Spatial Data Infrastructure Work in Japan 2000 – 2003

Government of Japan

Summary

In Japan, fundamental geodetic works are carried out principally by the Geographical Survey Institute (GSI) and the Hydrographic and Oceanographic Department (HOD), and various map production works are conducted by GSI, HOD the Ministry of Land, Infrastructure and Transport (MLIT), which the National Land Agency (NLA) was integrated into due to the governmental restructuring in 2001, the Ministry of Agriculture, Forestry and Fisheries (MAFF), and the Geological Survey of Japan/National Institute of Advanced Industrial Science and Technology (GSJ/AIST).

Various geodetic survey activities are being carried out, such as:

Operation of a nationwide GPS observation network for precise geodetic control surveying and crustal movement monitoring; detection of crustal movement for earthquake prediction research; leveling in the ground subsidence areas; geodetic satellite observation for control of the geodetic networks and for determination of positions of isolated islands; geoid surveys for the determination of geoid height; gravity measurement for preparation of gravity anomaly charts; geomagnetic observation for preparation of geomagnetic charts.

In addition, global geodetic projects which connect the Japanese geodetic network to the world geodetic system are being undertaken by GSI; utilizing VLBI (Very Long Baseline Interferometry) system, and by HOD; utilizing SLR (Satellite Laser Ranging) system, respectively.

GSI has been conducting periodical revision survey of national base maps on the scale of 1:25,000, preparation of basic maps on the scales of from 1:5,000 to 1:5,000,000, and several kinds of thematic maps such as land use maps, land condition maps, etc.

In 1995, GSI started the preparation of the Spatial Data Framework (SDF), whose scale is 1:2,500 for urban area and 1:25,000 level for the rest of all Japan. GSI almost completes preparation of SDF until 2003, and publishes them in CD-ROM.

MLIT (NLA) has been conducting cadastral survey. The scales of cadastral maps are from 1:250 to 1:5,000. MLIT (NLA) has also been producing land classification maps on the scales of from 1:5,000 to 1:200,000 and water use maps on the scales of 1:25,000 and 1:50,000.

MAFF has been producing soil maps of cultivated and forest lands and has already covered all the national forests in a series of soil maps.

GSJ/AIST has been producing geological, geophysical, geochemical and other thematic maps on the scales of from 1:50,000 to 1:5,000,000.

To promote safe navigation, HOD has been publishing various nautical, bathymetric and tidal current charts, including electronic navigational charts (ENC) in CD-ROMs.

Spatial Data Infrastructure Work in Japan 2000 – 2003

Most of the spatial data infrastructure works in Japan are carried out under the Survey Act. Main objectives of the act are to coordinate various survey work efficiently, to standardize accuracy and to avoid overlapping work.

Survey works are mainly classified into two categories by the act. The first one is the Fundamental Survey executed by the Geographical Survey Institute (GSI) nationwide, and the other is the Public Survey for local governmental projects or special projects which are carried out by other governmental or public organizations such as the Forestry Agency, the Geological Survey of Japan/National Institute of Advanced Industrial Science and Technology (GSJ/AIST), the Ministry of Land, Infrastructure and Transport (MLIT), etc.

Preparation of various kinds of hydrographic charts is carried out by the Hydrographic and Oceanographic Department (HOD) of the Japan Coast Guard.

1. Geodetic Work

Fundamental geodetic works in Japan are principally executed by the Geographical Survey Institute (GSI) and

the Hydrographic and Oceanographic Department (HOD).

The Japanese national geodetic network consists of 1,000 first order triangulation points, 5,000 second order triangulation points, 32,700 third order triangulation points and 64,500 fourth order triangulation points, and 20,000 km of precise leveling routes. Fourth order triangulation points are still being added mainly for cadastral surveys.

The establishment of a nationwide GPS observation network has started in 1992, and the operation started in 1994.

GSI is preparing for adoption of world geodetic system as national geodetic datum, i.e., Japanese Geodetic Datum 2000. New datum will be provided after amendment of Survey Act.

The Law for Hydrographic Activities is amended and put into force as of 1 April 2002, the Japanese domestic positional reference frame is changed from the Tokyo Datum (TD) to the World Geodetic System (WGS). Accordingly, datum of Japanese nautical charts and those in the Notices to Mariners and the Navigational Warnings have been integrated into the WGS.

