ASIAN RICE CROP MONITORING for GEOGLAM-

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Abstract: Asian countries are responsible for approximately 90% of the world's rice production and consumption. As a result, rice is the most significant cereal crop in Asia. The Japan Aerospace Exploration Agency (JAXA) led to develop a work plan of Asia rice crop monitoring in GEO global agriculture monitoring (GEOGLAM). This paper presents an overview of Asia rice crop monitoring in GEOGLAM.

INTRODUCTION

In our increasingly interconnected world, it is critically important to consider food security issues on a global scale. To analyze these issues and to take appropriate action, we need a comprehensive view of global croplands, their productivity, and their water requirements. In 2011, G20 agriculture ministers agreed to task GEO (The Group on Earth Observations) to define and implement a Global Agriculture Monitoring (GLAM) project (Meeting of G20 Agriculture Ministers, 2011). The G20 GEOGLAM work plan aimed to reinforce the international community's capacity to produce and disseminate relevant, timely, and accurate forecasts of agricultural production on a regional, national, and global scale. This will require the creation of a framework of best practices that will lead to the development of an advanced geospatial information system for croplands, their productivity, and their water requirements. Such a complex agricultural monitoring system is only feasible through the use of remotely sensed data from satellites, which is globally consistent, repeatable, and scalable. Rice crops are part of the G20's food security concerns, being the most significant cereal crop in Asia - with Asian countries being responsible for approximately 90% of the world's rice production and consumption. The Japan Aerospace Exploration Agency (JAXA) worked with the Thai Geo-Informatics and Space Technology Development Agency (GISTDA) to develop a prototype system designed to provide crop acreage and yield estimation. The system uses space-based radar and other Earth observation satellite-based data along with ground observation data and a crop growth model for rain-fed rice in Thailand. This paper presents an overview of Asia rice crop monitoring in GEOGLAM.

GEOGLAM

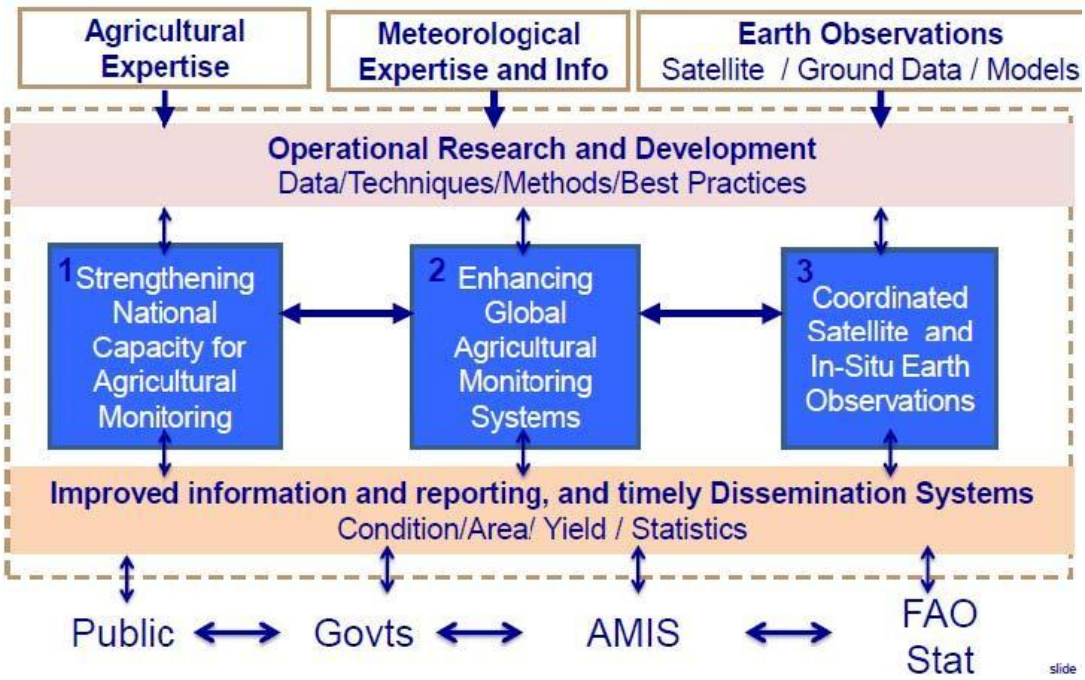
The Group on Earth Observations (GEO) is an Intergovernmental body with 90 members and 64 participating organizations seeking to deploy a Global Earth Observation System of Systems (GEOSS) for 9 social beneficial areas such as water, climate change, disaster, weather, agriculture, energy, health, bio-diversity. The vision for GEOSS is a world where decisions and actions are informed by coordinated, comprehensive and sustained Earth observations. In November 2011, the G20 Agriculture Ministers addressed the issue of food price volatility with the ultimate objective to improve food security and agreed on an "Action Plan on food price volatility and agriculture". To increase information availability, quality and transparency, 2 initiatives are suggested. One is FAO's Agricultural Market Information System (AMIS) and another is GEOGLAM. The G20 final declaration in France mentioned that the GEOGLAM initiative would coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections and weather forecasting data. The objective of GEOGLAM is to reinforce the international community's capacity to produce and disseminate relevant, timely and accurate forecasts of agricultural production at national, regional and global scales. There are 3 actions of GEOGLAM as follows;

- Action 1. National capacities for agricultural monitoring Strengthening, capacity building, experience sharing, research + focus on countries at risk.

