

NATIONAL REPORT OF JAPAN

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ABSTRACT

The National Report of Japan outlines developments and activities in photogrammetry, remote sensing and GIS during the period 1992-96. In photogrammetry, real time dynamic Photogrammetry became active. In remote sensing, global change studies has become a main driving force for the planning of future satellite programs while practical use of remote sensing has been also pursued. In GIS, practical usage has expanded and the development of various new geographic data has started. Review of scientific and professional organizations on photogrammetry, remote sensing, and GIS is also included. As a national mapping agency, the activities of Geographical Survey Institute are reviewed in detail. This report was co-authored by members of the editorial committee of the Japan Society of Photogrammetry and Remote Sensing.

1. DEVELOPMENT OF PHOTOGRAMMETRY

Digital photogrammetry recorded in real time is expected to become a useful tool in various fields in the future, e.g. in industry, machine and robot vision, medical science, sports and construction management. There are still, however, some issues which need to be resolved before real time photogrammetry will become operational. These problems include accuracy, measuring speed, imaging and recording, the handling of large data volumes, etc. Research in real time dynamic photogrammetry is currently performed by individual companies, institutes or universities, but to make it operational, an interdisciplinary team to cover the related institutions is needed. With this motive, an Association for Real-time Imaging and Dynamic Analysis (ARIDA), was established in Japan in May, 1994. The key words that describe ARIDA's activities are : digital imaging, real time image recognition and

dynamic analysis. Meetings are held every two months to report related research progress from various fields of work. A newsletter is also published and English newsletter is sent to every ordinary members of ISPRS. Symposia or seminars will be held periodically. As an international activities, ARIDA held workshop in February, 1995 at ETH with the Swiss side working group on "Close-Range Photogrammetry and Machine Vision". There are presently seven working groups within ARIDA : 1) Sensors and Recording, 2) Image Processing, 3) Automated Measurements, 4) GPS, 5) Dynamic Analysis, 6) Special Instruments, and 7) Hardware and Software. The primary focus theme of ARIDA is dynamic real time measurements which includes, 1) fixed sensor and moving target, 2) moving sensor and fixed target, 3) moving sensor and moving target. The aims of ARIDA are an operationalization of real time photogrammetry and an international contribution in this field.

2. DEVELOPMENT OF REMOTE SENSING

2.1 Trend of research

Global change studies have become one of the main fields of remote sensing research. Many individual researchers and research institutes have been and are trying to develop global datasets of key environmental variables using remote sensing technique. Many natural scientists have joined in the field of remote sensing. On the other hand, practical use of remote sensing data in local area is also encouraged to increase the benefit of remote sensing.

2.2 Remote Sensing Satellite Programs

Three major programs are now going on in Japan. These are ADEOS, TRMM and ASTER programs.

ADvanced Earth Observing Satellite(ADEOS) is a joint program of National Space Development Agency(NASDA), Environment Agency(EA) and Ministry of International Trade and Industry(MITI) of Japan with NASA of USA and CNES of France. The mission is to provide global observation of environmental change and to contribute to international community in the earth observation field. ADEOS carries two core sensors, OCTS and AVNIR, and six AO sensors, NSCAT, TOMS, POLDER, IMG, ILAS and RIS. The satellite is to be launched in August, 1996. ADEOS Science Program was also established to develop algorithms for processing and utilizing ADEOS data with AO to domestic and international communities.

As a successor of ADEOS, ADEOS-II program has started. The planned sensor systems are AMSR, GLI (a successor of OCTS), SeaWinds, POLDER and ILAS-II. The satellite is planned to be launched in 1999.

Tropical Rainfall Measuring Mission(TRMM) is a joint program of NASDA, Communication Research Laboratory(CRL) and NASA. The

main mission is to measure tropical and subtropical rainfall, which is one of the most important but least-known parameters affecting to the global climate system. Five sensors, PR from Japan, TMI, VIRS, CERES and LIS from USA will be boarded. The satellite will be launched in 1997. TRMM Science Program has been activated both in Japan and USA.

Advanced Spaceborne Thermal Emission and Reflection Radiometer(ASTER) is a program by MITI with the joint to NASA EOS Program. The objective is to understand the local and regional scale processes occurring on or near the Earth's surface and lower atmosphere. ASTER sensor systems consists of visible/near IR, shortwave IR and thermal IR. They will be boarded on EOS AM-1, which will be launched in 1998.

The history and plan of the earth observation satellites by Japan are as follows.

