

## Remote Sensing Activities in Mongolia

Mongolia is situated in Central Asia. It is a landlocked country with 2.3 million population and has 1.56 million square kilometer area. Different regions of the country differ considerably from each other by structure of relief and elevation. The medium elevation of the country's territory is 1580 m above the sea level. There are nearly 540 rivers and 3000 lakes, but they are mostly situated in the north half of the country. Such geographic traits of Mongolia determine the severe nature, sharp continental climate and frequently unfavorable weather conditions. The country has extensive natural resources, minerals, fossil fuels, forests and vast areas of grassland, much of which is suitable for raising livestock. As yet, the major portion of these resources is untapped. The Mongolian Government is going to develop the capability to utilise these resources. To do this it will be required to create comprehensive natural resources and environment database and information network. Using traditional techniques like ground surveys, field experiments or the establishment of research and observation sites into unpopulated areas would be difficult and economically ineffective. The advent of remote sensing data offers a solution to this information gap. Therefore, the Government of Mongolia attaches great importance to the development of remote sensing technology and values its application to national economic development and environment management.



## **Available Facilities of Remote Sensing Applications**

### *Satellite Information Receiving Ground Stations*

In 1971, the first APT meteorological station was established in Ullanbaatar through which received cloud data only through TV channel, which was successfully used in weather forecasting services. Since 1987, Mongolia using HRPT meteorological satellite station, is using data for both meteorological and non-meteorological applications such as forest and steppe fires, land cover mapping and flood assessment. Also, those data are important for the estimation of weather conditions over Central Asia.

According to the agreement of the Government of Mongolia and the former Soviet Union in 1984, in East-Southern part of Mongolia was established a Meteorological Rocket Sounding station. The data of this rocket were successfully used for studies of middle atmosphere's process including ozone layers over Mongolia. Since 1970s Mongolian earth scientists have used satellite imagery for mapping activities and most of the thematic maps were produced with the support of remotely sensed data basically derived from former Soviet Union's space vehicles.

The Remote Sensing Laboratory of the Academy of Sciences is working in close cooperation with DLR Germany (Space Agency of Germany) and in 1998 mobile receiving station for collection of ERS data was established.

The Civil Aviation Meteorological Center has a satellite data receiving station, which gathering data from NOAA-APT, GMS and meteor satellites uses them for civil aviation services and short-term weather forecasting of Ulaanbaatar city.

### **Remote Sensing Organisations in Mongolia**

During the past decade there was extensive growth of national organisations working in the field of remote sensing applications. Currently, following national government organisations are actively using and developing remote sensing applications:

- The Ministry for Nature and Environment
- National Remote Sensing Center
- The National Hydro-meteorological Agency and meteorological related research institutes and centers
- The Ministry of Agriculture and Enterprises.

- The Ministry of Infrastructure Development
- State Agencies for Forest and Water Management.
- State Agency of Geology and Mineral Resources.
- Land Management Agency
- State Administration of Geodesy and Cartography.
- Institutes belonging to the Mongolian Academy of Sciences

There are also numbers of private and non-government organisations, which have started to use remote sensing data and ground positioning systems. Some specific targeted remote sensing laboratories and centers are available in Mongolia.

The Academy of Sciences of Mongolia has Remote Sensing Laboratory, which was established in 1986 under the framework of the Institute of Physics and Technology and its main functions are supplying of thematic theory, methodology and techniques for the interpretation of aerospace information in geo- and environmental sciences; the elaboration of mathematical models to describe the relationship between bio- geophysical and geo-chemical parameters for studying objects and their spectral characteristics; establishing the correlation of linear and circular geological structures with evidence of mineral locations; and complex analysis of natural and anthropogenic processes in different natural and climatic conditions.

The State Agency of Geology has the Remote Sensing and Geo-information Center, which was established in 1980 on a commercial basis to meet the growing needs of geology. The main goals of the Remote Sensing and Geo-information Center are to develop reliable and cost-effective remote sensing techniques, to compile topographic and thematic maps obtained by compiler-aided field surveying and to establish an integrated GIS for geology, especially for minerals, oil and gas assessment. This Center implemented (finished in 1999) joint MAGIC (Mongolian Advanced Geological Information Center) project with French SPOT Company and within the framework of project, established modern geographic information and remote sensing center and uses SPOT data for geological applications.

#### *Technical capabilities of remote sensing centers and laboratories in Mongolia*

National Remote Sensing Center and other remote sensing related centers equipped with image processing computer systems and interpretation facilities towards harnessing the remote sensing potentials for natural resources management are:

- Ground station for NOAA-HRPT and GMS LRFAX based on Quorum antenna and Qtrack tracking of receiving system with receiver, controller and bit synchronizer

integrated in a Gateway 586 personal computer and MicroVAX-II computer for processing;

- PC based receiving SKYPC system
- PC based mobile receiving system
- Image data processing system IVAS-system on MicroVAX-II;
- HP and Silicon Graphics Unix Workstations for image processing;
- PC-based IDRISI raster geo- informational image processing system
- PCI image processing software based on workstation
- Sun SPARC station 20 and VAX Workstation with Arc Info 7.0.3 and Calcomp 9500 digitizer, Calcomp Classic pen plotter, HP750C DeskJet ink plotters for GIS and remote sensing for environment management;
- MicroVAX 3400 and VAX 4000 cluster system for integrated environment database;
- PC based ERDAS and ILWIS image processing system
- 0Windows NT workstation based Arc/INFO, ArcView and ERDAS software;
- Color scanners, tape drivers and color printers;
- GPS for geographical positioning

#### *The National Remote Sensing Center of Mongolia*

The National Remote Sensing Center of Mongolia was established in 1987. The responsibilities of this center are to coordinate all activities related to remote sensing in Mongolia, and aimed at developing local capability for evolving efficient methods of investigating, classifying and monitoring natural resources of the country by using modern space science and remote sensing technology. The National Remote Sensing Center also effects monitoring of environmental and natural disasters, such as cyclones, droughts, forest fires, hurricanes, severe snow cover and air pollution on the territory of Mongolia. At present one full-fledged national remote sensing center and several remote sensing sub-centers were established in Mongolia. Also, the National Remote Sensing Center has scientific agreement with NASA on 1km AVHRR data archive. The National Remote Sensing Center has bilateral cooperation with the Center for Environmental Remote Sensing of Chiba University of Japan.

