LAND COVER DATA AND DESERTIFICATION DATA OF ASIA

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ABSTRACT:

This paper describes land cover dataset of Asia produced by Asian Association on Remote Sensing(AARS) Land Cover Working Group, desertification dataset of Asia, and Twenty-year global 4-minute AVHRR NDVI dataset. All these data have been distributed free of charge. Another activity by the author is to develop Global Land Cover Ground Truth(GLCGT) database for free usage. The author requests the input to GLCGT database from any researcher.

1. AARS Asia 30-second Land Cover Data Set

This land cover dataset of Asia was produced as an activity of Land Cover Working Group of AARS since 1993. The dataset was completed in 1999 and has been distributed widely to many researchers by the form of CD. The CD includes the complete description about working group and the methodology to produce the dataset.

1.1 Ground truth

Ground truth data were collected mainly from existing thematic maps by the cooperation of the working group members. Some of ground truth data were collected by field survey in Central Asia such as Kazakhstan, Uzbekistan and Turkmenistan.

1.2 Used data

Global Land 1-km AVHRR Data Set was used as the source of satellite data. 10-days composite data of AVHRR NDVI, channel 4, and channel 5 were used for this project. NDVI data from April 1, 1992 to March 31, 1993 and channel 4 and channel 5 data from April 1, 1992 to October 31, 1992 were used.

The Global Land One-kilometer Base Elevation(GLOBE), Version 1.0 , was used in this project. GLOBE data is a global 30 arc-second grid digital elevation data.

The DCW is a 1:1,000,000 scale vector base map of the world with 17 attribute layers. The seashore lines and national boundaries were used in this project for geometric registration and product's display.

1.3 Data processing

The extracted geographical region covers 25 east longotude to 165 west longitude, 15 south latitude to 90 north latitude. The pixel numbers of the extracted region is 20,400 by 12,600.
The following data were prepared for the classification.

- Ts(surface temperature)/NDVI : seven monthly data from April to October 1992
- Maximum NDVI : the maximum monthly data from April 1992 to March 1993
- Minimum NDVI : the minimum monthly data from April 1992 to March 1993
- Digital elevation data

All these data are registered together in 30-second grid in latitude/longitude.
Classification was carried out by the following steps.

(1) Clustering of monthly Ts/NDVI from April to October
(2) Finding classification rules for decision tree method
(3) Classification by decision tree method
(4) Post-classification modification

Clustering by ISODATA was applied to monthly Ts/NDVI from April to October 1992. One hundred clusters were obtained as a result of clustering.
Rules for decision tree method were found by comparing cluster numbers, maximum NDVI, minimum NDVI, digital elevation data of the ground truth regions. Out of one hundred clusters, 46 clusters can be directly assigned to one of sixteen land cover classes. The rest of clusters are assigned land cover classes using threshold values of maximum NDVI, minimum NDVI or digital elevation data. The threshold value of 0.15 for maximum NDVI is used to discriminate "vegetation" and "non vegetation". The threshold value of 0.23 for minimum NDVI is used to discriminate evergreen vegetation and the others.

2. Desertification dataset of Asia

Kharin, et al. (1999) produced Desertificatin map of the drylands of Asia in 1999 and published its monograph. The map covers 30-125 east longitude, 5-55 north latitude with nominal scale of 1:10,000,000. Its digital data with a resolution of four minute is also available from the author.

Criteria of desertification assessment take in consideration the local conditions of study area, which should be investigated through field experimentation with the help of remote sensing tools. The results of such investigation could be interpreted in form of desertification types and degrees. The considered types of desertification in this study are as follows:

1- Vegetation cover degradation.
2- Wind erosion
3- Water erosion
4- Soil Salinization
5- Soil Salinization caused by the drop of the Sea Level
6- Rangeland waterlogging in Central Asia

Desertification degrees are classified into three types of (1)slight, (2)moderate, and (3)severe and very severe. Land use types mapped in this study are (1)forest/woodland, (2) rangeland and medow, (3) dry agriculture, (4) irrigation agriculture, and (5) dried up sea floor.

Assessment and mapping desertification in the frame of this project was based on application of low resolution space imagery. NOAA/AVHRR data were found to be similary correlated with desertification.

Two types of NOAA/AVHRR data were used :

- 21 – 31 May (1992 – 94) data, 4 arc-minute resolution imagery
  The original data is NOAA/NASA Pathfinder AVHRR Land Data Set which has nominally 8-km resolution data. This data were geometrically registered to 4 arc-minute grid.
- April - October monthly (1992) data, 30 arc-second resolution imagery.
  The original data is Global Land 1-km AVHRR produced by United States Geological Survey(USGS) which is 10-day composite, nominally 1-km resolution data. From this data, monthly composite 30 arc-second data were derived.

The first type of data was used because in Central Asia and in joining areas the maximum growth of vegetation take place in the end of May, after intensive winter and spring precipitation.

Thematic maps and publications were used for collection of the ground truth. 660 plots with roughly uniform area were selected by these sources. For each sample plot, the mean NDVI (4 arc-minute imagery) was calculated from 5 pixels, a pixel and its surrounding four pixels.