1.1 Precise Geodetic Network Surveying Project

GSI started the Precise Geodetic Network Surveying Projects in 1974 in order to switch over from old geodetic data obtained by conventional method (such as triangulation) to more precise new data by trilateration, using optical EDMs (Electro-optical Distance Measuring instruments). Since 1990, Surveying the first and second order triangulation points with optical EDM has been replaced by surveying with GPS. The geodetic framework of the project is classified into two networks. One is the Primary Precise Geodetic Network composed of 6,000 first and second order triangulation points, and the other is the Secondary Precise Geodetic Network composed of 32,700 third order triangulation points.

Recently major technique used for this survey was changed from EDM to GPS (Global Positioning System). GSI started the operation of the nationwide GPS observation network composed of 210 GPS observation stations called 'GPS-based Control Stations' in 1994. Additionally, 990 GPS-based Control Stations had been added by March 2002. The network is operated continuously and the data are transferred to GSI in real time.

The establishment of a nationwide GPS observation network has started in 1992, and the operation started in 1994.

1.2 Leveling

GSI accomplished the eighth revision leveling survey along the first order leveling routes throughout Japan in March 1997. The ninth revision leveling survey has been carrying out from April 1997. About 2,000 km of revision surveys are carried out every year. In addition to the revision survey, GSI is conducting 2,000 km of re-leveling annually in the Specified Observation Areas and the Intensified Observation Areas designated in the National Earthquake Prediction Program.

138 tidal stations are registered with the Coastal Movement Data Center and all the tidal data obtained at these stations are compiled and published every year.

1.3 Satellite Positioning

GPS observation is a large part of satellite positioning of GSI. Continuous observation at 1200 GPS-based control stations plays a main role in crustal deformation monitoring in GSI. Asides from continuous observations, GPS is used for positioning of isolated islands in Japan.

GSI is also carrying out data submission to IGS (International GPS service), IGS data distribution as a regional data center and IGS data analysis as an associated analysis center.

GSI has been carrying out EGS (Experimental Geodetic Satellite, nicknamed "AJISAI") observation since 1986. Observation of EGS are carried out also by NASDA (National Space Development Agency of Japan) and HOD. GSI is carrying out positioning of the satellite by telescopic photograph and spin rate estimation by photoelectric observation.

In order to measure the precise position of the mainland and islands of Japan in the World Geodetic System, HOD has been conducting a series of satellite laser ranging (SLR) observation of LAGEOS at the Shimosato Hydrographic Observatory since 1982, and has constantly determined the positions of more than 70 off-lying islands using differential techniques of NNSS since

1974 and GPS since 1994.

HOD started a marine geodetic control project in 1988 to determine the precise position of 10 major islands of Japan by the simultaneous SLR observation of AJISAI, and has already determined the precise position of 9 islands (all islands but Etrofu Shima). HOD studied the plate movement around Japan Islands by repeated observations of our geodetic control points which include Chichi Shima, Ishigaki Shima, Tsushima, and Wakkanai. The observations were performed at Wakkanai in 2000, and Tsushima in 2001.

Both of these SLR observations are supported by the cooperative research provided by the U.S.A-Japan cooperation in the field of space development. The cooperative research is also related to the Crustal Dynamics Project conducted by NASA.

The obtained data were previously analyzed by the method SPORT (Successive Passes Orbit Revising Technique) developed at HOD to determine the relative positions of these major islands referred to Shimosato as precisely as the uncertainty of 7mm for the baselinelength of about 2,000 km in the case of Minami Tori Shima.

Since 1997, HOD changed the analytical procedure from SPORT to Global Data Analysis which utilizes SLR observation data from all over the world with the help of the software GEODYN-II developed by NASA.

In order to watch the middle size crustal deformation (about 50 km), HOD continuously monitors the baselines in the Minami Kanto area, known as the nest of big earthquakes, by GPS geodetic survey in Izu Oshima, Manazuru, Yokosuka, Minami Izu, Kozu Shima, and Miyake Shima.

HOD has been conducting monitoring of GPS geodetic survey to detect the crustal deformation at the Japanese coastal area.

1.4 Astronomical Observation

HOD is also carrying out the observation. For the purpose of preparing the Japanese Ephemeris (the most precise almanac in Japan), nautical almanac, abridged nautical almanac, etc., HOD has been conducting observation of occultation of stars by the moon at the hydrographic observatories at Tokyo, Sirahama, Simosato and Bisei, and grazing occultation at two places in Japan.

