

# DATABASE COLLECTION FOR LAND COVER VALIDATION AND MONITORING ON REMOTE SENSING/GIS IN WEST PART OF MONGOLIA

R.Tsolmon<sup>1</sup>, John van genderen<sup>2</sup>, D. Narantuya<sup>3</sup>

<sup>1</sup> NUM-ITC-UNESCO Remote Sensing/GIS laboratory National University of Mongolia Room 315, Building 1, National University of Mongolia - tsolmon@num.edu.mn

<sup>2</sup> ITC, Department of Earth Observation Science.P.O.Box 6, 7500 AA Enschede, The Netherlands.- genderen@itc.nl

<sup>3</sup> “National Geoinformation Centre for Natural Resource Management in Mongolia” in Ministry of Nature and Environment Mongolia (MNE) project - dnanantuya@yahoo.co.uk

**KEY WORDS:** Situ data, ISPRS, Regional network

## ABSTRACT:

The Research Addresses Two Major objectives related to land cover monitoring in Mongolia. First, we collected of in situ land cover variables by ground truth surveys and then implemented different land cover models to assess land cover and its change with remote sensing imagery in Mongolia. We then assessed the spatial composition and pattern of land cover within the special protected areas in western Mongolia. This project work is designed to develop the tools, methods, data, and collaboration needed to better characterize land-cover dynamics across the study area of west part Mongolia. The outcomes were intended to consolidate a regional network of test sites.

## 1. INTRODUCTION

Mongolia has undergone an economic and political transition into a market economy since the 1990s and has suffered great economic hardship. Little attention has been paid to problems of land degradation in western of Mongolia after the collapse of the communist system due to economic difficulties. Environmental scientists in Mongolia and abroad are coming to understand the importance of the study of land cover and land use analysis and particularly in the region of the Great Lakes Protected Area. During Mongolia's transition to a free market, socio-economic factors such as poverty and profit-seeking have greatly increased small and large scale mining activities resulting in exploitation of the environment in the western region. This has contributed to the regional environmental

deterioration related to the loss of biodiversity, increased land degradation and increased livelihood and social vulnerability.

Land degradation in the western region of Mongolia, as well as in other arid areas, is a serious problem that threatens Mongolia's sustainable development. The loss of regional economic activities has caused migration from western areas into urban centers. This has been coupled with significantly decreased cropland areas, increased pasture degradation, reduced surface and ground water, increased water pollution, and has generally exacerbated desertification pressures combined with drought and dust storm processes. In response to land degradation problems in the study region, the Government of Mongolia has initiated several soil and great lake conservation projects throughout the country. However, few research projects has been undertaken on factors that reduce land degradation in the protected areas in western regions of Mongolia using Remote Sensing/GIS data.

This research aimed to establish a set of land cover test sites for analysis of boreal and temperate regions. This objective also directly addresses the goals of the Northern Eurasia Regional Information Network (NERIN). Researchers and students at the Khovd Agricultural University and University of Khovd were trained to complete ground truthing exercises, image processing with computer programs and perform land cover modeling procedures. For the land cover scenarios, we used forest coverage data, vegetation indexes, surface temperature data and snow coverage data. The land cover maps were processed with GIS land cover methods. This project involved mapping multi-temporal patterns of land cover from different satellite imagery and modeling rates and types of changes in land cover patterns as a function of land cover change in Mongolia's western provinces and provides an opportunity for the NERIN and the Northern Eurasian Earth Science Partnership Initiative (NEESPI) scientists working in these environments to share research results and to expand the participation of international partners and collaborators.

Land cover classification and ground truthing exercises incorporated here: different vegetation zones in the region; identified areas affected by desertification pressures, land degradation linked to pasture overgrazing; hydrology-related issues, such as glaciers, water resources and snow cover.

The approach of the project combined thematic collection land cover data and GIS data as well as continuous topographic and multitemporal satellite data.

## 2. APPROACHES

### 2.1 Study area and ground truth data collection

There are three provinces in western part of Mongolia. These are Bayanulgi, Khovd, Uvs provinces.