Each sample plot contains the following information : coordinates of the central points, land use type, type of land degradation, desertification class and the causes of desertification. The sample plots were distributed across the region in the following way : Central Asia – 280, Middle East – 154, China – 94, Mongolia – 66, Afghanistan, Pakistan and India – 66.
Interpretation of small scale imagery was conducted by the following procedure :

1. Unsupervised classification of 4 arc-minute imagery,
2. Land cover classification of 30 arc-second imagery,

3. Visual interpretation of different classes of imagery within landscape – analogues in the limits of geographical zones.

By visual photo interpretation, Desertification Response Units (DRU) were recognized as mapping units. The following sources of information were used in this process: space imagery, thematic maps, desertification maps and personal knowledge of the same land use, similar physical conditions (climate, soil, vegetation) and common characteristics of land degradation (types and class of desertification). In several cases some DRU included two land use types, which were impossible to delineate in a small scale, in this case the percentage of each category was estimated by a dot grid and the complete description was given in the map.

3. Twenty-year global 4-minute AVHRR NDVI dataset

The source data is the Pathfinder global 10-day composite 8 km AVHRR NDVI data. Tateishi Lab. of the Center for Environmental Remote Sensing (CEReS), Chiba University applied two types of processing to the source data. One is the transformation of the map projection. The map projection was changed from Interrupted Goode Homolosine projection to Plate Carree projection for easier usage of the data. The other is Temporal Window Operation (TWO) method (Park, et al. 1999) which makes smooth natural NDVI temporal change patterns.

3.1 Data characteristics

- geographic coverage:
  global (from 90 degree north to 90 degree south latitude,
  from 180 degree west to 180 degree east longitude)
- geographic resolution:
  4 minute latitude by 4 minute longitude
  The center of the first pixel of the data set is 89 degree 58 minute north latitude,
  179 degree 58 minute west longitude.
- map projection:
  Plate Carree
- temporal coverage:
  from July 11, 1981 to December 31, 2000
- temporal resolution:
  10 day
  The first composite of each month is for days 1 to 10, the second composite is for days 11 to 20 and the third composite is for the remaining days.
- data format:
  one datum is recorded in 8 bit
  one data set consists of 36 (= 3 x 12) 10-day composites of 5400 x 2700 pixels by BIP format. One pixel consists of 36 time series data.
- data value (X):
  NDVI = (X - 128) * 0.008
  X = 0 is missing data over land,
  X = 1 is ocean,
  X = 2 is Goode's Interrupted Space

3.2 Format

compressed by gzip
data volume of uncompressed file: approximately 500 Mega byte for one file (one year)
BIP format: thirty-six 10-day (one year) temporal data per pixel

4. Global Land Cover Ground Truth (GLCGT) database

There are many global/continental or large area land cover mapping projects because land cover is one of key parameters in environmental studies. Though ground truth collection is a important but difficult task in land cover mapping, it is usually performed independently in each project without any cooperation between them. This is the background of the development of Global Land Cover Ground Truth (GLCGT) database by the cooperation of many projects and researchers. The developed GLCGT database will be used freely by any researcher. This cooperative and common development of GLCGT

database will realize reliable and continuously improved land cover ground truth data. It also eliminates duplicated efforts of ground truth collection among projects.

The GLCGT database consists of regional land cover ground truth (RLCGT) data. The geographical size of a RLCGT data is flexible, from a city size to a continental size.

The regional land cover ground truth (RLCGT) data consists of
- metadata of RLCGT data (text) dataset name: "meta****"
- ground truth (GT) land cover code data (raster data) dataset name: "lcgt****"
- ground truth (GT) site code data (raster data) dataset name: "site****"
- description of GT sites (text) dataset name: "source****"
- optional data (raster data or text)

Metadata of RLCGT data Text
Ground truth (GT) land cover code data Raster
Ground truth (GT) site code data Raster
Description of GT sites Text
Optional data Text, raster or any

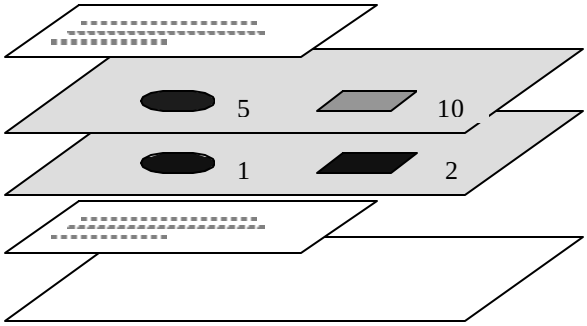

Figure 1 Architecture of global land cover ground truth (GLCGT) database

5. Conclusions

The author introduced the following four types of available data.

- AARS Asia 30-second Land Cover Data Set	completed	CD	
- Desertification dataset of Asia	completed		attached file of email
- Twenty-year global 4-minute AVHRR NDVI dataset	completed	CD	
- Global Land Cover Ground Truth (GLCGT) database	developing	CD	

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