Year	Satellite	Sensor
1977	GMS-1	
1981	GMS-2	
1984	GMS-3	VISSR
1987	MOS-1	MESSR/VTIR/MSR
1989	GMS-4	digital VISSR
1990	MOS-1b	MESSR/VTIR/MSR
1992	JERS-1	SAR/OPS
1995	GMS-5	digital VISSR
1996	ADEOS	OCTS/AVNIR/IMG/ ILAS/NSCAT/RIS/ TOMS/POLDER
1997	TRMM	PR/TMI/CERES/VIRS/ LIS
1999	ADEOS-II	GLI/AMSR/ILAS-2/ Sea-Winds/POLDER-2
2002	ALOS	AVNIR-2, V-SAR
2003	ADEOS-III	GLI-2

ADEOS: Advanced Earth Observing Satellite
 ALOS : Advanced Land Observing Satellite
 GMS : Geostationary Meteorological Satellite
 JERS : Japanese Earth Resources Satellite
 MOS : Marine Observation Satellite
 TRMM: Tropical Rainfall Measuring Mission

2.3 Remarkable Research Activities

2.3.1 JERS-1 System Verification

JERS-1 system verification program was proceeded after the launch of JERS-1 in February, 1992 by domestic and international Principal Investigators, MITI and NASDA. The program was combined with ERS-1 system verification. It continued until March, 1995 and the result reporting meeting was held on November 29 to December 1 in 1994 in Tokyo.

2.3.2 International Project in Asia and Pacific Region

Global Research Network System (GRNS) was initiated by Science and Technology Agency (STA) in 1993 and will continue five years. Its aim is to establish human and information network in Asia and Pacific region. As the actual activities, various data sets have been created with the cooperation of relating institutes of Japan and several countries in Asia and Pacific region. STA also has been organizing an international project for microwave remote sensing application in tropical regions with four ASEAN countries, which was initiated in 1992 and will continue until March in 1997.

2.3.3 The Great Hanshin-Awaji Earthquake

There was a large earthquake at Kobe City and Awaji Island in January, 1995 and more than six thousand peoples were killed. Many projects for assessment and investigation of the damage and the cause of the earthquake were organized. In remote sensing filed, many institutes/ organizations/ universities such as NASDA, Remote Sensing and Technology Center (RESTEC), National Institute for Earth Science and Disaster Prevention (NIESDP), Geographical Survey Institute (GSI), Geological Survey of Japan (GSJ), Earth Remote Sensing Data Analysis Center (ERSDAC), Tokai University, etc., were involved in studies for application of satellite remote sensing data.

2.3.4 SAR Data Analysis and Application

Many intensive studies for Synthetic Aperture Radar (SAR) data analysis has been conducted using JERS-1 and ERS-1 SAR data mainly in a framework of JERS-1 verification program. The main targets were the basic data calibration and correction and information extraction for vegetation, agriculture, forestry, land use, geology and oceanic phenomena. Also SAR interferometry has been recognized to be a promising technology because it succeeded to detect the displacement by the Great Hanshin-Awaji Earthquake.

2.3.5 Data Set Creation

Various products for global or regional monitoring using satellite data sources have been developed using NOAA, MOS-1 and JERS-1 data. Some of them were developed as a part of ISY activities. The data set examples are Vegetation Data Set in South-East Asia, Asian Land Cover Data Set, Sea Surface Temperature Data Set around Japan, Polar Extent Ice Data Set in Antarctica and Okhotsk, MESSR Mosaicked Data Set in Indo-China and SAR Mosaicked Data Set in Amazon. These activities will be expanded with the data set creation using ADEOS data.

3. DEVELOPMENT OF GIS

The developments of GIS in Japan during 1992-96 are as follows.

3.1 Expansion of the use of GIS to smaller local governments

GIS has been used mainly by large cities with more than one million population such as Tokyo, Osaka and Yokohama. Similarly in private company, only large companies such as Tokyo Gas have developed and used GIS. This is because the preparation of database for the installation of GIS costs much and only large organizations have staffs who have enough technical knowledge about GIS. However in the past four years, many smaller local governments with the population of 100,000 - 500,000 have started to use GIS. The reasons of this

expansion are:

- a. The cost of hardware and software for GIS have largely reduced.
- b. The development of database, which is the most expensive part of the installation of GIS, has been performed cooperatively by various related divisions. This trend reduces a financial burden in one division.
- c. People of local governments have got know-how of the use of GIS and understood the effective use of GIS. This enables the development of practical GIS to meet their needs.

The reason b. is important because, in large local governments, GIS was used mainly by individual divisions, not for common use by several divisions. There were other trends which expand the use of GIS. They are the publications of manuals or guidelines for the use of GIS, the establishment of consultant company for GIS, and the education through seminars of GIS.