1.5 Very Long Baseline Interferometry (VLBI)

GSI has been operating five permanent stations at Shintotsukawa with 3.8m, at Aira with 10m, at Chichijima with 10m, at Kashima with 26m and at Tsukuba with 32m diameter antenna. GSI has carried out domestic VLBI experiments with five stations four times per year. Tsukuba has been participating in international VLBI projects of VLBI global network for a deeper understanding of inter/intra-plate crustal deformation and Earth orientation changes. The projects are Continuous Observation of the Rotation of Earth (IVS-R), The International Terrestrial Reference Frame sessions (IVS-T), The Astronemical geodesy sessions (VLBA), The monitor UT1 sessions (IVS-INT2), and Asis-Pacific Space Geodynamics (APSG). The major purposes of GSI's VLBI activities are below.

a) Connecting Japanese geodetic reference frame referred to International Terrestrial Reference Frame (ITRF) to participate in the International VLBI Service (IVS).
b) Precisely finding the movement of continents or the variability of the earth rotation to carry out VLBI experiments repeatedly.
c) The monitoring of mean sea level change to measure the position of tidal stations by VLBI and GPS repeatedly.
d) Establishment of a terrestrial reference frame is Asia and the pacific area by geodetic survey techniques in cooperation with the related countries.

1.6 Gravity Survey

Gravity Surveys are executed on land by GSI and at sea by HOD. GSI is repeating fundamental and 1st order gravity surveys at fundamental and 1st order gravity stations to detect gravity changes associated with crustal movements. Since 1984, an absolute gravity measuring system has been operated for fundamental gravity survey. Since 1992, GSI has introduced FG-5 absolute gravimeters and measured absolute gravity at the fundamental gravity stations. Using the fundamental and 1st order gravity data, GSI built Japanese Gravity Standardization Network 96 (JGSN96).

In 2001, GSI conducted the forth absolute gravity measurement at Syowa Station as an activity of the 42nd Japanese Antarctica Research Expedition (JARE).

In March 2000, GSI produced gravity anomaly relief maps of Japan in collaboration with Nagoya University, the Geological Survey of Japan (GSJ/AIST), and Hokkaido University.

In April 2002, GSI published a new 2 km-grid geoid model of Japan "GSIGEO2000". GSIGEO2000 is a hybrid geoid model constructed by adopting the gravimetric geoid model "JGEOID2000" to the nationwide geoidal heights data of more than 800 points by GPS/leveling (that is, GPS survey at benchmarks).

HOD has been conducting gravity measurements in the Izu Syoto every year. These observation data are used to delineate vertical crustal movements related with earthquakes and volcanic eruptions.

HOD has also been conducting the gravity surveys at sea area using survey vessels for prediction of earthquake and volcanic eruptions.

GSJ/AIST has conducted gravity surveys for the coverage of regions scarce of data, a part of Kyushu, Chugoku and Shikoku districts, southwestern Japan, during the period from 1999 to 2003. The results are being published as "Gravity maps (Bouguer Anomalies) at 1:200,000 scale", and 19 maps of this series have already been published by 2003. GSJ/AIST also compiled "Gravity Map of Japan (Bouguer Anomalies)" using total of about 350,000 land data and about 1,000,000 marine data in 1999. The Japanese Islands and their adjacent sea areas are covered by these sheets of the map at 1:1,000,000 scale. The digital data for the map was published in 2000 with CD-ROM. GSJ/AIST has been conducted marine gravity surveys since 1974 as a part of the geological mapping program of continental margin around the Japanese Islands. The survey vessel Hakurei-maru No.2 has been used since 2000 after the retirement of the 26-years-old Hakurei-maru. The cruises until 2002 have covered almost the continental margin around the Japanese Islands. Free-air and Bouguer anomaly maps have been published as appendices of "Marine Geology Map Series" at a scale of 1:200,000. 1:1,000,000 scale. The digital data for the map will be published in 2000.

1.7 Geomagnetic Survey

GSI has been conducting land geomagnetic and aeromagnetic surveys. The land geomagnetic surveys are conducted at 105 1st order geomagnetic stations at about two or five year intervals. GSI also set up 11 fundamental geomagnetic stations throughout Japan for continuous geomagnetic observation and has started observation since 1996.

The data obtained by GSI are used for compilation of magnetic charts on the scale of 1:4,000,000 for D (declination), H (horizontal intensity), I (inclination), Z (vertical intensity) and F (total intensity) components. In April 2002, GSI published the magnetic charts for the epoch of 2000.0.