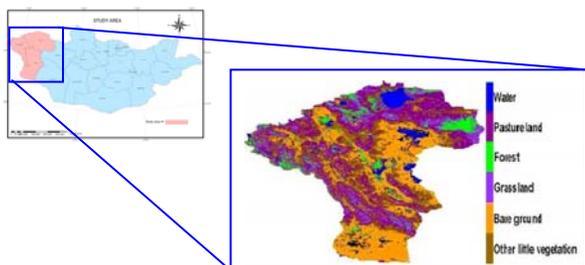


Figure 1 Land cover classification for the study area using EVI data from MODIS , June 2006

Collection of good ground truth data is a key issue for reliable land cover mapping. Ground truth data were collected mainly from field trip to the study area and existing thematic maps from Joint Russian-Mongolian complex biological expedition Map Ecosystems of Mongolia, Moscow 2005, Soil Mapping of Mongolia. Ground observation data from Khovd Agricultural University was used for the project work in western provinces of Mongolia. The ground truth collection was held from June 2007 to September 2007. Totally 57 sample areas chosen for ground truth collection. Land cover class code is taken from Land Cover Working group, Asian Association of Remote Sensing 2001).

The land cover classification map was done using Enhanced Vegetation Index (EVI) data from MODIS , June 2006 (Figure 1).

### 2.2 Methodology and data

Different land cover/use maps were developed for the west part Mongolia; land cover, vegetation change, land surface temperature, snow coverage, forestry, crop and socio

economic information maps using multi spectral data from PAL NDVI NOAA 8km, SPOT VEGETATION (www.free.vgt.vito.be), MODIS and LANDSAT (http://glcf.umiacs.umd.edu) images.

For the land cover classification map we used MODIS 250 m Enhanced Vegetation Index (EVI) data. The Land-use GIS data, Landsat TM/ETM, were employed as reference data. Enhanced vegetation index (EVI) was developed to optimize the vegetation signal with improved sensitivity for high biomass regions and improved monitoring through de-coupling of the canopy background signal and reduction in atmospheric influences. The EVI is represented by the following equation1 :

$$EVI = G \frac{NIR - Red}{NIR + C_1 Red - C_2 Blue + L} \quad (1)$$

where L is the canopy background adjustment that addresses nonlinear, differential NIR and Red radian transfer through a canopy, and C1, C2 are the coefficients of the aerosol resistance term, which uses the blue band to correct the aerosol influences of the red band. The coefficients adopted in the EVI algorithm are, L=1, C1=6, C2=7.5, and G (gain factor)=2.5 (Kaurivi, Jorry Z.U., 2003,).

### Land Surface Temperature:

The MODIS Land Surface Temperature (LST) products are created through spatial and temporal transformations, to daily, eight-day and monthly global gridded products. For this research work we downloaded MODIS Land Surface Temperature Daily daytime 1 km grid data from the MOD11 production ([http://edcdaac.usgs.gov/includes/edg\\_bridge.php](http://edcdaac.usgs.gov/includes/edg_bridge.php)). After downloading MODIS LST data we made mosaic and reprojection and converted it to C degree units. LST data were applied in the study area in the time period of 2001 to 2006 from April to September . As evident in figure 2 LST of study area is increasing.

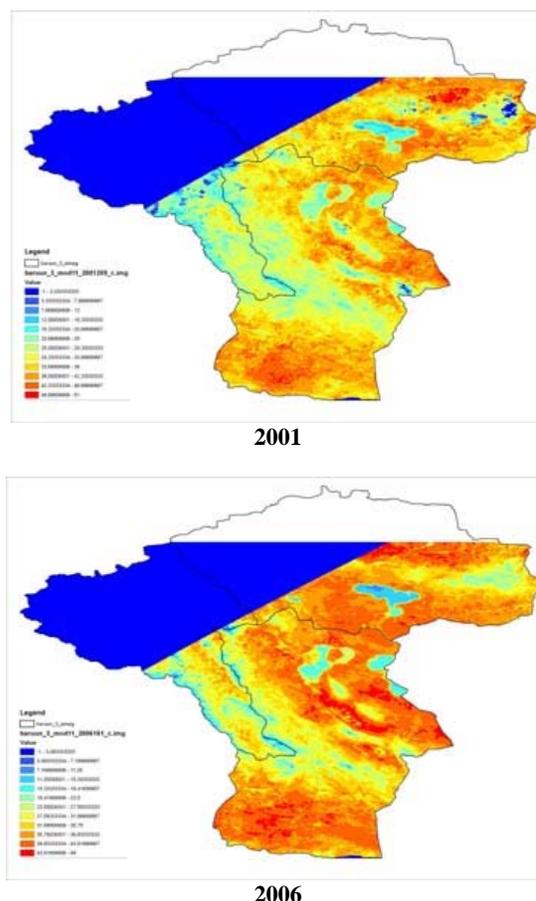


Figure 2. Change of surface temperature using LST data between the years 2001-2006

**SNOW COVER DATA:**

MODIS sensors MOD10A2 and MODIS's snow product 8 day temporal resolution data from 2000 to 2006 was applied to this research work to determine the continuity period of snow coverage and the relative difference between Glaciers and Snow coverage in square km (figure 3).

