Alex Mark Lechner (1), Tuong Thuy Vu (1)(2)

[1] School of Environmental and Geographical Sciences, University of Nottingham Malaysia Campus, Semenyih, Malaysia
[2] Faculty of Science and Engineering, Hoa Sen University, Ho Chi Minh City, Vietnam
E-mail: hgxdn1@nottingham.edu.my; alex.lechner@nottingham.edu.my; thuy.vutuong@hoasen.edu.vn

Abstract: Synthetic aperture radar has great potential for land cover mapping, especially within tropical regions, where frequent cloud cover obstructs optical remote sensing. The objectives of this study were to assess the utility of multi-temporal Sentinel-1A SAR images for land cover mapping and to evaluate the performance of Support Vector Machine (SVM) and Random Forest (RF) classifiers. Twenty-one SAR images acquired in the Mekong Delta, Vietnam in 2016 were classified in a four-step process. Firstly, the SAR images were pre-processed and Grey Level Co-occurrence Matrix (GLCM) texture images were produced. Then, to reduce the effect of rainfall variation confounding the classification, the images were divided into two categories: dry season (Jan-April) and wet season (May-December) and three sets of input image combinations were produced: 1) a single-date composite image (two VV-VH bands), 2) a multi-temporal composite image (eight VV-VH bands for dry season, sixteen VV-VH bands for wet season) and 3) a multi-temporal and textural composite image (sixteen bands for dry season, thirty two bands for wet season). We then applied and compared SVM versus RF classifiers using 500 random training samples to characterize urban, forest, aquaculture/water, and paddy field for the three input image sets. We found that SVM had a higher overall classification accuracy than RF in both multi-temporal and textural input image sets of dry and wet season (overall accuracy of 92.59% and 96.3% and Kappa coefficient of 0.88 and 0.94 respectively). However, the overall accuracy differences associated with using different image sets (i.e. multi-temporal versus single date) was far greater than the differences between SVM and RF. The study results showed that the inclusion of multi-temporal Sentinel-1A imagery results in the greatest improvements in classification accuracy. Along with SVM and RF classifiers, multi-temporal Sentinel-1A imagery can be used as an effective tool for land cover mapping in tropical region.

Keywords: Multi-temporal Sentinel-1A SAR, Mekong Delta land cover mapping, Support Vector Machines, Random Forest

ON THE COSEISMIC DISPLACEMENT OF 2018-0206 HUANLIEN EARTHQUAKE OBSERVED WITH GNSS

Phil Yeh-Yu Chin (1), Peter Tian-Yuan Shih (1)

[1]National Chiao Tung University, Civil Engineering, 1001 University Road, Hsinchu 300, Taiwan
Email: chin_phil@yahoo.com.tw; tyshih@mail.nctu.edu.tw

Abstract: A destructive earthquake occurred at 23.50 local time on Feb. 6, 2018, at Hualien city, Taiwan. This earthquake with the magnitude 6.4 on the moment magnitude scale caused 14 death and the collapse of many buildings, including four major. This study utilizes GNSS observations from continuous operating stations to evaluate the coseismic displacement caused by this earthquake. Six stations operated by National Dong Hwa University, and a station of the CivilNet network, were included. The study period is from Jan. 28 to Feb. 12. Both the PPP (Precise Pointing Positioning) and relative positioning schemes are applied and compared. While the displacement could be observed clearly from the coordinate changes, physical interpretation and understanding require further analysis and knowledge.

Keywords: Geological fault, Precise Point Positioning, Relative Positioning

TIME SERIES IMAGE FUSION FOR FORMOSAT-2 AND LANDSAT IMAGERY

Tee-Ann Teo (1), Yu-Ju Fu (2)

[1] Professor, Dept. of Civil Engineering, National Chiao Tung University, Hsinchu, Taiwan 30010
[2] Master Student, Dept. of Civil Engineering, National Chiao Tung University, Hsinchu, Taiwan 30010
Email: tateo@mail.nctu.edu.tw; fcud0271929@gmail.com

Abstract: Time series image fusion is a technology generating sequential images from multisensor and multi-temporal images. The data with high temporal resolution are usually with coarse spatial resolution, while the data with high spatial resolution are usually with low temporal resolution. For example, daily Modis image in 500m spatial resolution and every 16 days Landsat image in 30m spatial resolution. Multi-nodal image fusion simulates high spatial resolution time series images in dates where only low spatial resolution images are available. Therefore, multi-nodal image fusion is an important technology for generating time series images from different sensors at different time. Landsat-8 satellite acquires 15m panchromatic and 30m multispectral images at a fixed view angle while Formosat-2 provides 2m panchromatic and 8m multispectral images. The time interval of Landsat-8's time series images in a certain location is 16 days. Although Formosat-2 has higher spatial resolution than Landsat8, it acquires imagery in different view angles in the way of body rotation, and consequently, the time interval of time series Formosat-2 images is not a fixed time interval. Hence, the fusion of Formosat-2 and Landsat-8 images may improve both spatial and temporal resolutions for constructing the time series images. Time series image fusion methods between high spatial resolution systems and high revisit frequency systems have been proved to be an effective way to mitigate the constraint caused by low spatial resolution, low temporal resolution, or unpredicted cloud coverages. It can be generated by several ways, for example, image resampling, pan-sharpening or Spatial and Temporal Adaptive Reflectance Fusion Model (STARFM). The STARFM was originally developed based on Modis and Landsat images. This method can also be applied to other sensors, for instance, Formosat-2 and Landsat-8 images. The aim of this study is to construct time series images from multi-nodal images. This study also compares different time series image fusion techniques for Formosat-2 and Landsat-8 images. Three different image fusion approaches are included to improve the quantity of time series of Formosat-2 images, including image resampling, Pan-sharpening and STARFM. The goal is to integrate satellite images from sensors with different spatial or temporal characteristics. The image resampling directly interpolates the Landsat-8 images into a new image with the same resolution as Formosat-2 images. Pan-sharpening replaces the spatial frequency of Landsat-8 image from Formosat-2 image. The STARFM simulates Formosat-2 image by producing synthetic surface reflectance data from a base pair of Landsat-8 and Formosat-2 images and a single Landsat-8 image collected on the simulation date. In order to assess the quality of simulated images, this study calculates the biases between the observed and the synthetic reflectance for Formosat-2 image. This study demonstrates the simulation of Formosat-2 image from Landsat image through different methods. Finally, the advantages and disadvantages of different fusion methods will be provided.

Keywords: image fusion, time-series, STARFM

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DAILY LAND SURFACE TEMPERATURE GENERATION USING THE FUSION OF LANDSAT AND MODIS SATELLITE IMAGERY

Saeid Hamzeh (1), Parisa Mohammadizadeh (1), Majid Kiavarz (1),
Ali Darvishi Blorani (1)

[1] A Department of Remote Sensing and GIS, Faculty of Geography, University of Tehran
Email: saeid.hamzeh@ut.ac.ir

Abstract: Land surface temperature is one of the most important parameters in environmental studies. Having satellite imageries with spatiotemporal resolution leads to better interpretation, analysis and clarity of images; therefore the best way to solve this problem is to combine images with high spatial and temporal resolution. There is no satellite that captures thermal band with both spatial and temporal resolution simultaneously due to technical difficulties and considerable cost. Therefore, the aim of this article is using SADFAT algorithm for providing land surface temperature images with spatial resolution of Landsat and temporal resolution of MODIS. This paper uses seven dates of MODIS and Landsat including 24th May, 9th June, 11th July, 27th July, 12th Aug, 28Aug and 13th September of Salman Farsi sugar cane Industry. The results are evaluated with four indexes of correlation coefficient, Average difference, Mean Absolute Error and Universal Image Quality Index. Comparison of predicted and observed images indicate that the value of indexes correlation coefficient, Root Mean Square Error, Mean Absolute Error and Universal Image Quality Index are between 0.85-0.99, 0.73-1.32, 0.581.73, 0.9124-0.9973. The results showed high, reliable and precession of SADFAT algorithm for providing daily land surface temperature with spatial resolution of Landsat in case study.

Keywords: Spatiotemporal fusion, Thermal imagery, Land surface temperature, Remote sensing

COMPARISON OF IMAGE FUSION METHODS FOR HYPERSPECTRAL SATELLITE DATA

Xuejian Sun (1), Yi Cen (1), Lifu Zhang (1), Hai Huang (2), Mingyuan Peng (1)

[1]Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, No. 20, Datun Road, Chao Yang, Beijing, China
[2]School of Earth Sciences and Resources, China University of Geosciences(Beijing) No. 29, Xueyuan Road, Hai Dian, Beijing, China
Email: sunxj@radi.ac.cn; zhanglf@radi.ac.cn; huanghai_94@163.com; pengmy@radi.ac.cn

Abstract: The GF-5 satellite is the world's first full-spectrum hyperspectral satellite for comprehensive atmospheric and terrestrial observation, and an important scientific research satellite in the Chinese national major project of high-resolution earth observation system. It was successfully launched on May 9, 2018. To study the performance and data quality is very important for the application and exploration of GF-5 image data. In this paper, a fusion experiment of a simulated GF-5 hyperspectral data and GF-1 multispectral data was conducted by using Coupled Non-negative Matrix Factorization (CNMF), Color Resolution Improvement Software Package (CRISP), Gram-Schmidt and the Wavelet transform-based fusion methods. The evaluation indices Spectral Angle Mapper (SAM), Peak Signal to Noise Ratio (PSNR), Correlation Coefficient, Erreur Relative Globale Adimensionnelle de Synthèse (ERGAS) and Universal Image Quality Index (UIQI) were selected to objectively evaluate the fusion results. The results showed that CNMF had the best visual effect, and the fusion method based on wavelet transform had the best general performance. The CRISP fusion method had the highest spectral fidelity with the improvement of cutoff frequency, but the visual effect was bad. GramSchmidt performed better in the infrared band. Selecting different fusion methods and parameters according to different application requirements can provide theoretical support for GF-5 image data to better serve scientific research.

Keywords: Data Fusion, Hyperspectral, GF-5

IMPROVING CITYGML LOD-1 BUILDING MODELS USING TERRESTRIAL POINT CLOUD DATA

Fuan Tsai (1), Jhe-Syuan Lai (2), Yu-Ching Liu (1)

[1] Center for Space and Remote Sensing Research, National Central University, Taoyuan 32001, Taiwan
[2] Department of Civil Engineering, Feng Chia University, Taichung 40724, Taiwan
Email: ftsai@csrsr.ncu.edu.tw

Abstract: Open Geo-spatial Consortium (OGC) suggests five LODs (Level of Detail) for building models in the CityGML Specification. Among them, OGC CityGML LOD-1 defines buildings as block-based, cube-shaped, and flat-floor models. The elevation of the generated LOD-1 models is usually determined as the height of the roof from ground. However, this criterion might result in significant discrepancies between the generated models and some real building in some cases, such as arcades and open spaces on first floors. To address this issue, this study develops a procedure to improve the reality of OGC CityGML LOD-1 building models with terrestrial point clouds derived from close-range images. The point clouds are generated from multiple photos acquired using non-metric cameras (including cell phones), and analyzed by the CMVS (Clustering Views for Multi-view Stereo) algorithm which is one of dense matching methods for point cloud generation. Experimental results presented in this paper demonstrate the effectiveness of the developed procedure, and show that the improved LOD-1 building models are more close the real buildings in terms of shapes and appearances. In addition, this study also briefly compares the develop method with other conventional approaches (e.g., laser scanning and total station) to improving OGC CityGML LOD-1 building models.

Keywords: 3D building model, dense matching, level of detail, OGC CityGML, point cloud.

LINEAR SOLUTION OF OVERDETERMINATED 7-PARAMETER TRANSFORMATION

Tsai, Ta Tzu (1), You (1), Rey-Jer (1)

[1] Graduated student, No. 1, University Rd., East District, 70101 Tainan City, Taiwan
Professor, No. 1, University Rd., East District, 70101 Tainan City, Taiwan
Email: klnes5218@gmail.com; rjyou01@gmail.com

Abstract: The current application in Photogrammetry and mobile mapping systems (MMSs) use normally the centric perspective projection to construct the mathematic relationship of images and their corresponding ground points. The relationship is based on the three dimensional seven-parameter similarity transformation which is nonlinear. Traditionally, to solve these kind of transformation problems, we have to first use the linearization method and offer the initial values together with iterative processing to solve the orientations of the images and the ground coordinates of object points. Linearization solution procedures need relatively good initial values of orientation elements and approximated ground coordinates which may lead to some instable problems and computation-effectiveness. In this paper, we transform the nonlinear the seven-parameter similarity transformation to a linear one by a special transformation, namely the Cayley transformation. In this model, we do not need the initial values and linearization. The solution procedures of the linear model here will be suggested by two-step and three step stages. The algebra formulation will be derived. We will simulate a set of three coordinates for the study. The results of the linear method including two-step and three-step stages will be compared with those of the iteratively linearized method. Finally, we will discuss the application possibility of the linear model for Photogrammetry and MMSs.