3.2 Development of digital map data and spread of car navigation system

The basic requirement for the use of GIS is the preparation of geographic data. Geographical Survey Institute of Japan published DEM with the grid of 50 m and digital topographic map data with a scale of 1:10,000 for large cities. 7,000 sets of this digital map data were sold for the first one year. This indicates strong needs for digital map data.

Annual updating of the national digital map data for car navigation has been going on by the Japan Digital Road Data Association, which is a semi-governmental organization. The data with various value added information to the national digital map data became available and were circulated. As a result, car navigation system has spread widely, and several hundred thousand sets are used in Japan. As an additional information, the cost of a car navigation system with data is about two thousand US dollars.

3.3 Expansion of social interest in GIS by the effect of the Great Hanshin-Awaji Earthquake

One of the problems in the Great Hanshin-Awaji Earthquake was information management, that is the situation of the disaster could not grasped timely. GIS is recognized as an important tool which manages various information in a disaster and display its situation plainly. The term "GIS" was first on a large nationwide newspaper when the database of the damage by the earthquake was developed and published by university researchers. In the damaged city, Kobe, GIS was used effectively for the management and planning for the activity to remove collapsed houses. Due to these experiences, many organizations from local governments to national government has started to investigate the GIS use for the management of disaster information. The next item, Japanese NSDI, is one of the results of this tendency.

3.4 Japanese National Spatial Data Infrastructure (NSDI)

The understanding of the effectiveness of GIS for various fields including disaster makes the recognition that the development of the basic geographic data is important. Therefore a committee on GIS has started mainly by government with the intention of the standardization of basic geographic data and its development and circulation. This movement is a similar one to the National Spatial Data Infrastructure(NSDI) in the National Information Infrastructure(NII) in the USA. Therefore it can be said that the Japanese NSDI has started.

4. ORGANIZATIONS

4.1 Academic Societies

The Japan Society of Photogrammetry and Remote Sensing (JSPRS) was founded in 1962. Its academic field covers photogrammetry, remote sensing, geographic information

system(GIS), and related spatial sciences. JSPRS has approximately 1,100 members, issues its journal six times a year, and holds academic conferences twice a year. JSPRS is an Ordinary Member of the International Society for Photogrammetry and Remote Sensing (ISPRS) and the Asian Association on Remote Sensing (AARS).

The Remote Sensing Society of Japan (RSSJ) was founded in 1980. It covers all aspects of remote sensing. RSSJ has approximately 1,300 members, issues its journal five times a year, and holds academic conferences twice a year.

The Geographic Information Systems Association (GISA) was founded in 1991. GISA has approximately 600 members and issues its journal twice a year.

There are many other societies which are related to remote sensing. They include the Society of Instrument and Control Engineers (SICE), the Japan Society of Hydrology and Water Resources (JSHWR), the Japan Society of Civil Engineers (JSCE), the Oceanographic Society of Japan (OSJ), the Association of Japanese Geographers (AJG), etc.

4.2 Universities

Photogrammetry, remote sensing and GIS are usually taught by a few faculty members in each university respectively. In the field of remote sensing, however, some universities have more remote sensing researchers. They include University of Tokyo, Chiba University, Tokai University, and Kanazawa Institute of Technology.

4.3 Governmental organizations

Geographical Survey Institute(GSI) is a national mapping agency of Japan. Its activities during 1992-96 is described in the following chapter.

Most remote sensing satellites such as MOS and ADEOS are launched by the budget of Science and Technology Agency (STA), while the budget

for JERS-1 was from STA and Ministry of International Trade and Industry (MITI) and the budget for GMS series is from Meteorological Agency, Ministry of Transport.

The actual launch of satellites is performed by the semi-governmental organization, National Space Development Agency (NASDA) under STA. NASDA has a large committee, "Earth Environment Observation Committee", which consists of a little more than 400 scientists from universities and institutes. One feature of this committee is that it includes many remote sensing scientists and natural scientists for global change studies. The main objective of the committee is to clarify scientific needs for earth observation and to establish the methodology of the actual observation process. This committee will be moved from NASDA to Earth System Science and Technology Organization under Japan Resources Association in 1996.

There are many governmental research institutes conducting remote sensing research, most of which are located in Tsukuba, one hour from Tokyo by train/car.