GSI completed a nationwide aeromagnetic survey at an altitude of 5000m on 1999. The data was compiled to publish the aeromagnetic total intensity chart at 5000m for the epoch of 1995.0.

GSI carried out a precise aeromagnetic survey at Mt. Usu and Mt. Tarumae areas in 2000, Mt. Komagatake in 2001 and Mt. Bandai in 2002. The results of the precise aeromagnetic survey at Mt. Iwate in 1999 and Mt. Usu in 2000 was compiled to aeromagnetic anomaly charts, and published in 2000 and 2001 respectively.

HOD conducted landmagnetic and aeromagnetic surveys on and over the Japanese islands and its surrounding waters. In order to maintain the safety of a vessel or an aircraft using a magnetic compass, magnetic variations and annual changes must be shown on the nautical and aeronautical charts. For that, HOD is regularly conducting geomagnetic observations and measures magnetism and annual variations by means of land magnetic surveys at the repeated observation points every five years.

HOD has been conducting the magnetic surveys at sea area using survey vessels for prediction of earthquake and volcanic eruptions. HOD carries out the land and aeromagnetic surveys to predict volcano eruptions.

GSJ/AIST has been conducting high-resolution aeromagnetic surveys over the Japanese islands and adjoining sea areas, using an airborne magnetometer of Cesium optical pumping type or proton precession type with high repetition rate. Total intensities (F) of magnetic field in the air are observed along with the precise position-fix data acquisition. Data obtained are processed

and magnetic anomaly field is extracted after removing the International Geomagnetic Reference Field (IGRF), which are published as aeromagnetic anomaly maps at the scale of 1:25,000 to 1:200,000.

Recent target areas of high-resolution aeromagnetic survey are mostly related to the elucidation of active volcanoes. In 2000, a helicopter borne survey employing a nose-stinger system was conducted over Usu volcano with a special reference to the 2000 eruption, revealing the precise image of subsurface structure of the volcano. Similar surveys but with magnetic and EM bird systems were also conducted over Usu and Iwate volcanoes to monitor the course of those volcanic activities. A new helicopter borne survey system has been developed recently at GSJ/AIST especially for the survey over rugged mountains even higher than 3,000m ASL.

1.8 Synthetic Aperture Radar Interferometry

In order to obtain high resolution surface displacement over a large area, GSI studies synthetic aperture radar (SAR) interferometry. One of its achievements is the detection of surface displacement with JERS-1 (Japanese Earth Resources Satellite-1) SAR data.

1.9 Precise distance measurements

GSI has carried out precise distance measurements using precise short-range EDM (ME-5000) with resolution of 0.5 mm for the purpose of observing crustal movements in swarm earthquakes area and active faults.

1.10 Mobile Observation

GSI has carried out observation of crustal movements in Mt. Usu and Miyake volcanic area with a mobile GPS continuous station and an automated polar system (APS) since 2000, when the volcanic activities of Mt. Usu and Miyake started.

1.11 Unmanned/manned Survey Launches

JCG has two unmanned/manned survey launches, “JINBEI” and nicknamed “MANBO II”, to investigate submarine volcanoes. “JINBEI” was launched in 2002. “MANBO II” was constructed as a survey launch of survey vessel “SHOYO” in 1998. They can be operated in unmanned remote-controlled mode in the dangerous area. “MANBO II” surveyed a submarine volcanoes off Miyakejima Island in 2002, and “Minami-Hiyoshi Seamount” in 2002 for the volcanic eruptions prediction.

1.12 The Earthquake Prediction Program

GSI has been participating in the National Earthquake Prediction Program. In order to monitor the crustal activity in and around the Japanese islands, GSI has been conducting several kinds of geodetic surveys and researches on measurement techniques and crustal movements. Detected crustal movements have been compiled and reported to the Coordinating Committee for Earthquake Prediction (CCEP), the Earthquake Assessment Committee and the Earthquake Research Committee.

GSI has been conducting the Precise Geodetic Network Survey and leveling to reveal horizontal and vertical crustal movements, respectively. The results have contributed to the long-term prediction of earthquakes as the designation of the Intensified Observation and Specified Observation Areas. GSI has carried out distance measurements and leveling in the regions which suffered from severe damages of earthquakes. In 2000, GSI revealed crustal movements associated with the Tottori-ken-seibu earthquake.