Keywords: Nonlinear seven-parameter transformation, Cayley transformation, linear solution, Photogrammetry, mobile mapping systems.

EVALUATION OF BUILDING ENVELOPE'S THERMAL TRANSMITTANCE BY DUAL IMAGE SENSOR DRONE TECHNIQUE

Ting-Chen Chu (1), Jen-Yu Han (1)

[1] Department of Civil Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan (R.O.C.)
Email: r05521118@ntu.edu.tw; jyhan@ntu.edu.tw

Abstract: To evaluate buildings' energy efficiency, it is necessary to analyse the thermal transmittance of building envelops. In this study, the integration of quantitative thermography and 3D point cloud method is proposed for a building's thermal transmittance analysis. A drone-based platform system mounting an infrared thermal camera and a typical digital camera was developed for the data acquisition. Geometric calibration of infrared camera has been performed, ensuring its capability of acquiring information necessary for a 3D spatial information reconstruction. Due to the low resolution of the thermal camera, a much efficiency way for determining the IR images' exterior orientation parameters was developed by establishing the relative orientation of dual-camera drone system. The relationship of dual-camera drone system was determined by the collinearity condition. Furthermore, a radiation calibration of IR thermal camera was applied to acquire the real temperature of target object's surface. Then, the down-scale experiment revealed that the thermal transmittance of different materials can be readily evaluated by infrared thermography method. Finally, realistic visualization and geometrical analysis of the thermal behavior has also been achieved by the integration of 3D point cloud and IR thermal images. That is to say, this study gives a clear evidence that a reliable and cost-efficient solution for buildings' energy conservation has become available.

Keywords: Drone, Infrared Thermography, Digital Photogrammetry, Digital Photogrammetry, Thermal Transmittance Analysis

AUTOMATIC SCALING OF CRITICAL FREQUENCY FOF2 FROM IONOGRAMS BASED ON A PIXEL-FOLLOWING TECHNIQUE

Weeranat Phasamak (1), Yuttapong Rangsanseri (1)

[1] Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok 10520, Thailand
Email: 59601303@kmitl.ac.th; yuttapong.ra@kmitl.ac.th

Abstract: This paper proposes a new technique for automatic scaling of critical frequency foF2 parameter of F2- layer from ionograms. Ionograms are generated by ionosondes, showing the radio wave propagation time delay against operating frequency can be got when using high frequency radio waves to detect the ionosphere. There are many parameters related to the ionosphere from ionogram but this paper will focus on foF2 parameter. foF2 is the ordinary wave critical frequency of the highest stratification in the F region and is the most important parameter for telecommunication applications. The process for extracting the feature parameters is called scaling. Scaling of ionograms initially had to rely on experienced staff for manual operation. In this paper, we have examined ionograms data collected at Chumphon, Thailand, in March 2015, during the period that the observed F2 layer traces can be identified. Our method extracts foF2 value by finding a pixel on the beginning of the trace line and will use this pixel as the starting point for finding the ends of the traces by scanning either one or two lines. In each step we need to prepare the ionogram image, remove unnecessary part of image then remove noise, and refill the trace line before final scanning process. Based on a pixel-following technique, the method produces high accuracy results because it can scan until the final pixel of the trace line. The proposed method has been successfully tested on various ionograms, the results match with a single-pixel accuracy comparing to manual scaling.

Keywords: foF2 Automatic Scaling, Ionogram, Pixel-Following

APPLYING OBJECT-BASED IMAGE ANALYSIS TO SENTINEL-2 SATELLITE IMAGES FOR THE CLASSIFICATION OF FOREST TYPES

Nyamjargal Erdenebaatar (1) and Amarsaikhan Damdinsuren (1)

[1] Institute of Geography and Geoecology, Mongolia Academy of Sciences, Ave.Enkhtaivan54B, Ulaanbaatar-51, Mongolia
Email: eb.nyamjargal@gmail.com; amarsaikhan64@gmail.com

Abstract: This study investigates the use of object-based image analysis for the classification of forest types. We used Sentinel-2 satellite data acquired on August 15 and October 13 in 2016 with 10 m ground sampling distance. The study site is Bogdkhan mountain which is situated south side of Ulaanbaatar city and the forests consist of six types including larch, spruce, pine, pinus sibirica, birch and brush. First of all, multiresolution segmentation was applied to dataset and segmentation parameters were selected based on the experiment to find the optimal scale, shape and compactness and performed using eCognition 9.0 software. Then, the ruleset was established based on the threshold values estimated using normalized vegetation index, green leaf algorithm and band ratios and training samples obtained from field survey. Finally, the accuracy of forest types classification through object-based image analysis were examined with the respect to the field measurement result and reference forest type map generated in 2008 using confusion matrix. The three deciduous forest types larch, birch and brush were correctly classified with an overall accuracy of about 90% in our study. The producer's accuracies of all classes were achieved more than 86.2% except the "pine" class. But, user's accuracies were observed which ranged from 71.6% to 100% for all classes. We conclude that low producer's accuracy of pine is related to its similar characteristics to pinus sibirica. The achieved results will be showed in detail in the main paper.

Keywords: forest type mapping, object-based classification, segmentation, Sentinel-2

FORMOSAT-5 SATELLITE IMAGE DATA TRANSFERRING MECHANISM FROM NORWAY RECEIVING STATION

Chin-Yin Chen (1), Hsin-Yen Chen (2), Yu-Ling Kuo (1), Sheng-Yun Yan(1), Simon C. Lin (3)

[1] National Space Organization, 8F, 9 Prosperity 1st Road, Hsinchu Science Park, HsinChu, Taiwan
[2] Academis Sinica Grid Computing Center, Research Center for Information Technogly Innovation, Academia Sinica
[3] Institue of Physics. Academia Sinica, 128, Sec. 2, Academia Rd. Nankang, Taipei 11529, Taiwan
Email: fifi@nspo.narl.org.tw; hychen@sinica.edu.tw; kuoyl@nspo.narl.org.tw; ysyun@nspo.narl.org.tw; SimonLin@twgrid.org

Abstract: The path for the telemetry satellite observation data, from the FORMOSAT-5 satellite to the receiving station at Svalbard, then data processing and long-distance file transfer to NSPO in Taiwan, is a complex one. Due to the limited network bandwidth and long latency, we have used the tape storing the satellite data and deliver the media via airline logistics for a long time. The critical issue is whether one may download the data sets including the raw data as fast as possible to the user communities in Taiwan. We have thus developed the automatic long distance file transferring platform. Taking advantage of the Taiwan Academia Grid Computing Center's research network infrastructure and secure long distance transferring technology we could ensure the data sets up to 30GB would be transferred to Taiwan in 2 hours. It is much shorter than one manually does it using the ad-hoc network service in 4 hours. We have been optimizing the network parameters in the file transferring platform since the beginning of the project. Now, we could receive the data sets in Taiwan within 1 hour after various optimizations. This long-distance data transferring mechanism could help us to develop the applications which need fast delivery of satellite image production, such as the development of earthquake prediction, disaster image identification and forest fires, etc. It could greatly improve the international emergency rescue services. The experience of long distance file transferring mechanism could help the other countries to receive image data at the Arctic receiving station and to quickly transmit relevant data back to their countries.

Keywords: Telemetry, Satellite Image Data, Emergency Rescue Service, Long Distance Data Transferring

PRELIMINARY ORBIT DESIGN AND SIMULATION FOR FIRST SMALL SATELLITE REMOTE SENSING CONSTELLATION MISSION OF TAIWAN

Chuang-Wei Hsueh (1), Feng-Tai Hwang (1)

[1] National Space Organization,8F, 9, Prosperity 1st Road, Hsinchu Science Park, Hsinchu City, Taiwan, R.O.C.
Email: chuangwei@nspo.narl.org.tw

Abstract: After the successful launch of FORMOSAT-5 on August 25, 2017, National Space Organization (NSPO) focusses on the first self-reliant small satellite remote sensing constellation mission of Taiwan. The paper presents the preliminary orbit design and simulation for the satellite constellation mission, and the main objective of this paper is to provide the feasibility study on different conditional parameters to increase the temporal resolution of overall constellation system. The mission orbit is a sun-synchronous orbit of 561 km altitude with repeating ground tracks every day. Depending on the design for different number of satellites in constellation, the mission could reach the goal of the global coverage with a 45 degree field of regard (FOR) and have the capability of revisiting Taiwan area many times per day. Some different scenarios are proposed in this paper. For each scenario, the orbit of satellite constellation is performed and analyzed by AGI's Systems Tool Kit (STK). Finally, comparisons of the advantages and disadvantages for each circumstance will be described in detail.

Keywords: Remote sensing satellite, Satellite Constellation, STK simulation

SHIP MOLDED LINES AND DISPLACEMENT MEASUREMENTS USING TERRESTRIAL LASER SCANNING DATA

Xiaojun Cheng (1), Zexin Yang (1), Jixing Zhang (2), Zhenlun Wu (1)

[1] College of Surveying and Geo-Informatics, Tongji University, No. 1239, Siping Road, Shanghai 200092, China
[2] SAIC General Motors Corporation, No. 1500, Shenjiang Road, Pudong New Area, Shanghai 201206, China
Email: cxj@tongji.edu.cn; zexinyang@tongji.edu.cn; 15900522279@163.com; 1633313@tongji.edu.cn

Abstract: The problems of how to measure ship molded lines and displacement are of great significance. In terms of the ship molded lines measurement, the common method is using a total station to measure a series of points at horizontal or vertical lines and then reconstruct ship molded lines based on these observed points. However, this method is time-consuming and labor-consuming. As for ship displacement measurement, there are two common methods: the geometric measurement method and the capacity comparison method. Nevertheless, the precision and accuracy of the former is low; the accuracy of the latter is high, but the cost is also very high. Therefore, the main objective of this paper is to measure the ship molded lines and displacement much faster and more accurate by using TLS (Terrestrial Laser Scanning) point cloud data. Firstly, the point cloud data are sliced into thin point cloud slices along the z-axis direction. For each point cloud slice, points are projected to a plane grids and feature points are extracted by computing the center of gravity of points in each grid. The molded lines are then reconstructed using NURBS curve. The area of each slice, meanwhile, is calculated by coordinate analytic method. Accordingly, the volume of every polyhedron between two neighboring slices are calculated. Finally, the displacement result can be acquired by accumulating the volume of every polyhedron. To evaluate the result of our proposed method, we calculate the difference between the experimental results and the results of common workflows, and the difference is generally slight which shows that the accuracy of our method is high enough for ship surveying. Moreover, the results indicate that the working efficiency has been greatly enhanced.

Keywords: Ship Molded Lines Measurement, Ship Displacement Measurement, TLS, Point Cloud

DROUGHT MONITORING USING THE NDVI OF LISAT (LAPAN-IPB SATELLITE) AND LANDSAT 8 SATELLITE IMAGERY OVER PATI REGENCY, CENTRAL JAVA, INDONESIA

Luisa Febrina Amalo (1), Irza Arnita Nur (1), Nur Riana Rochimawati (1)

[1] Environmental Research Center, Bogor Agricultural University, Lingkar Akademik St.,PPLH Building 4th Floor 1680 West Java, Indonesia
Email: luisafebrina@gmail.com; irzaarnitanur@gmail.com; eineiku@gmail.com

Abstract: Drought is a natural hazard indicated by the decreasing of rainfall and water storage in the region and impacting agricultural sector. Drought assessment has been used to monitor agricultural sustainability. Drought indices are commonly used for drought assessment. Recently, satellites data are widely used for calculating the drought indices. Satellite data is an easy, quick, and inexpensive tools in monitoring drought in the regional scale compared to weather data observations. In this study, Normalized Difference Vegetation Index (NDVI) were conducted to identify drought. Drought can be measured by vegetation condition, whether the vegetation is healthy or unhealthy–suffered from drought. NDVI is calculated by using Near Infrared and red band from LISAT (LAPAN-IPB Satellite) and Landsat 8 Satellite imagery. The study area will focus in Pati Regency, Central Java, one of Central Java agricultural production center. This research aims to compare NDVI values from two different satellites as LISAT is a new launched-satellite, while Landsat is a well-established and developed satellite which has been widely used for many scientific researches. The results showed that LANDSAT 8 Satellite imagery had more clouds clover than LISAT and generally it showed similar data view because the spatial resolution for both data were relativily similar (LISAT: 18 m; Landsat 8: 30 m). NDVI data showed similar range values between LISAT and LANDSAT 8. Therefore, the identification of drought in Pati using LISAT can be used as drought monitoring indicator.