They include:

- National Institute for Environmental Studies (NIES) under Environment Agency
- Geographical Survey Institute (GSI) under Ministry of Construction
- National Institute for Earth Science and Disaster Prevention (NIESDP) under STA
- National Institute of Agro-Environmental Sciences (NIAES) under Ministry of Agriculture, Forestry and Fisheries
- Forestry and Forest Products Research Institute (FFPRI) under Ministry of Agriculture, Forestry and Fisheries
- National Institute for Resources and Environment (NIRE) under MITI
- Geological Survey of Japan (GSJ) under MITI
- Meteorological Research Institute (MRI) under Meteorological Agency
- Communication Research Laboratory (CRL) under Ministry of Posts and Telecommunications

4.4 Foundations

Remote Sensing Technology Center (RESTEC) is a foundation authorized by STA. Main activities of RESTEC are data service, research, and coordination of committees and training courses. Most satellite data can be purchased through RESTEC.

Earth Remote Sensing Data Analysis Center (ERSDAC) is a foundation authorized by MITI. The objective of ERSDAC is to promote remote sensing for resources, energy, and environment. The concrete activities of ERSDAC focus on JERS-1 and ASTER which is a sensor launched by EOS-AM1, USA in 1998 and is funded by MITI.

4.5 Research groups

The Japan Association on Remote Sensing (JARS) is a non-profit research group consisting of about ten professors/scientists and about twenty people from private firms. JARS was founded in 1974, and it is one of the most active research group in remote sensing because JARS has published six books on remote sensing including "REMOTE SENSING NOTE" (1993).

The Association for Real-time Imaging and Dynamic Analysis (ARIDA), which is described in the the first chapter, is also the same type organization in the field of photogrammetry.

5. ACTIVITIES IN THE GEOGRAPHICAL SURVEY INSTITUTE

The Geographical Survey Institute (GSI) is a major surveying and mapping agency in Japan. It carries out geodetic survey and cartographic work including publication of topographic and thematic maps. Major new activities in the GSI during the period of 1992-1996 are summarized as follows.

5.1 GRAPES

More than 600 (610 as of March 1996) fixed

GPS observation stations have been set up in Japanese islands with about 30 km interval. The system is nicknamed GRAPES which stands for "GPS Regional Array for Precise Surveying". Crustal movement can be continuously monitored by this system. The GPS data can also be used as reference point for GPS positional survey. Provision of the data for this purpose is under consideration.

5.2 Preparation of Digital Cartographic Data

5.2.1 Publication of "Numerical Map" in Floppy Disks

Several kinds of digital cartographic data produced by the GSI have been published in FD's since 1993. The following data are now available to general public.

- Digital elevation data in about 50 m grid interval (covers more than 1/2 of Japan)
- Digital elevation data in about 250 m grid interval (covers all Japan)
- Digital elevation data in about 1 km grid interval (covers all Japan)
- 1:10,000 Topographic map data
- Sea coastline and administrative boundaries from 1:25,000 topographic map

5.2.2 Spatial Framework Data

Preparation of "Spatial Framework Data" began in 1995. This is a project to produce structured digital cartographic data of major map contents such as administrative boundaries up to the smallest unit, road networks, rivers and so on corresponding to map scale of 1:2,500 - 1:10,000. The data are made through digitization of hard copy map.

5.2.3 Raster image data of topographic maps

Raster image data of 1:25,000 and 1:50,000 topographic maps are made by scanning original films of maps in a resolution of 25 μ m. These data are used for map revision with the Raster map revision system described later. Publication of these map data with reduced resolution in CD-ROM's is now under consideration.

5.3 Development of Raster map revision system and utilization to mapping processes

homepage of the GSI is:
<http://www.gsi-mc.go.jp/>

Map revision system based on raster image of a map was developed on an engineering workstation. After the test and examination on adapting it to actual map revision work, it became to be used for all the map revision work of 1:25,000 topographic maps conducted in-house in GSI in 1994. This system is also modified for 1:50,000 topographic maps which have slightly different map symbols and now used for revision work.

5.4 Establishment of the International Steering Committee for Global Mapping

Geographic information on global scale is still insufficient for increasing needs of such information required for coping with global environment problems. Based on an appeal of the Geographical Survey Institute and the resolution of the 1st International Workshop on Global Mapping held in Izumo, 1994, the International Steering Committee for Global Mapping was established and the 1st meeting was held on February 14, 1996. The outcome of the meeting is summarized as a resolution and it emphasizes to make existing data sets publicly available, national mapping organizations to assist in the development of missing global data set, and to get international recognition for the Global Mapping efforts as one of the positive activities toward addressing global concerns.

5.5 Participation in the ISO/TC211 activities

Japan is participating ISO/TC211 activities as P-member (Participating member) and as project leader of two working groups for standardization of Geographic Information/Geomatics.

5.6 Others

The latest information of the GSI can be accessed through Internet. The URL of the