GSI has also been conducting precise distance measurements and leveling with a short interval and continuous GPS observations in the Intensified Observation and Specified Observation Areas for the purpose of short-term prediction. Furthermore GSI has been continuously monitoring crustal tilts and strains in the Intensified Observation Areas with extensometers and long baseline tiltmeters. In particular GSI detected crustal movements associated with the eruption of Usu and Miyake-jima volcano and the Tokai silent earthquake.

The CCEP was established in 1969 to exchange information on crustal activities and evaluate them. The CCEP consists of 30 members from agencies and universities conducting observations and researches for earthquake prediction. GSI has been serving as the secretariat of the CCEP since its establishment.

HOD surveys for the earthquake prediction program.

In order to obtain data and information necessary for the prediction of earthquakes, HOD has been carrying out surveys and investigations for submarine topography and active sea-bottom structures in specific areas off Miyagi in which large-scale earthquakes have occurred before, as well as on Sagami-Nankai Trough which is designated as the Intensive Observation Areas for earthquakes.

For this purpose, magnetic and gravity surveys were also conducted in offing Miyagi and other plate boundaries. Total intensity magnetic anomaly and free-air gravity anomaly maps were made for elucidation of sea-bottom structure. Free-air gravity anomaly is also used to calculate precise geoid.

The seafloor geodetic observation using a combined technique of the kinematic GPS and acoustic ranging has started in 2000 off Sanriku coast. Until 2002, HOD has been establishing 12 seafloor geodetic reference points mainly on the land-ward slope of the major trenches, such as Japan Trench and Nankai Trough, and started repeated observations. The primary purpose is to detect and monitor the seafloor crustal movement affected by the subduction of oceanic plates.

1.13 Japanese Geodetic Datum 2000 (JGD2000)

As of April 2002, the century old Tokyo Datum has been legally superseded by a brand new one, the Japanese

Table 1 Geodetic Work for the Period from 2000 – 2002

		2000	2001	2002	Total
Primary Precise Geodetic Network using GPS		108	104	95	307
Secondary Precise Geodetic Network using GPS		197	200	104	501
Fourth Order Triangulation		1,018	1,109	1,166	3,293
First Order Revision Leveling		3,877	3,593	4,107	11,577km
Satellite Laser Ranging (HOD)	Mainland	Since 1982			1
	Islands	1	1	0	2
GPS	GPS-based Control Stations	GSI			1,200
	Islands	HOD 10	10	11	31
VLBI	Stations	5	5	5	15
Geoid observation (GPS/Leveling)		-	186	111	297
Gravity Survey	Fundamental (GSI)	5	6	4	15
	1st Order (GSI)	8	39	35	32
	2nd Order (GSI)	34	-	-	34
	Island/Harbors (HOD)	1	3	2	6
	Sea (HOD)	3	3	2	8
	Others (GSI)	1 (Antarctica)	-	-	1
Geomagnetic	Fundamental Magnetic Stations (GSI)				11
	1st Order (GSI)	9	7	6	22
	Island (HOD)	0	2	1	3
	Sea (HOD)	2	3	2	7
Aeromagnetic Survey	Volcanic area (GSI)	2 areas	1 area	1 area	4 areas
	Land/Sea (HOD)	2,400	1,200	1,400	5,000km

*In all tables in this report, year represents Japanese fiscal year which starts from April of the year and ends in March of the next year. (Except Notices to Mariners, Japan Navigational Warnings, NAVAREA XI navigational warnings and NAVTEX navigational warnings in Table 14)

*Numbers in the table mean the number of surveyed points unless otherwise specified.

Geodetic Datum 2000 (JGD2000), which is a local definition of International Terrestrial Reference System (ITRS) at the epoch of 1997.0 with a reference ellipsoid of GRS80 mainly based on space geodetic techniques such as GPS and VLBI. Tokyo Datum had the origin shift of -146m, 507m, 681m in XYZ components with respect to ITRS, and the old geodetic network suffered from internal distortions due to accumulation of crustal deformations and inevitable survey errors. Now GSI provides newly adjusted coordinates of GPS continuous observation stations (1,200 pts) and the 1st to 3rd order horizontal control points (about 38,000 pts), together with transformed coordinates of the 4th order control points (about 64,000 pts). Orthometric heights of benchmarks (about 20,000 pts) adjusted in 2000 and geoidal heights computed from the hybrid geoid model GSIGEO2000 based on gravimetric and GPS/leveling data complete a new geodetic reference system of Japan.