Keywords: LAPAN-IPB Satellite, Landsat, NDVI, Drought

QUALITY OF NOAA-20 SATELLITE TRACKING SIGNAL RECEIVED IN MRSA GROUND STATION TEMERLOH PAHANG

Muhammad Fakhrul Razi Mohamed Mokhtar (1), Siti Rohana Adi (1), Mohd Najib En (1), Siti Aishah Mat Said (1)

[1] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: fakhrul@remotesensing.gov.my; rohana@remotesensing.gov.my; najib@remotesensing.gov.my; aishah@remotesensing.gov.my

Abstract: The new NOAA-20 Satellite data will be the best option in the future for continuity of Suomi NPP Satellite data that been used in various project in Malaysia. The quality of NOAA-20 satellite tracking signal in low and high elevation angle in MRSA Ground Station Temerloh Pahang is important to be verified to ensure the receiving operation of NOAA-20 Satellite data in the future could be determined. Using the existing MRSA Ground Station 3.6 meter antenna to track NOAA-20 satellite both low and high elevation angle and record the signal gain based on spectrum analyser data in certain period that covered all orbit path of the satellite in Malaysia region are the collection of data that be analysed. From the result, NOAA-20 Satellite tracking signal is well received in MRSA Ground Station Temerloh Pahang and receiving operation in the future could be determined. All various project in Malaysia that using Suomi NPP Satellite could continue with NOAA-20 Satellite for sustainable operation.

Keywords: NOAA-20, Tracking Signal, Ground Station

CHARACTERIZATION AND CORRECTION OF LINE-WISE STRIPES FOR FORMOSAT-5 IMAGERY USING WAVELET FILTERING METHOD

Kuo-Hsien Hsu (1), Sunny Lee (1), Yu-Lin Tsai (1)

[1] National Space Organization, 8F, 9 Prosperity 1st Road, Hsinchu Science Park, HsinChu, Taiwan
Email: khhsu@nspo.narl.org.tw; sunnylee@nspo.narl.org.tw; morphling@nspo.narl.org.tw

Abstract: The primary objective of this paper is to implement a wavelet filtering method [Shresha, 2010] to remove the line-wise stripes of remote sensing imagery. This work concentrates on dealing with such kind of stripe removal and image detail preservation for remote sensing image. The wavelet filtering method invokes three different approaches. Low Frequency Sub-band (LFSB), High Frequency Sub-band (HFSB), and All Frequency Sub-band (AFSB) are used to decompose the image with different level of sub-banding. Then, we apply an identical filter on various component imagery to remove isolated stripes. Finally, we reconstruct the image using an inverse wavelet transform. The corrected image is evaluated qualitatively and quantitatively by Modulation Transfer Function (MTF) estimation. The result recommends that AFSB/Coiflets approach with one-level sub-banding is sufficient in removing the stripes and retaining most of the information of image at the same time.

Keywords: wavelet filtering, remote sensing imagery, line-wise stripes

STUDY ON CONTRAST ENHANCEMENT OF HIGH RESOULUTION SATELLITE IMAGE

DooChun Seo (1), Soohwan Yu (2)

[1] Korea Aerospace Research Institute, 45 Eundong Yusunggu Daejeon 34133, South Korea
[2] Department of Image, Chung-Ang University
Email: dcivil@kari.re.kr; shyu@cau.ac.kr

Abstract: Recently developed Earth observing satellites have excellent high spatial resolution as well as radiometric resolution. Using such high-resolution satellite imagery data, it is utilized in various application fields such as land development, GIS, and mapping production. When the satellite observing various features such as concrete structures on the ground, forests, roads, rivers, etc., the information of these various types of features should be included in the satellite image data. However, the dynamic range of image data by satellites has only within a certain range according to satellite hardware limit and atmospheric conditions etc. In this paper, we describe a method to improve the dynamic range of the image data acquired in high resolution satellite.

Keywords: Contrast Enhancement, satellite image

HOW GEONAMES DISAPPEARED? AN EXPLORING STUDY BASED ON HISTORICAL MAPS IN TAIWAN

Huang Weichia (1), Wu, Chia-Jung (1), Lay, Jinn-Guey (1)

[1] Department of Geography, National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan
Email: r99228023@ntu.edu.tw

Abstract: All of geonames are created, utilized, inherited by humans. However, some of them were forgotten by human and no longer appeared on maps. This study demonstrates how geonames disappeared through the digitalization of historical maps. We found that most of settlements in Taiwan remain fixed location and traditional names until today. However, the settlements outside of the wall of ancient city have the weakest geonames, which tend to be forgotten during the phrase of urban sprawl. We also notice that most of modern urban rail stations do not choose traditional geonames as their names. In the end of articles, we also discuss how citizens think this issue from newpapers.

Keywords: geonames, urban sprawl, historical maps, digitalization

3D LASER SCANNING IN THE RENOVATION OF WATPASATHARUAM, NAKHON RATCHASIMA, THAILAND

Intareeya Sutthivanich (1), Udomvit Maneewan (1), Punya Suemkumpung (1),Sirilak Tanang (1), Suriporn Charungthanakij (2), Anucha Prangsungneon (1), Benja Klinjundaeng (1),

[1] Suranaree University of Technology, Mueang District, Nakhon Ratchasima, Thailand, 30000
[2] Silpakorn University, Mueang Nakhon Pathom District, Nakhon Pathom, Thailand, 73000
Email: suttin1@sut.ac.th; udomvit@sut.ac.th; sirilak@sut.ac.th; scharung@hotmail.com
punya@sut.ac.th; banja@sut.ac.th

Abstract: Watpasatharuam is a long historic temple of Buddhism and is located in Nakhon Ratchasima province, northeast region of Thailand. The temple was established in 2475 B.E (1932 A.D.) and covered the area of 0.25 sq.km. (134 rai). It is a significant center of spiritual and religious practices for the surrounding local communities. The temple nourishes the natural landscape and traditional architecture building. Up to date, new technology takes part in renovation and preservation of historic temple processes. A 3D laser scanning can play an important role in the renovation and preservation of historic architecture. It can be expanded beyond the traditional dependence on 2D representations. The products from 3D laser scanning can be integrated into commercial Building Information Model (BIM)/ Computer Aided Design (CAD) and modeling applications that can be used from initial concept, throughout the design process to construction drawing. This paper discusses how 3D laser scanning is used to record the temple features and its 3D point cloud dataset can assist the architect exploring potential alternative design. The design solutions can be established within an accurate framework. Along with cost estimation can be calculated in the renovation process. 3D models built from laser scanning dataset ultimately improve the quality and understanding of a planned design for architectural reconstruction. A proposed renovation of the Watpasatharuam temple provides a case study illustrating how data derived from 3D laser scanning can form the basis of an accurate 3D model which can be integrated seamlessly into the architectural design process.

Keywords: 3D Laser Scanning, Point Cloud, 3D Modelling, Renovation, Preservation,

UPGRADING CITYGML LOD-1 BUILDING MODELS USING AIRBORNE LIDAR DATA

Jhe-Syuan Lai (1), Fuan Tsai (2), Yu-Ching Liu (2), Ching-Sung Yang (2)

[1] Department of Civil Engineering, Feng Chia University, Taichung 40724, Taiwan
[2] Center for Space and Remote Sensing Research, National Central University, Taoyuan 32001, Taiwan
Email: jslai@fcu.edu.tw

Abstract: The OGC CityGML LOD-1 (Level of Detail) building models can be automatically and fast reconstructed from large-scale topographic maps in Taiwan but with limited or approximated height and roof information of the reconstructed models. The degree of automation and difficulty in reconstruction depends on the complexity of roofs. Reconstructing flat and pitched (gable) roof based buildings is the objective in this study. In addition, this study integrates LOD-1 building models with airborne LiDAR (Light Detection and Ranging) data to refine the models to be conforming to the LOD-2 requirements. For reconstructing LOD-2 flat-roof building models, this study develops an automatic algorithm based on a majority operator to extract the heights of stories from point cloud data. Subsequently, the elevation of building models can be adjusted to be close to real height. For pitched roof buildings, a semi-automatic procedure is developed to adjust the elevation of building models vertex by vertex. For model validation, this study compares the constructed models with reference data in order to evaluate the averages (AVG), standard deviations (SD) of elevation differences and RMSE (Root Mean Squared errors). Experimental results indicate that the AVG, SD and RMSE of the constructed models are 0.71, 0.49 and 0.96 meters, respectively. Further exploring the reconstructed results reveals an inconsistent building height criterion between the generated models and reference data. The elevation of a generated model is determined as the height of the roof floor (because of the majority of point cloud) from ground. However, the reference data is measured from ground to the top of parapet walls for better mapping texture façades using in-situ images, representing different viewpoints between data-acquisition process, geometric modeling and visualization. However, the quantitative validation results, from a technical perspective, are reasonable and conform to OGC CityGML LOD-2 building model requirements.

Keywords: 3D building model, level of detail, LiDAR, OGC CityGML, point cloud.

A SKELETON EXTRACTION ALGORITHM FOR DENSE PIPELINE POINT CLOUD

Huang Kai (1), Cheng Xiaojun (1)(2)

[1] College of Surveying and Geo-Information, Tongji University, Shanghai 200092, China
[2] Key Laboratory of Advanced Engineering Surveying of National Administration of Surveying, Mapping and Geoinformation, Tongji University, Shanghai 200092, China
Email: 1633312@tongji.edu.cn

Abstract: In order to solve the problem of pipeline extraction under incomplete data in complex scenes, we propose a new method for automatic segmentation of dense pipeline data with circular section. The method is based on the L1-medial skeleton construction algorithm, which involves too many iterations and the random sampling method may cause the sample points distribution to be uneven. First, the pipeline point cloud data is filtered out based on general algorithms such as RANSAC to obtain high quality pipeline point cloud data. Then, the point cloud is downsampling through the octree structure and the L1-medial skeleton is calculated in parallel by the neighborhood point set of the sample points which is extracted using the Mahalanobis distance according to the spatial distribution of the point cloud data. Finally, the pipeline is fitted along the skeleton direction to correct the skeleton centerline. We apply this algorithm to scenarios such as simulation data and power plants with incomplete cloud data and dense pipelines. The experimental results show that the algorithm can extract pipeline point cloud data and obtain skeleton quickly and accurately when the data is incomplete.

Keywords: Lidar, Automatic segmentation, L1-Medial Skeleton, Random sample consensus algorithm, Dense pipeline

ESTABLISHING METHOD OF THE 3D GEOLOGICAL MODELS BASED ON AIRBORNE LIDAR DATA AND BIM TECHNOLOGY

Zhenlun Wu (1), Xiaojun Cheng (1), ZexinYang (1)

[1] College of Surveying and Geo-Informatics, Tongji University, No. 1239, Siping Road, Shanghai 200092, China
Email: 1633313@tongji.edu.cn; cxj@tongji.edu.cn; zexinyang@tongji.edu.cn

Abstract: BIM (Building information model) technology has played an significant role in infrastructure engineering design in recent years. The common 2D topographic map measured by digital mapping cannot satisfy the requirement of 3D design. Therefore, this study proposes to establish 3D geological models for BIM 3D design based on Airborne LiDAR data and geological exploring data. Airborne LiDAR is one of the most effective and reliable means of terrain data collection, using LiDAR data for DEM (Digital Elevation Model) generation is becoming a standard practice in spatial related areas. However, original airborne 3D point cloud cannot be used directly due to the low elevation precision and the influence of non-ground data, while this method is more effective in filtering LiDAR ground point cloud, retaining continuous undulate topography at the same time, and obtaining high precision DSM (Digital Surface Model) through point cloud elevation correction. Firstly, selecting CSF (Cloth Simulation Filtering) algorithm which constructs virtual grid to simulate terrain surface and filter the residual vegetation points by RGB features. Next, by fitting the quadric surface by the RTK control points and using the quadric surface equation to correct the elevation of point cloud, the high precision DSM can be obtained via revised point cloud data. Then, 3D geological models can be established by geologic exploring data and DSM. The results also indicate that the 3D geological models generated basing on Airborne LiDAR data can satisfy the requirement of BIM 3D design.