- Action 2. Global and regional agricultural monitoring systems harmonizing, connecting and strengthening of existing systems, inter-comparing and disseminating their information.
- Action 3. Global Earth observation system for agricultural monitoring : Developing an operational system : coordinated satellite and in-situ Earth Observation and weather forecasting;

And, there are 7 deliverables.

- Deliverable 1 : Access to Earth Observation data for agriculture monitoring
- Deliverable 2 : Access to Meteorological data and forecasts
- Deliverable 3 : Cultivated areas, crop-type distribution, crop yield forecasts
- Deliverable 4 : Improved monitoring methods
- Deliverable 5 : Strengthened national agricultural monitoring capacities
- Deliverable 6 : Dissemination of data to stakeholders;
- Deliverable 7 : A sustained Earth observation system of systems for agricultural monitoring



GEOGLAM participants (notably the GEO Agriculture Community of Practice) have developed a GEOGLAM high level work plan document for the initiative that outlines the approach via six components:

1) enhancing global agricultural production monitoring systems;
2) building capacity at the national level to utilize Earth observations;
3) supporting the monitoring of countries at risk to improve food security;
4) improving the coordination of Earth observations for agricultural monitoring;
5) coordinating research and development (R&D) in support of improved operational agricultural monitoring;
6) disseminating data, products and information.

The work plan identifies the primary activities and deliverables under each component together with the broad level of funding needed to implement them.

ASIA RiCE

It has been estimated that half the world's population subsists wholly or partially on rice – with 90% of the world crop grown and consumed in Asia. Given the importance of rice, Asian participants in tGEOGLAM have formed an ad hoc team and taken the initiative to develop a plan for the inclusion of rice crop monitoring as an integral part of the GEOGLAM initiative. The relevant GEOGLAM component focuses on the major grain crops (wheat, maize, rice and soybean, total grain) for the G20 + 7 countries covered by AMIS, and aims to provide enhanced, improved

and timely production forecasts to AMIS based on existing global monitoring systems, and in due course regional monitoring systems. The rice crop component of regional rice monitoring system of systems will focus on:

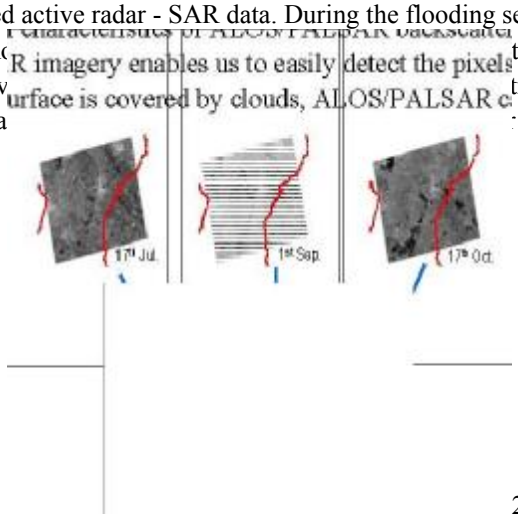
- Activity 1-1, Development and maintenance of Asian rice crop geo-dataset: Effort is already underway to establish rice crop area and calendar information and this dataset will continue to be developed and maintained to be as comprehensive as possible. As required, the data will be expanded with information specified in the GEOGLAM plan including information on crop management (fertilization, pesticide, irrigation, etc), soil moisture, historical statistics on area and yield etc.
- Activity 1-2, Ensuring regional monitoring systems are engaged in GEOGLAM and supporting AMIS: Recognizing the significant benefits of proper engagement with GEOGLAM, existing and proposed activities of bodies such as APEC and ASEAN will be identified and connected with the GEOGLAM effort, and the regional coordination team in particular. Inputs and contributions to AMIS will be coordinated on a regional basis and inter-comparison studies of different global monitoring systems supported as appropriate.