To use the MODIS products one need to calculate Mosaic and Reprojection functions. After this calculation we can do a classification of the snow cover using the digital number representative of snow cover. We study this digital number attached to the snow cover by following the instruction for MODIS snow cover products. The snow cover algorithm identifies snow-covered land; it also identifies snow-covered ice on inland water. There are approximately 288 swaths of Terra orbits acquired in daylight so there are approximately 288 MOD10\_L2 snow products per day (George A. Riggs.,2006).

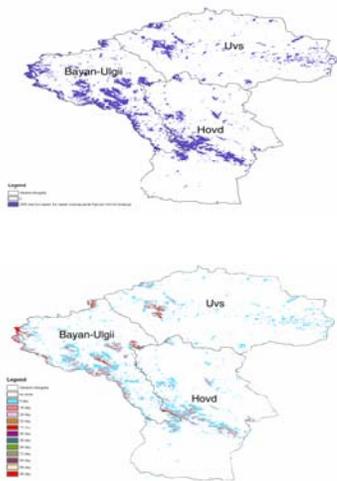


Figure 3. Continuity period of snow coverage

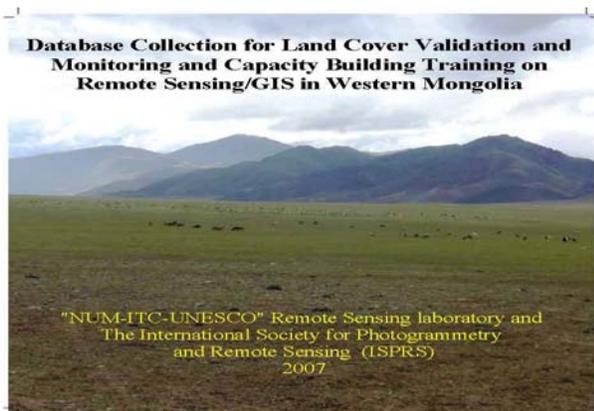


Figure 4. Coverage of the CD with the land cover information

**3. RECOMMENDATION AND CONSLUSION**

Geographical regions of each ground truth data are recorded in the data set, "gpg", and the information sources for each ground truth data are also recorded in the data set CD. The CD data set includes detail description of the ground truth information. The ground truth photos are in and description of ground truth shown in the database CD provided by NUM-ITC-UNESCO Remote Sensing/GIS Laboratory, National University of Mongolia (Figure 4).

We are recommending that the lead agencies in Mongolia should:

- ◆ The current processes for updating the land cover databases either do not exist or are too slow or poorly defined to fit the real time needs of local stake holders and policy decision makers.
- ◆ New techniques for collecting digital geospatial data (e.g. remote sensing, GPS, etc) are changing the local needs for, and uses of the data, and it is necessary to have more local stake holders aware of the benefits of geospatial data.
- ◆ The number of personnel educated and trained to make use of the GIS database is inadequate to meet the local demands for Mongolia.
- ◆ Begin completing annual field surveys to verify the satellite result and study of climate, vegetation, soil and socio-economic condition of selected areas.
- ◆ Development of better criteria for monitoring forest conditions and specific indicators of deforestation and processes associated with it. Deforestation should be calculated through the integration of the individual indicator class value. Forest condition indicator and forest maps should be evaluated by digitally overlaying results with verification data and other related indicators to form spatial correlation data sets.
- ◆ Inter-west provinces collaboration within Mongolia to facilitate local cooperation for land cover/use research.

**ACKNOWLEDGEMENT**

We would like to thank ISPRS for support this project. We express our special thanks colleagues from Khovd Agricultural University, Mongolia for their contribution and experience for ground truth collection. We wish to thank MODIS data center and SPOT /Vegetation for providing data.

**REFERENCES**

George A. Riggs., Dorothy K. Hall., Vincent V. Salomonson.,2006, MODIS Snow Products User Guide for Collection 4 Data Products, USA

LANDSAT: <http://glcf.umiacs.umd.edu>  
 MODIS: [http://edcdaac.usgs.gov/includes/edg\\_bridge.php](http://edcdaac.usgs.gov/includes/edg_bridge.php)  
 SPOT-VEGETATION: <http://www.free.vgt.vito.be/>