Keywords: Airborne LiDAR, Point Cloud Filtering, Surface Fitting, Elevation Correction, DSM, BIM

JOINT MODEL OF POINT CLOUD INITIAL REGISTRATION AND ITS SOLUTION

Zhou Tengfei (1), Cheng Xiaojun (1)

[1] College of Surveying and Geo-Informatics, Tongji University, Shanghai 200092, China
Email: tfzhou5713@163.com; cxj@tongji.edu.cn

Abstract: The initial registration of point clouds is usually divided into two steps, that is, using some features, such as points, lines and surfaces, to calculate the parameters of the rigid body transform based on the least square principle, and then transforming the non-public parts in the original coordinate system (point cloud I) into target coordinate system (point cloud II) according to transformation parameters. The point cloud are processed as equal accuracy during the registration process, and coordinate errors of the non-public parts in the point cloud I are ignored. In view of these above problems, a joint model of initial point cloud registration is proposed that put the transform parameter's solutions and non-public parts' transformation into joint processing. Then take the coordinate errors of all points in the two point clouds and the variance-covariance information into consideration in this model. Finally, the Gauss-Newton iterative algorithm is used to get the linear solution to obtain the initial registration reference. The linearization results of initial registration parameters and the predicted values of non-common parts in point cloud II are obtained by the Gauss-Newton iterative algorithm. Experimental results show that the new model can effectively improve the accuracy both the initial registration parameters and the prediction of non-common parts in point cloud II.

Keywords: terrestrial laser scanning, point cloud registration, joint model, Gauss-Newton iteration, Monte Carlo simulation

BUILDING DETECTION FOR AN URBAN AREA USING LIDAR DATA AND AERIAL PHOTOGRAPH

Sani Success Ojogbane (1)(2), Shattri Mansor (1), Helmi Zulhaidi Mohd Shafri (1), Zailani bin Khuzaimah (1)

[1] Department of Civil Engineering, Geospatial Information Science Research Centre (GISRC), Faculty of Engineering, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor Darul Ehsan, Malaysia
[2] Department of Surveying and Geoinformatics, School of Environmental Studies, Federal Polytechnic P.M.B 1037, ldah-Kogi State, Nigeria
Email: ojogbanesani@gmail.com; shattri@gmail.com; hzms04@gmail.com

Abstract: Airborne laser data can be used for 3D mappings and offers a lot of advantages which can be useful for building identification, updating and urban detection. The study proposes an automatic technique for object-based detection and analysis in an urban area through the combined usage of lidar data and orthophoto. A normalized digital surface model (nDSM) was initially produced based on the difference between Digital terrain model(DTM) and Digital elevation model(DEM). Subsequently, a layer stacking was done on the DTM, DSM, nDSM, laser intensity, slope image and orthophoto. Thereafter a segmentation was performed on the using Object based image analysis (OBIA) and the derived objects was classified into five classes namely, building, trees, water body and roads. Finally, the region size and spatial relation of trees and buildings were used to filter out trees occluded by buildings based on an object-based classification. The resultant model provides an efficient outcome for building detection and 3D model which is promising and efficient for planning and management of building detections.

Keywords: DSM, LIDAR, OBIA, Classification, Segmentation

HYDROLOGICAL INFERENCES FROM CATCHMENT ANALYSIS FOR NATURAL RESOURCE MANAGEMENT USING GEOSPATIAL TECHNIQUES

J.A.D.M. Sadani (1)

[1] Department of Geography, University of Colombo, Sri Lanka
Email: sadanijayasooriya@gmail.com

Abstract: The climate change and extreme weather conditions were occurred during the past two, three decade in Sri Lanka. Especially extreme rainfall, flash flood, and drought also. Therefore, an urgently need for the study and evaluate water resources and management of the water resources. Anyway this study is mainly focused to the calculate catchment and micro catchment and identify the human effect for the upper catchment area. The Maha oya river is originate from the middle part of the county, Sri Lanka. It is eight largest river in Sri Lanka. Any way the ArcHydro tool was used to develop several data sets that collectivity describe the drainage patterns of the catchments on ArcGIS platform. The selected upper part of Maha Oya catchment is located between 80°26'–80°32' Easting longitude and 7°2'30"–7°9'30" Northern latitude. It was falls within the Kegalla and Kandy District of the Sabaragamuwa and Central Province, Sri Lanka.The Digital Elevation Model (DEM) was develop based on 1:50,000 contour lines. The flow accumulation, flow direction, stream segmentation and sub catchment was extracted using DEM on raster operations. The land use was extracted using Landsat image and 1: 50,000 thematic layers which are collected form the Department of Survey, Sri Lanka. According to the watershed analysis and land use analysis of the upper part of the Maha Oya River was found correlation between catchment destructions and human activities. The majority of tea plantations were planted on upper sub catchment area. In that case land surface were eroded with extreme weather such as rainfall. According to the ArcHydro tool mapping and zonal statistical analysis were clearly indicated that speed up the conservation activities around the upper part of the catchment.

Keywords: ArcHydro tool, catchment mapping, catchment conservation

MOBILE APPLICATION FOR GEOGRAPHICAL INFORMATION SYSTEM (GIS) INFORMATION DISSEMINATION

Syahidah Fariza Moh Esa (1), Norhayati Che Musa (1)

[1] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC)
No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: syahidah@remotesensing.gov.my; norhayati@remotesenisng.gov.my

Abstract: A web application is developed with complete modules to serve targeted users. It provides a number of modules and functions according to the user requirement. However, some of the modules are rarely use or not of utmost important to the user. Therefore, a mobile application is built mainly to focus on the main module to provide express information access to the user. This paper will discuss on development using cross platform framework to develop a mobile application since it provides faster coding/programming solution to the developers. Our main focus is to build a mobile app containing a page that shows Geographical Information System (GIS) like coordinates location on a Malaysia map and also others information to complete the development of this app. This mobile application enables users to get the information faster and easier as they can reach it anytime and everywhere which will increase the effectiveness of information dissemination.

Keywords: mobile application, GIS, information dissemination, cross platform framework

CARTOGRAPHIC ASPECTS ON HOMECOMING ROUTE MAP (STUDY CASE : JAVA – BALI ISLANDS)

Kenny Anesya (1), Soni Darmawan (1)

[1] Institut Teknologi Nasional, Geodesy Engineering Department, Faculty of Civil Engineering and Planning, Jalan PKH. Mustopha, No. 23, 40124 Bandung, Indonesia
Email: kenvol76@gmail.com; soni_darmawan@yahoo.com

Abstract: Homecoming is the activity of migrants / migrant workers to return to their hometown. Mudik in Indonesia is synonymous with the annual tradition that occurs before the big religious holiday for example before Lebaran. For Mudik, map is needed as a material of planning / consideration in taking alternative paths according to the guidance in the map when there is traffic jam. Until now there are many variations of Homecoming route map that has been published by various institutions but without cartography rules and there is no standardization about the presentation of map of Homecoming. The purpose of this research is to identify the cartographic aspect that need to be considered in making Home coming map as well as make visualization cartographic design of Homecoming map 2018 properly to be interesting and easy to be understood by the users. The method used is qualitative research in the form of discussion and interview with related parties in making Homecoming map, studio activity and printing process. The results of this research are obtained by cartographic aspects of making Homecoming map and visualization of cartographic design of Homecoming map based on cartographic rules, then applied to print and share Homecoming Map 2018 for Java-Bali Island.

Keywords: homecoming, route map, cartographic rules, and design

DEVELOPMENT OF GEODATABASE ON HOMECOMING ROUTE MAP 2018 (STUDY CASE : JAVA – BALI PATH)

Mochammad Hafid Danang Jaya (1), Soni Darmawan (1)

[1] National Institute of Technology, Geodesy Engineering Department,
Faculty of CivilEngineering and Planning
Jalan PKH. Mustopha, No. 23, 40124 Bandung, Indonesia
Email: hafiddananggg@gmail.com; soni_darmawan@yahoo.com

Abstract: The application of spatial-based technology known as Geographic Information System (GIS) is an integrated alternative means to integrate all data and information both spatial data and attributes that are integrated in a database. Based on Presidential Regulation No. 9 of 2016 which explains that in order to encourage the use of geospatial information for the implementation of national development and to support the realization of a one-map policy that refers to one standard geospatial reference, one database, and one geoportal. Nowadays, the required of media that can give recommendation of optimum path like guidance map "Homecoming route map", so it is expected trip of the travelers can be more comfortable, reduce time and cost. Therefore, made a system database of geographic information systems around "Homecoming route map k". In GIS, there is a database that has a geographical reference or also called geodatabase. This research was conducted to identify the parameters and data what is needed in making "mudik" map 2018 and to know the formation of geodatabase that can fulfill the data element.The implementation stage of research undertaken in making geodatabase "Homecoming route map" map 2018 is preparation, identify the data elements needed in making geodatabase "Homecoming route map" map 2018, data collection, data renewal, data processing, database design, and manufacture of geodatabase. The final result of this research is the geodatabase model of "Homecoming route map" map 2018. The process of preparation made on the manufacture of geodatabase is divided into several stages: identification of data parameters, data identification, data structure development (three data type parameters and 24 data), and database model design.

Keyword: Geodatabase, Geospatial, Geographic Information Systems, Homecoming route map.

TREE BIOPHYSICAL PARAMETER RETRIEVAL USING CLOSE RANGE PHOTOGRAPHS

Sujata Upgupta (1), Poonam S Tiwari (1), Sarnam Singh (1)

[1] Indian Institute of Remote Sensing
4, Kalidas Road, Dehradun, Uttarakhand 248001
Email: sujata.upgupta1@gmail.com; poonam@iirs.gov.in; sarnam.singh@gmail.com

Abstract: Forests play a primary role in regulating Earth's biosphere and biota. Information on phytomass, carbon pool and productivity of different forest ecosystem form a crucial part of the global models for better predictions. Earth observation data in conjunction with field observations have been widely used for such assessments with associated uncertainties. The availability of very high-resolution stereo-images and digital photographs has opened up new vistas for forest/vegetation biophysical parameter retrieval. In this article, an approach to generate 3D models of individual standing trees to retrieve biophysical parameters is presented. We demonstrated an easy-to-use technology that requires little user intervention and allows full or semi-automated external orientation of images, camera calibration and creation of 3D models based on image correlation technique. Close range digital photographs of isolated and suitable trees taken from multiple angles were used to construct 3D models of trees and the generated 3D models were used to obtain measurements on tree height, crown height and crown diameter. Accuracy and precision of the results were tested, and validated using the conventional ground based measurements. We found that the field observed and model-based parameters were in good agreement and error in measurement was 4.64% for height and 13.75% for crown diameter. The correlation coefficient between phytomass based on field data and 3D modeled data was 0.7 for *Eucalyptus* sp. and 0.56 for *Tectona grandis* (Teak). More repetitive experiments and methodological studies particularly in forest ecosystem are required using very high-resolution close range digital photographs to understand the rate of growth, carbon pool assessment and carbon sequestration in tropical forests.

Keywords: Biophysical parameters, Trees, Close-range photographs, Digital camera, 3D model

ROBUST FUNDAMENTAL MATRIX ESTIMATION USING GENETIC ALGORITHM BASED APPROACH WITH MULTI-OBJECTIVE FITNESS FUNCTION FOR STEREO IMAGES

Manimala Mahato (1), Shirishkumar Gedam (1)

[1] Centre of Studies in Resources Engineering, Indian Institute of Technology Bombay, Mumbai 400076, India
Email: manimala.mahato@iitb.ac.in; shirish@iitb.ac.in

Abstract: A novel approach for the estimation of 3 X 3 fundamental matrix using genetic algorithm with multi-objective fitness function is proposed and implemented despite of false matches due to noise, occlusion, geometric and radiometric distortion present in stereo images by analyzing the stereo image pair. In stereo vision, fundamental matrix is the only geometrical constraint available for outlier removal in order to prune the stereo correspondences by relating the two perspective projections of the same point in the scene thus a core research area and received a large attention in the last two decades. Here, the genetic algorithm steps such as initialization of the population, fitness function, crossover and mutation operation are customized and implemented to estimate the optimal fundamental matrix. Each candidate in the population has a 2D structure representing the fundamental matrix for the input stereo image pair. To solve the complex real-world optimization problem of fundamental matrix estimation, improved initialization of population is used instead of randomly selected population, because it leads to more accurate and faster convergence. The proposed algorithm is divided into two parts. First part is the initialization of the population needed for the genetic algorithm. The second part is to improve the population using multi-objective genetic algorithm through iterations for finding the optimal solution. The set of correspondence points are obtained by extracting and matching the Scale Invariant Feature Transform (SIFT) feature points from the stereo image pair and are pruned by enforcing bidirectional constraints. The initial population is filled by the fundamental matrices computed from the set of pruned correspondence points using Random Sample Consensus (RANSAC) through random sampling. The most suitable fundamental matrices are chosen based on the evaluated parameter values using the designed fitness functions considering the constraints related to the epipolar geometry of the stereo image pair. Here, two objective functions are: maximization of number of inliers computed using each candidate and minimization of the distances between the points and its epipolar lines. The usefulness of this approach for is demonstrated by improving the number of inliers and comparing with state-of-the-art dense stereo image matching method.