In addition with system development, capacity building and knowledge transfer is a key of success to GEOGLAM. The capacity building component focuses on supporting national and regional institutions willing to develop agricultural monitoring capacities through the use of Earth observation and modeling. The Work Plan comprises a series of tasks to develop regional contributions to the relevant GEOGLAM deliverables:

- Activity 2-1, Asian Rice Crop Monitoring Inventory: A regional inventory of actors, institutional frameworks, and national programmes using Earth observation in support of rice crop monitoring will be developed.
- Activity 2-2, Apply GEOGLAM national capacity assessment methodology: GEOGLAM will develop and implement a methodology to assess national capacities, analyze gaps and requirements and design roadmaps for capacity development for the use of remote sensing to support agricultural monitoring. The rice crop component will coordinate the application of this methodology, when available, to key rice crop monitoring countries in the region.
- Activity 2-3, Establish capacity building priorities and promote funding opportunities:
- Activity 2-4, Promote regional uptake of GEOGLAM-developed guidelines, standards and best practices: This activity will promote and educate regional stakeholders regarding the GEOGLAM synthesis documents of standards and best practices in support the development of national crop monitoring capabilities. Regional workshops and training sessions will help the promotion and uptake of the GEO guidelines.

Observation requirement for ASIA RiCE

It is difficult to differentiate paddy rice areas from other crop areas because they have similar spectral and scattering signatures during the flowering stage. Xiao et al. [1] detected paddy fields by using optical images such as MODIS data to identify distinctive phenological stages when the surface is flooded just before paddy rice is planted and when the surface is matured after planting. The seasonal characteristics of paddy fields were retrieved from multiple space based active radar - SAR data. During the flooding season, backscatter is quite low because the flooding surface is so smo turing season, backscatter is at its highest because the surface of a v trong backscatter. Figure 1 is a schematic illustration of the seasona in a paddy field area in Khon Kaen in



2007. The ALOS/PALSAR imagery enables us to easily detect the pixels from the flooding and flowering seasons, because even if the land surface is covered by clouds,

Figure 1: Rice crop growth monitoring using space based radar observation

In addition to SAR observations to detect cultivated rice crop area in rainy season (cloudy condition), there are several observation requirements for rice crop monitoring. As an early warning of rice crop damage caused by weather conditions, it is important to have agro-weather information observed by satellites with ground data including soil moisture, temperature, rainfall, PAR, etc. These agro-weather information are also useful to implement crop yield estimation with crop growth models. Because some regions are cultivated two/three times in a year and Rice is the dominant crop in Asian countries with a large diversity of crop varieties (short, medium and long duration crops), detailed crop calendars (mean crop calendar and abnormal year crop calendar) are necessary.

Since the primary focus of GEO is to coordinate satellite and in situ Earth observations for societal benefit, the objective of the GEOGLAM initiative is to increase the use of Earth observations to improve operational agricultural monitoring. The rice crop component work plan will focus on reinforcing regional coordination mechanisms for the supply of the necessary observations, and on ensuring engagement where necessary with the broader international efforts.

- Activity 5-1, Strengthened regional space data coordination: The Asia Pacific Regional Space Agency Forum (APRSAF) is the most established of the space data related coordination mechanisms in the region. It has some heritage of success of promoting coordination of the space data assets of member countries in Asia in support of common challenges – such as for natural disasters (Sentinel Asia). Asian space agencies do not otherwise have a strong track record of coordination of their EO satellite programmes – despite having an increasing number of technically capable satellite systems. The regional rice crop monitoring work plan represents an opportunity to challenge APRSAF to establish itself to undertake improved coordination of space data in support of regional challenges and ambitions. This activity will explore the potential of APRSAF and other bodies to strengthen these practical coordination functions for common benefit, and will work directly with the main supply countries of India, China, Japan, Korea and Thailand to secure their governmental support for this purpose.
- Activity 5-2, International engagement for space data coordination: The rice crop team will engage with the CEOS Space Data Coordination Group (SDCG) and other key coordination bodies to supplement the regional data sources and ensure necessary acquisition capacity is available, using EO satellites of US, Europe and others as available.
- Activity 5-3, Development of rice crop monitoring space data acquisition strategy: CEOS SDCG is planning to undertake an analysis of the GEOGLAM information requirements in early 2013 and to draft a global space data acquisition strategy. The activity will ensure that the necessary information requirements, crop area maps, calendars, cloud cover information and rice crop specific information is provided to the SDCG such that the Asian rice crop needs can be fully addressed in the course of their acquisition strategy. Some dialogue may be necessary to communicate national experience as to the utility of different sensors and their observing modes (notably different SAR sensors and the different bands and polarizations) to ensure that the SDCG is well equipped to design a robust acquisition strategy.

CONCLUSIONS & RECOMMENDATIONS

This paper explains the overview of GEOGLAM's Asia rice crop component. After authorization of this Asia rice crop component in the GEOGLAM work plan, we will move to the development phase of the GEOGLAM system of systems to tackle global and regional food security issues using space-based technology.

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