#### ***Remote sensing activities for environmental management***

##### *Water and forest applications*

The Water and Forest Authority has applied satellite data for undertaking water and forest resources studies. Also satellite data have been used for flood mapping, planning of flood control measures and river routine surveying and mapping.

The National Forestation Program and land inventory program have been successfully using remote sensing technology. The forest condition mapping of Mongolia, which was completed by the Ministry for Nature and Environment has been prepared using remote sensing data. A set of information at 1:200,000 scale identified the different kind of forests of the country and their location and areas covered. About 8.6 per cent of territory of Mongolia is covered by national parks and protected areas. Remote sensing data and technology with the GIS helps to determine areas for national parks and reservation territory. These natural habitats are usually found in virgin forest and undisturbed natural areas.

Remote Sensing data are important for the preparation and implementation of freshwater ecosystems program. Remote Sensing can also monitor the rivers revival program. It will be able to determine water quality changes as a consequence of increased wastewater treatment by polluting industries and decrease in pollution loads.

#### *Application of remote sensing technology for natural disaster monitoring*

It is more convenient to apply satellite data to a territory as large as Mongolia with its sparse population and suffering from different kinds of natural disasters such as desertification, droughts, floods, forest and steppe fires, atmospheric cyclones, severe snow cover and dust storms. Mongolia has developed methodologies for the estimation and monitoring of atmospheric storms such as heavy rain, dust storms, snow cover and natural disasters, as fires, floods, droughts and desertification conditions using ground truth and NOAA-AVHRR data.

The remote sensing data are being used successfully for the Drought Assessment and Monitoring System. This system aims to jointly use satellite and ground data of the whole country on a weekly basis through spring and summer, when droughts occur in Mongolia. In the last several years in huge spring forest and steppe fires in the northern and eastern parts of the country have occurred. Since 1996 the NOAA satellite data importance has increased to a very high level in fire detection and monitoring. Everyday monitoring yielded very useful information for not only the decision makers but also for the public at large.

#### *Remote sensing technology for geology*

Satellite data are also being used for a variety of geological applications such as baseline geological evolution, regional geological mapping and structural and tectonic studies, especially with reference to their potential in oil exploration..

### *Non meteorological applications*

Mongolia also carries out non-meteorological applications of NOAA satellite data for land-cover mapping, pasture vegetation, fodder resource, snow cover, desertification, forest and steppe fires, drought, land and water surface temperature, soil moisture and evapotranspiration estimation.

### *Mapping*

A series of thematic maps of the Mongolian territory at 1:1000000 scale was compiled and put into use including land-use maps, botanic and forage maps, maps of forest, structural-geological maps with geotectonic elements, maps of average annual flow of ground and underground waters and landscape-typological regional planning maps. The National Remote Sensing Center together with other environment protection oriented institutes and centers is creating the remote sensing and GIS database.

### **Space application policy**

Understanding rapid development of space science and technology and its influence on economic and social development of the country, increasing demands and lack of awareness of high level decision makers, the Government of Mongolia, established in July 1999, the Coordination Council on Space Study and Use chaired by the Minister of Nature and Environment and vice-chaired by the President of Mongolian Academy of Sciences. The State Secretaries of Ministries and heads of some State Agencies included are as members. The major goals of the Mongolian National Space Program are utilisation of remote sensing techniques for the social-economic development and environment protection of the country. During the past years, remote sensing applications have grown from pilot scale experimental studies to operational methodologies.

### **International cooperation**

Mongolia is now moving away from a centrally planned economy and towards a market one. So, many private companies are using the remote sensing and GIS technology in business activities such as the environment impact assessment and mapping of natural resources. The Mongolian Government is placing importance on the promotion of international cooperation in the field of space applications for development.

Also a number of international organisations, under programs like World Wildlife Fund (WWF), Netherland's Wildhorse reintroduction programme, Germany's Technical Cooperation Programme are using remote sensing technology. A number of projects have already been

implemented or are presently being implemented under the Eastern Steppe Biodiversity programme funded by UNDP/GEF, (GTZ), TACIS and DANIDA.

Increased awareness of the role of space remote sensing and its application potential has resulted in enhanced demand for trained manpower in the country. The National Remote Sensing Center continued to provide training program for user scientists. So far, about 500 national staff has been trained in remote sensing in the country. Specific efforts are on for introduction of remote sensing at upper secondary school and post-graduate levels. As part of the regional remote sensing cooperation, Mongolia organised the 13th Asian Conference on Remote Sensing (1992) and 5th Meeting of Asia, Pacific Regional Space Agencies Forum (1998) in Ulaanbaatar. Mongolia is widely involved in the Regional Remote Sensing Programme for Asia Pacific through involvement in the implementation of pilot projects and training sessions, which were organised in different countries of the Region. Within its capabilities and constraints the NRSC has actively participated in Regional Space Application Programme (ReSAP) under the ESCAP.