Keywords: Fundamental matrix; genetic algorithm; multi-objective function; stereo vision

DEVELOPMENT OF LOW-COST REMOTE CONTROL PHOTOMETER FOR SOLUTION CONCENTRATION DETERMINATION

Po-Jui Chen (1), Chun-Chieh Lien (1), Yi-Hao Lin (1), Ming-Fu Chen(1)

[1]Instrument Technology Research Center, National Applied Research Laboratories,
20, R&D Rd. VI, Hsinchu Science Park, Hsinchu, Taiwan
Email: proray@itrc.narl.org.tw; 1209645@narlabs.org.tw; 1609809@narlabs.org.tw;
mfchen@itrc.narl.org.tw

Abstract: Researchers usually use spectrophotometers to analyze the compositions of the unknown solution and estimate the concentration according to its light absorbance. Although spectrophotometers could provide a wide range of spectrum for "spectro-scanning" purposes, most spectrophotometers were not suitable for outdoor measurements and expensive because of elaborate optical components. For some biochemical inspection or clinical analysis applications, only a few specific wavelengths of light are applied to examine the light absorbance of ascertaining chemical analyte. The light emitting diode (LED) is a kind of superior light source that brings an excellent monochromatic light beam profile and delivers wavelengths from ultraviolet to near infrared. In this work, a low-cost and remote control photometer is developed by use of the LED. Four different wavelengths of LEDs are installed inside the photometer as the inspecting light directly to substitute for the complicated diffraction grids or the delicate optical components to low down the cost of the photometer. These four LEDs are collimated by a single collimator lens to make all the light beams be able to irradiate the analyte entirely in the cuvette. Each time only one LED can be switched on, according to the wavelength requirements of the inspections. The proposed photometer is controlled by personal handheld devices, such as smartphones and tablets that are equipped the exclusive application program (APP). The APP is designated to communicate with the photometer via the interface of Bluetooth Low Energy protocol (BLE). A single 9V battery supplies the main power source to avoid the restriction of usage in the outdoors or other critical environments. The photometer establishes the excellent linearity relationship between sample concentrations and their absorbance in the testing experiments. As a result, the low cost photometer proves itself to determine the concentration of the sample preliminarily for industrial inspections as well as to be basic tutorial equipment in laboratory courses.

Keywords: Photometer, LED, Bluetooth, Concentration

ADJUSTMENT METHOD OF MMS POINT CLOUDS USING AERIAL PHOTOGRAMMETRY

Takehiko Ogami (1), Tatsuma Jahana (1), Toshiki Mitsuyasu(1), Taeko Hattori(1)

Higashi-Nihon Spatial Data Center, Asia Air Survey, 1-2-2 Mampukuji Asao-ku Kawasaki-shi Kanagawa, 215-0004 Japan
Email: tak.ogami@ajiko.co.jp; ttm.jyahana@ajiko.co.jp; tsk.mitsuyasu@ajiko.co.jp; tae.hattori@ajiko.co.jp

Abstract: In recent years, autonomous-driving technologies has received board attention. In Japan, Dynamic map is created for autonomous-driving map. Point clouds generated by MMS (Mobile Mapping System) is suitable for building the basic information of the Dynamic map. In order to integrate Dynamic maps and various data, it is important to maintain position accuracy of Dynamic maps. In order to maintain the accuracy of the MMS point clouds, GCP (ground control point) by GNSS positioning is necessary. However, it is difficult for the surveyors to get directly on the express-way. Pedestrians are prohibited from entering the expressway. Aerial photogrammetry was used as a solution to this problem. We adjusted MMS point clouds of using GCP acquired by aerial photogrammetry and the accuracy of point cloud data was verified according to the rules of the Geographical Survey Institute (GSI) of Japan. As a result, the accuracy of point cloud data was less than the allowable value of the map level 500 (horizontal error 300 mm, vertical error 300 mm) stipulated by the Geographical Survey Institute. The results clearly prove that the adjustment by GCP is capable of position accuracy (map information level 500). In this research, the reception status of GNSS radio waves was good. It is necessary to consider a method in a place where the reception environment is bad (city area etc.).

Keywords: MMS (Mobile Mapping System), Aerial Photogrammetry, Autonomous-Driving Point Cloud Accuracy, GNSS

MULTI-OBJECTIVE EVOLUTIONARY ALGORITHM FOR OIL SPILL DETECTION FROM COSMO-SKYMED SATELLITE DATA

Maged Marghany (1)

[1] School of Humanities, Geography Section, Universiti Sains Malaysia,
11800 USM Penang, Malaysia
Email: magedupm@hotmail.com

Abstract: This study has demonstrated work to optimize the oil spill footprint detection in synthetic aperture radar (SAR) data. Therefore, Entropy-based Multi-objective Evolutionary Algorithm (E-MMGA) and non-dominated sorting genetic algorithm-II (NSGA-II) have implemented with COSMO-SkyMed data during the oil spill event along the coastal water of along the Koh Samet Island, Thailand. Besides, Pareto optimal solution is implemented with both E-MMGA and NSGA-II to minimize the difficulties of oil spill footprint boundary detection because of the existence of look-alike in SAR data. The study shows that the implementation of Pareto optimal solution and weight sum in E-MMGA and NSGA-II generated accurate pattern of an oil slick. Furthermore, thick oil spill has highest value of 2.3 NSGA-II than thin and medium spills. The NSGA-II has the highest performance as compared to E-MMGA, which is able to preserve the morphology of oil spill footprint boundaries i.e. thick, medium, and light. In conclusion, NSGA-II is considered as an excellent algorithm to discriminate oil spill from look-alikes and also to identify thick oil spill from thin one within the shortest computing time.

Keywords: Multi-Objective Evolutionary Algorithm, Entropy based Multi-Objective Evolutionary Algorithm, Non-dominated Sorting Genetic algorithm-II, oil spill spreading, Cosmo-skymed satellite.

AUTOMATIC DETECTION OF 2004 TSUNAMI GENERATING INTERNAL WAVE ALONG ANDEMAN SEA USING ENVISAT SATELLITE DATA

Maged Marghany (1)

[1] School of Humanities, Geography Section, Universiti Sains Malaysia,
11800 USM Penang, Malaysia
Email: magedupm@hotmail.com

Abstract: In remote-sensing imaging, internal waves are among the foremost simply recognized of the oceanographic phenomena. The distinctive signatures of alternating bands of sunshine and dark, quasilinear strips are perceived in images of the ocean surface, in multispectral radiometer data, and in real and synthetic aperture radar data. Internal waves exist as a result of the deep waters of the ocean are denser than the surface waters. The novelty of this work is to implement the Particle Swarm Optimization algorithm for automatic detection of internal wave from ENVISAT data during the 2004 tsunami event. The results show the normalized radar cross section is ranged between -24 to -4 dB. The lowest normalized radar cross section of -28dB is described the low window zone shelter along the Andaman and Nicobar Islands. However, the highest backscatter of -4 dB describes the occurrence of whirlpool in the east of the Andaman Sea. This whirlpool is located between latitude of 14° N to 15° N and longitude of 94° E and 96°E. The whirlpool has a radius of 1.9 km and located above of water depth gradient of 1000 m. In conclusion, the Particle Swarm Optimization has automatically detected internal wave. In conclusion, 2004 tsunami generated internal wave along the Andaman Sea.

Keywords: Internal wave, automatic detection, ENVISAT SAR radar image, Particle Swarm Optimization algorithm.

UPGRADING OF THIN ICE AREA EXTRACTION ALGORITHM USING AMSR2 DATA

Kenta Miyao (1), Kazuhiro Naoki (1), Kohei Cho (1)

[1] Tokai University Research & Information Center (TRIC), 2-28-4, Tomigaya, Shibuya-k, Tokyo 151-0063, Japan
Email: kohei.cho@tokai-u.jp

Abstract: Sea ice has an important role of reflecting the solar radiation back into space. In addition, the heat flux of ice in thin ice areas is strongly affected by the ice thickness difference. Therefore, ice thickness is important parameter of sea ice. In the previous study, the authors have developed a thin ice area extraction algorithm using passive microwave radiometer AMSR2 for the Sea of Okhotsk. The basic idea of the algorithm is to use the brightness temperature scatter plots of AMSR2 19GHz polarization difference (V-H) vs 19GHz V polarization. However, when the authors applied the algorithm to the Bering Sea, two problems have become clear. One was that some thin ice areas were not well extracted, and the other was some of the consolidated ice were extracted as thin ice areas. In this study, the authors have improved the thin ice area extraction algorithm to solve these problems. By adjusting the parameters of the algorithm applied to the brightness temperature scatter plots of AMSR2 19GHz polarization difference (V-H) vs 19GHz V polarization, most of the thin ice areas were also well extracted in the Bering Sea. The authors also introduced an equation using the brightness temperatures difference of 89GHz vertical and horizontal polarization to reject the thin ice area mis-extracted over consolidated ice.

Keywords: Sea ice, Passive microwave radiometer, GCOM-W, global warming

DROUGHT MONITORING ON THE RICE PADDY FIELDS AREA USING SENTINEL-1 AND SENTINEL-2 IMAGERY (STUDY CASE: SUB-DISTRICT OF CIBEBER, CIANJUR DISTRICT, PROVINCE WEST JAVA)

Rifcky M. Helmizar (1), Soni Darmawan (1)

[1] Institut Teknologi Nasional, Geodesy Engineering Department,
Faculty of Civil Engineering and Planning, Jalan PKH. Mustopha, No. 23, 40124 Bandung, Indonesia
Email: rifckyhelmizar@gmail.com; soni_darmawan@yahoo.com

Abstract: Cianjur Regency suffered drought in 2017 which resulted in some areas of rice fields. Technology that can be used to monitor the drought of field area one of them is using remote sensing technology. The purpose of this study was to identify the drought of the rice field area using Sentinel-1 and Sentinel-2 imagery. The study area studied is located in Sub-district of Cibeber, Cianjur District, West Java. The research methodology is consisted data collection, including process geometric correction, radiometric correction, image cropping, NMDI (Normalized Multi-band Drought Index) algorithm to calculated identify drought-detected areas, NDVI (Normalized Difference Vegetation Index) to know the density of vegetation in Optical Imagery and created threshold drought index for Radar Imagery. The result in this research is drought map of Cibeber Districts identification using Sentinel-1 and Sentinel-2 Imagery.

Keywords: Drought, Sentinel-1, -2 Imagery, NMDI, NDVI, and Thresholding

TECHNOLOGY DESIGN OF APPLICATION-ORIENTED LONG-TERM SEQUENCE INTERFEROMETRIC SAR SATELLITE

Huang Yao (1)(3), An Jun (1)(2), Yang Lulu (1), Han Jingmin(1)

[1] ChinaRS Geoinformatics Co.,Ltd, 300384 TianJin, China
[2] Tianjin Enterprises Key Laboratory of Remote Sensing Intelligent Service Technology, 300384 TianJin, China
[3] Shenzhen ChinaRS Satellite Co, 518000 ShenZhen, GuangDong, China
Email: huangy@chinarsgeo.com; anjun@chinarsgeo.com; yangll@chinarsgeo.com; hanjm@chinarsgeo.com

Abstract: In recent years, with the continuous advancement of SAR remote sensing satellite technology and application technology, relevant market demand has been continuously cultivated and explored, and the launch of low-cost and micro-small synthetic aperture radar satellite can meet the requirements of timeliness and support capability of regional data services. Combining the application of SAR satellite data in dynamic monitoring of urban safety and major engineering, high-precision DEM acquisition, dynamic monitoring of geological disasters, high-resolution remote sensing land cover application in cloudy and rainy areas, and dynamic monitoring of marine environment, this paper introduces the mission objectives, technical indicators and preliminary technical solutions of the long-term interferometric SAR satellites which to be launched by ChinaRS Geoinformatics Co.,Ltd, and analyses the satellite orbit indicators, SAR radar indicators and platform indicators, and explores the solution of the two key technologies of precision orbit control and high-precision positioning for interferometric tasks. Through the above analysis, it is proved that technology design of the long-term sequence interferometric SAR satellite is reasonable, which can provide high-spatial resolution, high-time resolution and all-weather earth observation data services, and which will play an important role in stimulating local economy and improving government's precise decision-making.