2. Topographic Mapping

2.1 Medium Scale Topographic Maps

The first national base map series covering the entire country of Japan were 1:50,000 Topographic Maps, whose preparation began in 1895 and was completed in 1925 by GSI.

In 1964, GSI adopted 1:25,000 Topographic Maps as the national base map replacing 1:50,000 scale map. The preparation of 1:25,000 Topographic Maps was pushed forward over the whole country of Japan and was almost completed in 1983.

GSI has been conducting revision surveys for and recompilation of these maps with the following principles:

- The 1:25,000 Topographic Maps are revised every three years for urban areas, five years for suburban areas or ten years for mountains areas depending on the amount of changes in each map sheet. In addition to the above principle, the revision is carried out at the same time when new highways, etc., are begun their function.
- The 1:50,000 scale maps are revised with the revision of the corresponding 1:25,000 Topographic Maps.

In 1974, GSI started the Digital National Land Information project in cooperation with the National Land Agency (NLA). Various categories of information, such as elevation, coast lines, rivers, roads, railways, administrative boundaries, land use, etc., have been collected from 1:25,000, 1:50,000 and other smaller scale map sheets and filed onto magnetic tapes under each category.

In 1984, GSI started a new digital map information project and began to collect the data for fundamental categories of 1:25,000 Topographic Maps, namely, contour lines, administrative boundaries, roads, railways and shorelines. The purpose of this project is to prepare a digital cartographic database for automated compilation and production, and to provide basic data for GIS and other digital data services. GSI has been stored away digital elevation model (DEM), calculated from contour lines, administrative boundaries, shorelines, geographical names and public facilities digitized by this project and released them in forms of CD-ROM.

In 1993, GSI adopted raster-based revision method for the 1:25,000 Topographic Maps, and replaced the conventional method with the new digital method. GSI has been producing map images prepared from raster data of 1:25,000 or 1:50,000 Topographic Maps by this method and released them in forms of CD-ROM.

In 2001, GSI introduced NTIS (New Topographic map Information System) which adopted a database management system by a vector data model for 1:25,000 Topographic Maps, and carried out a switchover to JGD2000 in a coordinate system at the same time.

NTIS has five concepts to show in the following:

- Elimination of dual management
- Introduction of time series management of full vector model information
- Realization a seamless database for all Japan
- Adoption of topology calculation type data form
- Separation between data model and map drawing method

Since 2001, GSI has been producing Spatial Data Framework (SDF) on the scale of 1:25,000 levels for the whole country of Japan by extracting ten items (roads, railways, rivers, water boundaries, coast lines, administrative boundaries, datum points, geographical names, public facilities and elevations) from NTIS database and released them in forms of CD-ROM.

GSI pushes forward development of 1:50,000

Topographic Maps Editing Software which used vector data stored on NTIS database.

2.2 Large Scale Topographic Maps

GSI initiated the National Large Scale Topographic Mapping Project in 1960, in order to cover the flat areas of the country. The Forestry Agency also began promoting a similar project in mountainous areas, for the purpose of producing a Basic Forest Map (BFM) as the basis for surveying forests. The project covering mountainous areas was completed in 1980. Currently the Forestry Agency is promoting revision work of the existing Basic Forest Map.

Until 1974, local governments had been producing large scale urban planning base maps with their own standards. Since 1975, GSI and the City and Regional Development Bureau of the Ministry of Land Infrastructure and Transport (MLIT) had standardized 1:2,500 urban planning mapping processes by promoting the 1:2,500 scale map cooperative mapping project. In the Project, GSI took aerial photographs and executed aerial triangulation and local governments undertook mapping processes such as stereo plotting, map compilation and drafting. Around 50,000 km^2 of urban planning area was mapped according to the standard until the end of 1996. These maps are in principle revised every five years by local government.

GSI has been collecting Detailed Digital Information (10m Grid Land Use) since 1981 under the project of the Survey on the Trend of Housing Land Use, the objective of which is to prepare detailed information on present housing lots and possible future housing lots in the urban areas of Tokyo, Osaka and Nagoya and now GSI released these data.

In 1983, GSI began to compile 1:10,000 Topographic Maps for urban areas compiling existing 1:2,500 scale maps and released them.

In 1988, GSI proposed a standard format for large scale mapping with digital processes. Since then, most of local governments that have urban planning area have mapped most large scale maps by digital mapping with this standard.