Keywords: SAR remote sensing; long-term sequence; interferometric SAR; precision orbit control; high-precision positioning

MONITOR RICE PHENOLOGICAL STAGE USING SAR REMOTE SENSING

Siti Aishah bt Mohd Rasit (1), Abdul Rashid Mohamed Shariff (2), Aimrun Wayayok (2), Ahmad Fikri Abdullah (2)

[1] Geospatial Information Research Centre (GISRC), Level 6 Tower Block, Faculty of Engineering, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia
[2]Department of Biological and Agriculture, Level 3, Faculty of Engineering, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia
Email: aisyahrasyid1207@gmail.com; rashidpls@upm.edu.my; aimrun@upm.edu.my; afbagis@gmail.com

Abstract: The limitation of human eye cannot support for large scale area in crop scouting and monitoring, but remote sensing sensor helps to 'see' plant in a different way and allowing us to better understand on the crop stage, condition and health. Rice monitoring are important for crop practices management, yield and losses estimation. Remote sensing base earth observation allows timely monitoring of rice cultivation and could provide high accuracy of information compares to the traditional method besides independence from solar illumination, overcoming cloud cover and weather problem. This study explores the potential of SAR images, RADARSAT-2 and ALOS PALSAR-2 in gathering crop information at every rice growth stages in Sawah Sempadan, Tanjong Karang. The aims of this study are 1) to identify the crop growth status and biophysical characteristic at every growth stage, 2) to study the correlation between backscatter with plant height and plant density, and 3) to analyse the correlation of backscatter coefficients between two different sensor which is RADARSAT-2 and ALOS PALSAR-2. Radar backscatter of SAR images were extract from 80 points sample from 40 lot of rice field in second season of 2016. Both SAR images were acquired in different polarization co polarization (HH, HV, VV, and VH). Simple linear regression analysis was used to produce the correlation equation and image processing was perform using SNAP and ArcGIS software. Resultsof early experimentshowedthe paddy rice backscattering coefficient was low at early growth stage and peaked at themiddle growth stages.Radar backscatter showed at different phenological growth from sowing/transplant to ripening stage.This studyisexpected to givegood correlations for second and third objective.

Keywords: Rice Growth Stage, Radar Backscatter Coefficient, RADARSAT-2, ALOS PALSAR-2, Biophysical Characteristic

THE PLAN OF INTEGRATED LONG-ENDURANCE UAV WITH LIDAR

Ming-Yuan Yeh (1), Jer Ling (1)

[1] National Space Organization,8F, 9, Prosperity 1st Road, Science-Based Industrial Park, Hsin-Chu, Taiwan
Email: marco@nspo.narl.org.tw; jl@nspo.narl.org.tw

Abstract: Light detection and ranging (Lidar) mapping is an accepted method of generating precise and directly georeferenced spatial information about the shape and surface characteristics of the Earth. This paper describes the project plans to carry out the airborne Lidar function test verification and ground operation concept with the long endurance high altitude (HALE) solar-powered UAV. The plan is to use a long-endurance solar drone to cruise in the air 1~5km above with cruise speed about 30~35km/hr. The UAV will integrate Lidar with GPS and inertial navigation system (INS) to establish a higher resolution 3D terrain collection data without the need for personnel to conduct field surveys. Since the long-endurance drone can stay in the air for a long time and collect the flight data with stable attitude, it can be carried out away from the drone ground station for 3D mapping measurement tasks, and return to the ground station for fast transmission of measurement data every half-day or one-day cycle. Then, fly back to the mission to continue the mapping measurement task to achieve the function of a satellite like Pseudo Satellite. This paper describes the integration of HALE UAV and Lidar, its study will be used as a pathfinder of the space borne Lidar planned for the future 3rd phase space program in Taiwan.

Keywords: Lidar, GPS, INS, HALE, UAV

A STUDY ON IDENTIFYING NUMBER PLATES OF CARS AND MOTOR BIKES USING UAV

Kento Kojima (1), Kazuhiro Naoki (1), Kohei Cho (1)

[1] Tokai University
4-1-1 Kitakaname Hiratsuka, Kanagawa 259-1292, Japan
Email: kohei.cho@tokai-u.jp

Abstract: Due to the rapid advancement of the unmanned aerial vehicle (**UAV**) technologies, the ways of using UAVs, or drones, are expanding in the field of remote sensing. The authors have been using UAVs for connecting satellite images with in situ measurements. One of the interest for police to use UAV is to identify the number plates of cars and motor bikes. Under the cooperation with the Tokyo Metropolitan Police Office, the authors are investigating the suitable flight height of UAVs and the suitable view angle of the cameras onboard the UAV. In this study, the authors have used Zenmuse X3 camera attached on Inspire-1 of DJI for the investigation. In case of the above system, the flight height had to be lower than 20m for identifying the number of the motor bikes. However, the color difference reflecting the class difference of motor bikes could be identified until 40m height.

Keywords: Disaster, Police, Camera, Drone

APPLICATION OF UAV IN JIUZHAIGOU EARTHQUAKE EMERGENCY WORK

Qisong Jiao (1), Yi Luo (1), Xin Wang (1), Qiang Li (1)

[1]Institute of Crustal Dynamics, China Earthquake Administration,
Haidian District, 100085 Beijing, China
Email: 1985jqs@163.com; luoyi1983@126.com; wangxinjapan@163.com; liqiang08@163.com

Abstract: On August 8, 2017, a magnitude 7.0 earthquake occurred in Jiuzhaigou, Sichuan province. As of August 13, the earthquake caused 25 deaths and over 73,000 houses were damaged. The earthquake caused a large number of earthquake landslides that blocked the road. Moreover, it caused the field investigation and earthquake rescue fail to carry out normally, which seriously affected the earthquake emergency investigation and disaster assessment. UAV (unmanned aerial vehicle, UAV) had the advantages of strong flexibility with high resolution image acquisition capability and have been widely applied in the fields of geological environment and disaster investigation, post-earthquake emergency and disaster assessment. Due to the urgency of the rescue, we conducted UAV aerial survey in Zhangzha town the nearest settlement to the epicenter and acquired 17.55 km2 images with spatial resolution of 0.2 m. Then, we used these images to do landslides interpretation. Elevation, slope, relief, aspect and roughness were selected as topographic factors to carry out statistical on the landslides spatial distribution. The relationship between the landslides spatial distribution and the active fault was also analyzed. This work provided technical support for the earthquake field emergency, earthquake landslide prediction and disaster loss assessment.

Keywords: Jiuzhaigou Earthquake, UAV, Landslide Extraction, Spatial Distribution Analysis

MALARIA GEO-REFERENCE INFORMATION AND COORDINATION SYSTEM FOR MALARIA ELIMINATION (MAGICS.ME)

Jenarun Jelip (1), Mohd Hafizi Abdul Hamid (1), Shimatun Jumani Ibrahim (2), Rose Nani Mudin (1), Norimaniah Mazelan (2), Mohd Aizat Hisyam Ismail (2), Ong Chia Ching (1), Ahmad Shah Ibrahim (1)

[1]Disease Control Division, Ministry of Health Malaysia, Level 4, Block E10, Parcel E, 62590 Precinct 1, Putrajaya
[2] Malaysian Remote Sensing Agency (MRSA), Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC), No.13 JalanTun Ismail, 50480, Kuala Lumpur, Malaysia
Email: jenarun@moh.gov.my; shimatun@remotesensing.gov.my

Abstract: Malaysia has committed to and on the right track to eliminating human malaria by 2020. This paper aims to describe a spatial decision making system to support malaria elimination program in identifying priorities for malaria prevention and surveillance response. Ministry of Health Malaysia, in collaboration with Malaysia Remote Sensing Agency developed a system known as *Malaria Geo-reference Information and Coordination System for Malaria Elimination* (MAGICs.ME) which is equipped with GIS and remote-sensing functionality. Data from the National Malaria Registration Database known as eVEKPRO were extracted and transferred into MAGICs.ME for analysis. Within eVekpro malaria cases and geographical reconnaissance (GR) data are readily available. Malaria cases were mapped either by place of infection or place of residence. GIS queries were integrated into the MAGICs.ME-framework to automatically classify and map transmission foci based on the spatiotemporal distribution of cases. The system allows for identification of area of interest (AOI) and extraction of household and population data to facilitate conduct of foci-specific response. The number of malaria cases in Malaysia declined from 3,923 in 2014, to 2,311 in 2015 and 2,327 in 2016. Concurrently, the annual incidence showed similar trend with incidence rate of 0.132 per 1000 population in 2014, 0.076 in 2015 and 0.075 in 2016. All locally acquired cases were geo-referenced and mapped at their place of infection, whereas the imported cases were geo-referenced at their place of residence. Incidence rates were used as measure of disease burden and computed at state, district and at sub-district (mukim) level. The different stages of disease burden progress in each district or sub-district were displayed in the form of geo-spatial and temporal maps. MAGICs.ME was developed to support Malaysia to achieve malaria elimination by 2020. This smart system is able to identify the target area and provide household, epidemiological and population data for implementation of appropriate foci-specific targeted response. Furthermore, the system is able to provide information on operational implications such as logistical and financial requirement in implementation of interventions.

Keywords: Malaria Elimination, Surveillance, GIS, Mapping

DEVELOPING WEBGIS-BASED DASHBOARD PLATFORM FOR MONITORING DISASTER MANAGEMENT IN MALAYSIA

Siti Nor Afzan Abdul Habib (1), Az-Azira Abd Aziz (1), Siti Nordiana Mohd Rabai (1)

[1] Malaysian Remote Sensing Agency, Ministry of Energy, Science, Technology, Environment and Climate Change, No. 13, Jalan Tun Ismail, 50480 Kuala Lumpur, Malaysia
Email: afzan@remotesensing.gov.my; azazira@remotesensing.gov.my; diana@remotesensing.gov.my

Abstract: This research describes the development of dashboard in geospatial information web application for disaster management. The main aspects of the development including data collection, data integration, geospatial database design, and data presentation and dashboard design are discussed in this paper. Malaysia has experienced various of disasters like floods, forest fires, landslides and haze. It is important for agencies at regional level to monitor and manage for preparedness, response, recovery and mitigation. However, overloaded disaster information in many types of formats and applications from different sources made decision makers facing difficulties to gather and select the most significant data that should be used in disaster situation. WebGIS-based dashboards are designed to display multiple visualizations that work together on a single screen to help the decision makers understand and analyze the information easier, therefore process of decision making more effective and efficient.

Keywords: Dashboard, WebGIS, Disaster Management

URBAN LAND USE CHANGE STUDY IN MONGOLIA USING RS AND GIS TECHNIQUES

D.Amarsaikhan (1), B.Byambadolgor (1), Nyamjargal (1), D.Enkhjargal (1), G.Tsogzol (1)

[1] Institute of Geography and Geoecology, Mongolian Academy of Sciences av.Enkhtaivan-54B, Ulaanbaatar-51, Mongolia
Email: igg.mas1@gmail.com

Abstract: In recent years, because of the rapid increase in world population and the irreversible flow of people from rural to urban areas, the urbanization and urban sprawl have become the common problem of governments and decision-makers in both developed and developing countries. As it is known, the developed countries have a higher percentage of urban inhabitants than the developing countries. However, rapid urbanization process is mainly occurring in less developed countries, and it is expected that in future most urban expansions will occur in the developing world. Mongolia, as many other developing countries, has problems with the urban expansion and the growth of population in the main cities. For example, within the last two decades, Ulaanbaatar, the capital city of Mongolia has been significantly expanded due to mainly enormous migration of people from rural areas as well as some development activities. To prevent from the rapid urban expansion, especially from the unplanned urbanization process, urban planners and decision-makers need to regularly evaluate the current development procedures using updated urban planning maps. One of the easy solutions could be the use of satellite images, because present remote sensing (RS) has the huge potential of providing accurate spatial information over a large area in a short time sequence. The aim of this study is to analyze the urban land use changes of Central Ulaanbaatar, Mongolia using very high resolution RS and geographical information system (GIS) data sets. For the study, the changes that occurred before 1990 were compared with the changes that occurred after 1990 and the socio-economic reasons for the changes were described. For the development of the primary digital database, a large scale topographic map and historical description of the land use elements were used. To update the database and extract the reliable urban land use information, very high resolution panchromatic and multispectral Quickbird images of 2018 were fused. For the fusion, some advanced data fusion techniques are compared in terms of the enhancement of spatial and spectral variations of urban features. Overall, the study demonstrates that during the market economy the central part of the capital city is urbanized very rapidly.

Keywords: Urban, Land use, Change study, RS, GIS

SPATIAL AND TEMPORAL CHANGES ON LAND SURFACE TEMPERATURE BY LAND USE/ LAND COVER OF PAUNG TOWNSHIP, MON STATE, MYANMAR

Dr. Khin Mar Yee, Dr. Mu Mu Than, Dr. Kyi Lint, Dr. May Myat Thu,
Dr. Mar Lar Han, Candidates of PGDGIS

Abstract: Rapid changes in the land use and land cover of a region have become a major environmental concern in recent time. The main goal of this paper is to quantify the changes in the land cover and consequent changes in surface temperature. For this research, Landsat satellite images of 1997, 2007 and 2017 of Paung township area were used. Geospatial technologies such as remote sensing and GIS are very effectiveness in measuring, monitoring and predicating the land use/land cover changes. The findings of this paper revealed a notable land use and land cover change and surface temperature for the future sustainable mining related areas; Paung Township. This study demonstrates that rapid human actives and mining areas significantly decreases the dense forest areas, hence increased the surface temperature and modified around the Pound Township microclimate. This has led to unsustainable development with the reduction of green spaces and also changes in local climate a formation of region heat.

Keywords: land cover change and surface temperature, Geospatial technologies, human actives

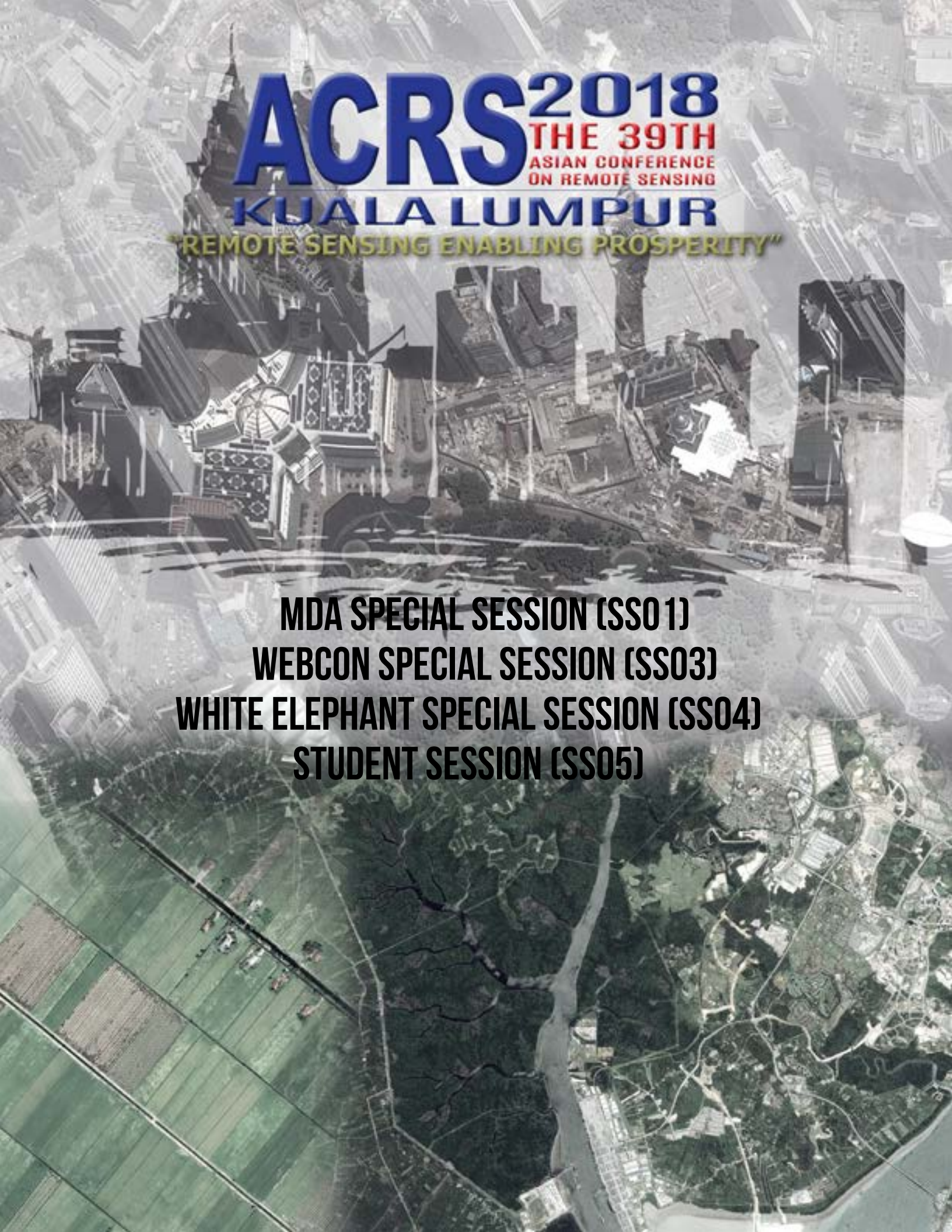
DEVELOPMENT OF INDONESIA NATIONAL FORESTS MONITORING SYSTEM USING GEONODE AS OPENSOURCE PLATFORM

Arif Wijayanto (1)(2), Sahid Hudjimartsu (1), Lilik Prasetyo (1), Yudi Setiawan (1)(2)

[1] Forests 2020, Environmental Analysis and Spatial Modelling Laboratory, Department of Forest Resources Conservation and Ecotourism, Faculty of Forestry, Bogor Agricultural University, Darmaga Campus, Bogor District, West Java Province, Indonesia 16680
[2] Environmental Research Center, Bogor Agricultural University, Darmaga Campus, Bogor District, West Java Province, Indonesia 16680
Email: akwijayanto@apps.ipb.ac.id; s.hudjimartsu@apps.ipb.ac.id; lbprastdp@apps.ipb.ac.id; setiawan.yudi@apps.ipb.ac.id

Abstract: Monitoring of national forest resources is needed to provide information on the condition of Indonesia's forests as a whole. The Indonesian Ministry of Environmental and Forestry (MoEF) conducts the national forests monitoring by involving several parties spread throughout Indonesia. To publish the data, the institution serves the data as online services using proprietary platform. Geonode as an opensource platform for managing geospatial data, can be alternative to the proprietary platform by concerning cost, reliability, and performance. Geonode is a geoportal opensource system with a combination of Django as framework and Python as programming language that can display the visualization of spatial dynamic information with interactive way. The application was designed to be used as support tool for decision makers related to national forests policy. The application has been developed as beta version and can be accessed online.

Keywords: monitoring, national forest, goenode, opensource



MDA SPECIAL SESSION (SS01)
WEBCON SPECIAL SESSION (SS03)
WHITE ELEPHANT SPECIAL SESSION (SS04)
STUDENT SESSION (SS05)

2 Special Session (SS)

SS01 : **MDA Special Session**

- MDA01 : SAR for Urban Monitoring
- MDA02 : SAR for Forest Monitoring
- MDA03 : SAR for Oil & Gas Infrastructure Monitoring
- MDA04 : Machine Learning in SAR: Current and Future Directions

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- MDA04 : Machine Learning in SAR: Current and Future Directions

SS04 : **White Elephant Special Session**

- 01 : What is the White Elephant Club?
- 02 : How to Write a Thesis
- 03 : How to Make a Research Proposal?
- 04 : How to Give a Presentation?

SS05 : **Student Session**

Fathiera Mansor
Geoscience & Digital Earth Centre, University Technology of Malaysia, Malaysia

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The University of Tokyo, Japan

STS03 **Tzu Heng Chou**
National Taiwan Normal University

STS04 **Keith Landicho**
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STS05 **Shaily Gandhi**
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STS06 **I-Chen Yang**
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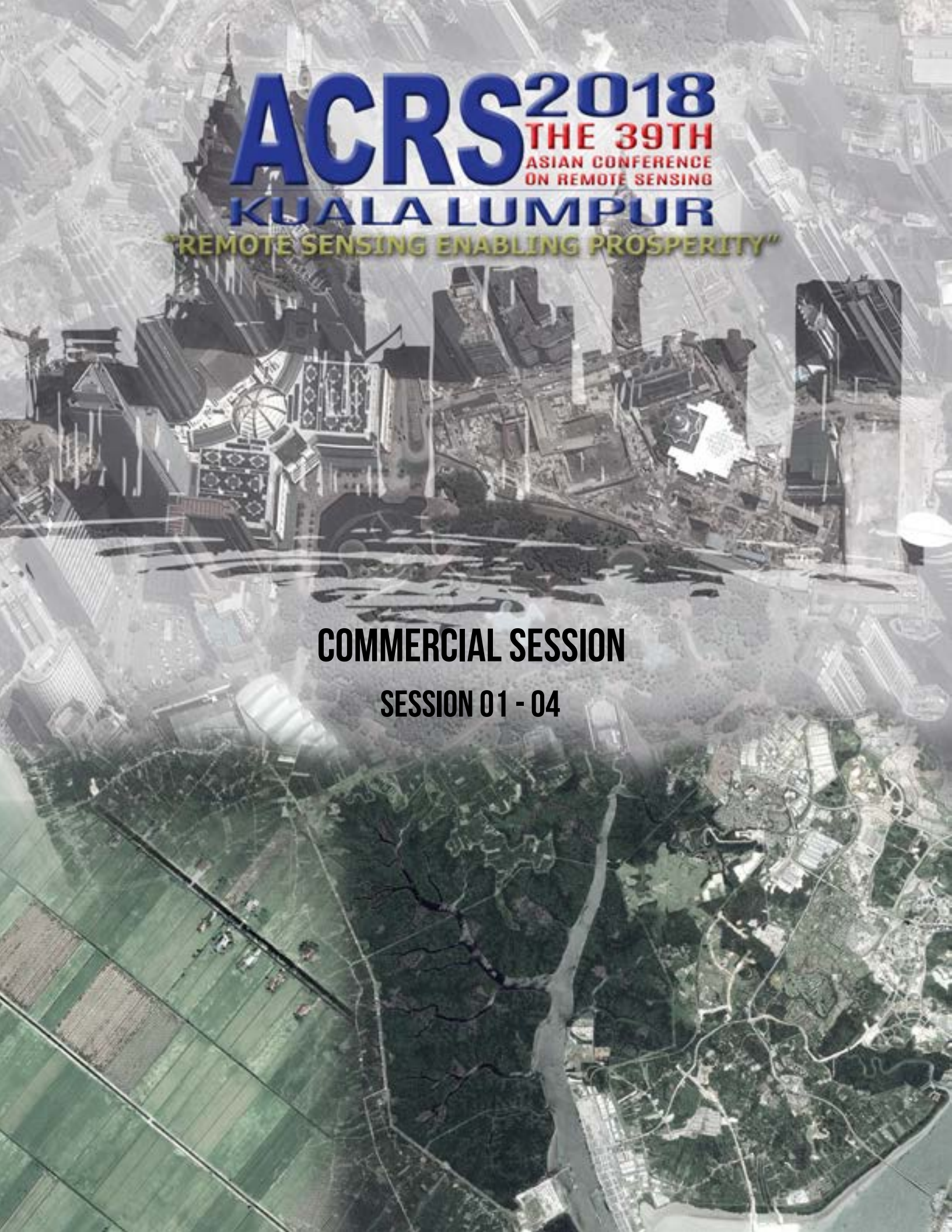


COMMERCIAL SESSION

SESSION 01 - 04

Commercial Session (CS)

Day 1

1	:	Spectris Pte. Ltd.	(CS01)
2	:	GPS Land (M) Sdn. Bhd.	(CS01)
3	:	Survey Satellite Technology Limited	(CS01)
4	:	Beijing Space View Technology Co. Ltd.	(CS02)
5	:	Sky-Shine Corporation (M) Sdn. Bhd.	(CS03)