In Japan, digital map data have been produced and used for urban planning, utility management, navigation, etc. by public organizations and private companies. Under these circumstances, the effective and proper use of survey data of digital maps is indispensable. To avoid duplication of mapping and to maintain accuracy, GSI initiated the Kokudo-kihon-zu (Japanese expression of "National Large Scale Map") Data Base (KDB) project in 1989. In this project, digital map data, scaled from 1:500 to 1:10,000, produced by fundamental and public surveys have been compiled and stored in KDB, which was opened to the public in 1993.

Since 1995, on the scale of 1:2,500 levels, GSI has been producing SDF for GIS whose components are road network, administrative boundaries, inland water area, etc., and released them in forms of CD-ROM. 1:2,500 levels SDF was prepared in the main urban areas of approximately 96,000 km^2 areas that belong to urban planning area by 2002.

In 2003, using technology of aviation laser scanner surveying, GSI started publication of very detailed and highly precise DEM (digital elevation model), which grid interval was 5-meter.

Table 2 shows the amount of Large and medium scale topographic mapping works undertaken during the past three years.

Table 2 Amount of the Large and Medium Scale Topographic Mapping Works

Title		Fy2000	Fy2001	Fy2002
1:10,000	New edition	-	23 sheets	27 sheets
	Revision	59 sheets	60 sheets	43 sheets
1:25,000	Revision	878 sheets	1,299 sheets	42,988.87 km^2
	Recompilation	5 sheets	54 sheets	-
1:50,000	Revision	84 sheets	119 sheets	127 sheets
	Recompilation	1 sheet	-	1 sheet

Table 3 Basic Forest Mapping

Title	2000	2001	2002
1:5,000 Photomaps	499 km^2	731 km^2	780 km^2
1:5,000 BFM Revision	992 km^2	1,156 km^2	927 km^2

Currently Forestry Agency is promoting Forest GIS (Geographic Information System) and digital mapping work of Forest Planning Maps. Table 3 shows the basic forest mapping work during the same period.

2.3 Small Scale Maps

Small scale maps and others published by GSI are shown in Table 4 and Table 5 (July, 2003).

3. Metadata and Clearinghouse

In Japan, Japanese Metadata Profile (JMP) is used for registering a metadata with the clearinghouse. JMP1.1a was developed based on the 1st Committee Draft (CD) of ISO19115 under a joint research project between GSI and private companies. Central government adopted JMP1.1a for its metadata preparation. Then revising the JMP1.1a was frozen during CD and DIS stage in ISO/TC211. JMP2.0 has been developed on this May based on ISO 19115 issued on this March. JMP2.0 is composed of core metadata and some elements such as keywords, distribution information and so on which are necessary for clearinghouse activities. All existing metadata will covert JMP1.1a into JMP2.0 in this summer using tools developed by GSI.

GSI has operated the Japanese clearinghouse gateway under the Japanese language environment since 2000. JMP is adopted as the Metadata form, and Z39.50 as the retrieval protocol.

Now there are eighteen clearinghouse nodes.

- Thirteen nodes by eight central government ministries.
- Four nodes by private companies.
- Three nodes by research institutes including universities.

The node number of the central government is increasing under the Action Program. Regarding the basic surveys by local governments, Japan has a system of gathering the abstract information of public survey to avoid duplicate survey based on Survey Act. GSI is the organization responsible for gathering the abstract

Table 4 Publication of Digital Maps

Title	Number of CD-ROM	Area
DM 2500 (Spatial Data Framework)	16	Urban Planning Area
DM 25000 (Spatial Data Framework)	53	All Japan
DM 25000 (Map Image)	75	All Japan
DM 25000 (Administrative Boundaries)	1	All Japan
DM 25000 (Geo. Names, Pub. Facilities)	1	All Japan
DM 50000 (Map Image)	30	All Japan
DM 200000 (Map Image)	3	All Japan
DM 5m Grid (DEM)	1	SE part of Saitama
DM 10m Grid (DEM (Volcanic Areas))	1	13 Volcanic Areas
DM 50m Grid (DEM)	3	All Japan
DM 250m Grid (DEM)	1	All Japan
The National Atlas of Japan	1	All Japan