Day 2

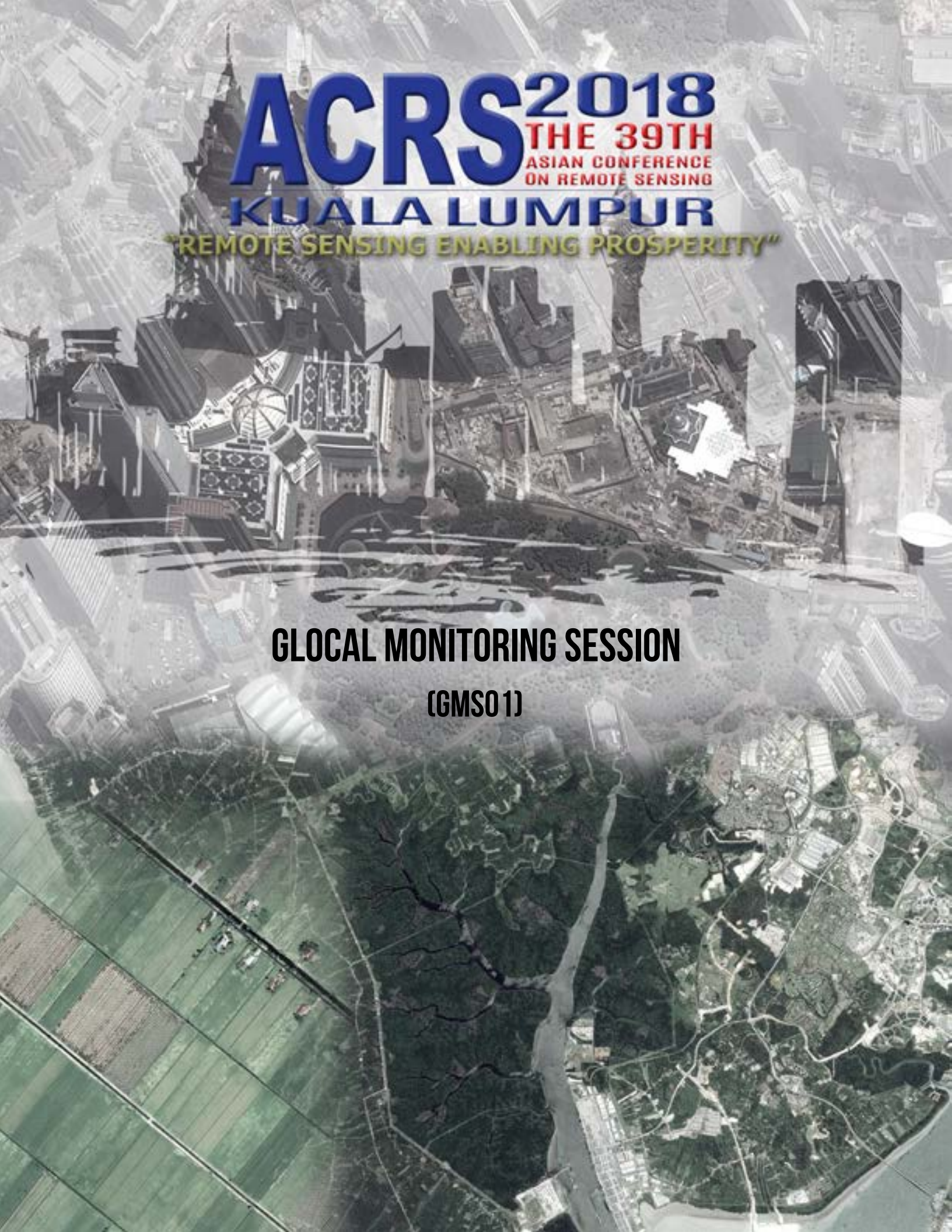
6	:	Twentyy First Century Aerospace Technology (Asia) Pte. Ltd	(CS04)
7	:	KQ GEO Technology Co. Ltd.	(CS04)
8	:	Infinity Success Solutions Sdn. Bhd.	(CS04)
9	:	Remote Sensing Technology Center of Japan (RESTEC)	(CS04)

Day 3

10	:	Beijing PIESAT Information Technology Co. Ltd.	(CS05)
11	:	ST Electronics (Satcom & Sensor Systems) Pte. Ltd.	(CS05)
12	:	LARS Department of Geoinformatics, University of Seoul	(CS05)
13	:	PCI Geomatics	(CS06)

Day 4

14	:	National Space Organization	(CS07)
15	:	RedPlanet Solution Sdn. Bhd.	(CS07)
16	:	SI Imaging Services	(CS07)
17	:	Japan Aerospace Exploration Agency (JAXA)	(CS07)



GLOCAL MONITORING SESSION

(GMS01)

Glocal Monitoring Session

GMS01

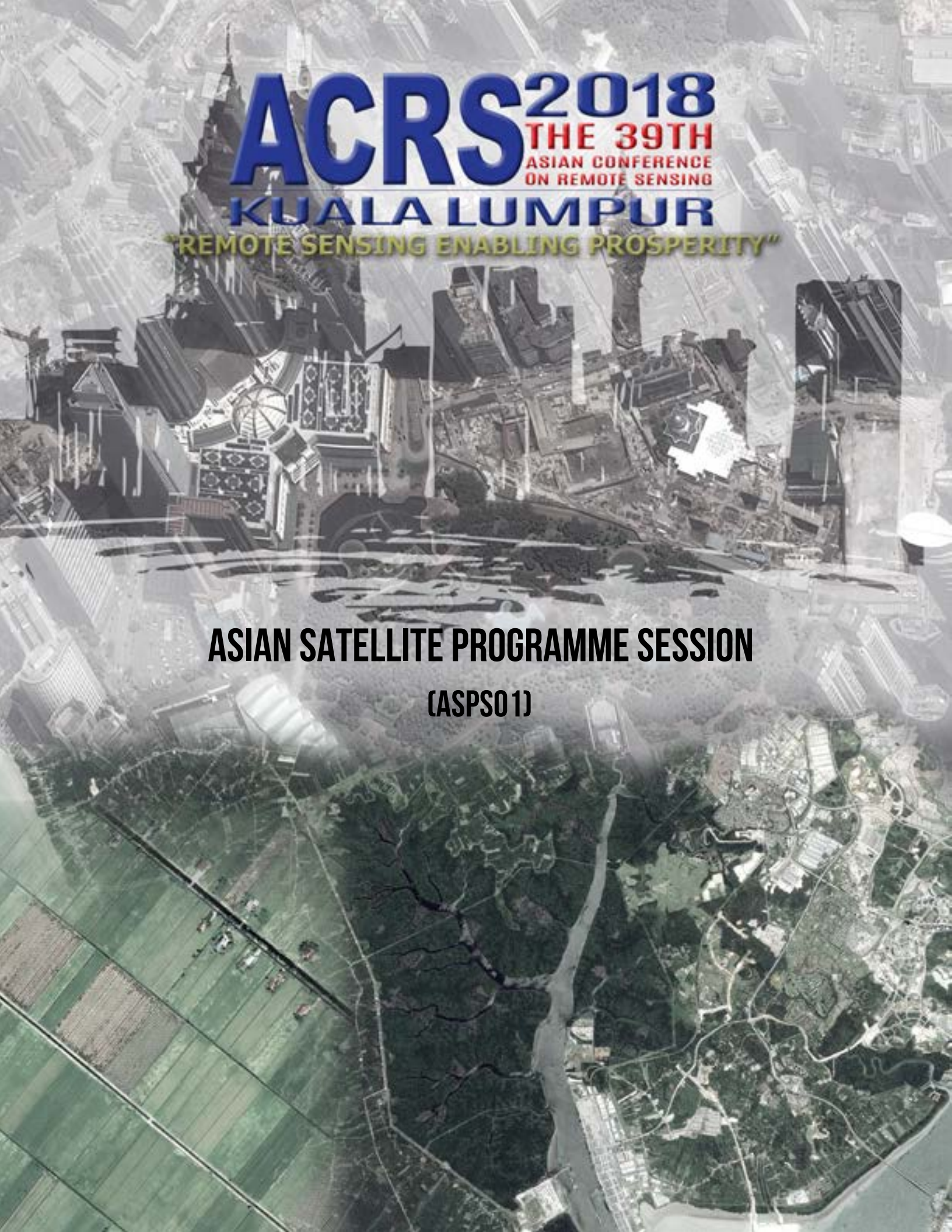
1 : **Prof. Dr. Kohei Cho**
General Secretary
Asian Association on Remote Sensing
A

2 : **Prof. Osamu Uchida**
Department of Human and Information Science, School of Information Science and Technology, Tokai University, Japan
A

3 : **Dr. Husi Letu**
Chinese Academy of Sciences, China
A

4 : **Dr. Enrico C. Paringit**
University of the Philippines Diliman, Philippines
A

5 : **Mrs. Norizan Abdul Patah**
Malaysian Remote Sensing Agency
A



ASIAN SATELLITE PROGRAMME SESSION

(ASPS01)

Asian Satellite Programme Session

ASPS01

1 : **CHINA** A
Prof. Dr. GU Xingfa
Director General
Institute of Remote Sensing Applications, Chinese Academy of Science

2 : **CHINA-TAIPEI** A
Dr. Kuo-Hsien Hsu
Associate Researcher
Satellite image division, National Space Organization, National Applied Research Laboratories (NSPO)

3 : **INDIA** A
Dr. Sameer Saran
Secretary
Indian Society of Remote Sensing (ISR)

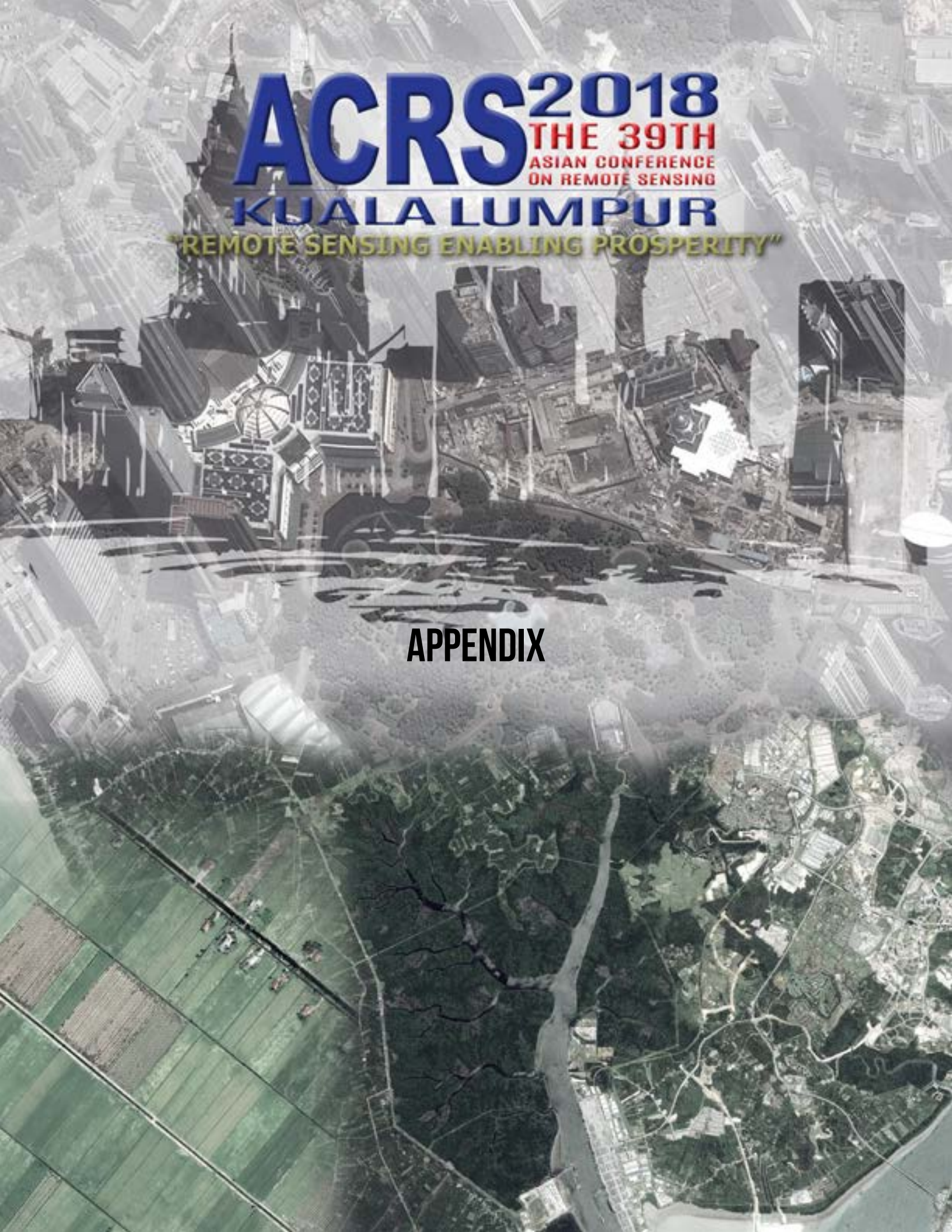
4 : **INDONESIA** A
Mr. Wahyudi Hasb
Head of Dissemination Division
Satellite Technology Center, National Institute of Aeronautics and Space (LAPAN)

5 : **JAPAN** A
Dr. Shiro Ochi
Visiting Scientist
Japan Aerospace Exploration Agency (JAXA)

6 : **KOREA** A

7 : **MALAYSIA** A
Prof. Ir. Dr. Md. Azlin Md Said
Universiti Sains Malaysia

8 : **THAILAND** A
Dr. Warinthorn Kiadtikornthaweeyot
Researcher
Geo-Informatics and Space Technology Development Agency (GISTDA)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APPENDIX

Appendix

List of Unpresented Papers

AB504	"Assessment of Wave Renewable Energy in Malaysia from Satellite Altimetry: Issue and Challenge"	(TS16)
AB649	"Landslide Hazard Distribution and Zonation Mapping Using Geo Spatial Approach – A Case Study in Badulla District, Sri Lanka"	(TS52)
AB652	"The Evaluation of Coast Line Movement from The Kalu River Mouth to Bolgoda River Mouth Using DSAS Tool Based on GIS"	(TS45)
AB653	"The Evaluation of Coastal Erosion And Its Impact on Coastal Environment Between Kalu River Mouth And Bologoda River Mouth, Sri Lanka."	(TS38)
AB475	"Object-Based Approach for Impervious Area Detection on Various Scene of Pleiades Satellite Images"	(TS56)

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