DM: Digital Map, DEM: Digital Elevation Model

Table 5 Publication of Paper Map Preparation

Title	Number of sheets	Size of sheets	Number of Colors	Remarks
1:10,000 Topographic Map	297	52.0 × 73.8 cm	5	
1:25,000 Topographic Map	4,339 19	46.0 × 58.0 cm 59.4 × 84.1 cm	3 6	
1:50,000 Topographic Map	1,291 4	46.0 × 58.0 cm 46.0 × 58.0 cm	4 6	
1:200,000 Regional Map	130	46.0 × 58.0 cm	6	Hill Shading
1:500,000 District Map	8 8	78.8 × 109.1 cm 78.8 × 109.1 cm	9 4	Layer Tints
1:1,000,000 IMW (The International Map of the World)	3	78.8 × 109.1 cm	12	Layer Tints, Hill Shading
1:1,000,000 Nippon	3	78.8 × 109.1 cm	4	
1:3,000,000 Japan and Her Surroundings	1	78.8 × 109.1 cm	12	Layer Tints, Hill Shading
1:5,000,000 Japan and Her Surroundings	1	78.8 × 109.1 cm	9	Layer Tints
1:25,000 Composite Map	1	63.6 × 93.9 cm	14	
1:50,000 Composite Map	3	63.6 × 93.9 cm	14	
1:100,000 Composite Map	1 5	63.6 × 93.9 cm 78.8 × 109.1 cm	4 5, 16	
1:300,000 Composite Map	1	78.8 × 109.1 cm	6	Hill Shading

information of public survey. GSI can easily convert the abstract information into metadata. These metadata are registered and distributed through a public survey clearinghouse node. One special clearinghouse is by National Spatial Data Infrastructure Promoting Association (NSDIPA). Many private companies register metadata in the clearinghouse. It is a single node but covers many private companies. Through the clearinghouse gateway by GSI, the government metadata and private companies' metadata can be retrieved.

The URL of this clearinghouse gateway is http://zgate.gsi.go.jp/, in Japanese.

4. Thematic Mapping

4.1 Geographical Thematic Map

GSI is engaged in various kinds of thematic mapping in cooperation with other governmental organizations for the purpose of providing basic geographic information for regional development, disaster prevention, etc. Table 6 shows some typical thematic maps prepared and published by GSI during April 2000 – March 2002.

GSI generates digital thematic maps by both digital mapping method and digitization from existing maps. Table 7 shows some typical Digital thematic maps prepared and published by GSI.

In 1999 GSI started to digitize thematic information of existing thematic maps in order to display and analyze with other information on GIS (Geographic Information System). Digitization of the land condition maps and active fault maps in urban area are on going, and other thematic maps are planned to be digitized in due course.

4.2 Soil Maps

Soil maps in Japan are roughly divided into two categories; for cultivated lands and for forest lands. They are prepared by the Ministry of Agriculture, Forestry and Fisheries.

A 1:50,000 scale map series of soil types and

Table 6 Thematic Mapping by GSI (2000 – 2002)

Type of Map	Scale	Number of sheets
Basic volcano map	1: 5,000, 1:10,000	16
Land condition map	1:25,000	2
Land condition map of volcano	1:30,000	1
Topographic map of costal areas	1:25,000	2
Land condition map of coastal areas	1:25,000	2
Lake chart	1:10,000	2
Active fault map in urban area	1:25,000	33

Table 7 Digital Thematic Mapping by GSI

Title	Format	Item or explanation	Original Source
Detailed Digital Information (1981-, GSI)	10m grid 100m grid	Land Use, Administrative Division, Land Regulation, Land Adjustment, DID (Densely Inhabited District), Land Usage, Floor Area Ratio, Required Time Zone, Land Price etc.	National Large scale Map, Aerial Color Photograph etc.
Digital National Land Information (1975-, GSI, NLA, HOD, JMA)	1km grid 250m grid 100m grid point line	Coastline, Topography, Land Classification, Land Use, River Basin, Administrative Boundary, Road, Railway, Public Facility, Land Price etc.	Topographic Map, Thematic Map etc.
Digital Map 10m Grid (Elevation of Active Volcanos)	10m Grid	Elevation	1:5000 and 1:10,000 scaled Volcanic Base Maps

productivity of cultivated lands has been prepared by the Agricultural Production Bureau since 1959, and the entire area of cultivated land, 51,000 km^2 in all, is covered.

A 1:20,000 or a 1:50,000 scale map series of soil types in national forests has been prepared by the Forestry Agency since 1947. 65,000 km^2 were covered by this series. This agency has also prepared a 1:50,000 scale map series of soil types for many private forests.

4.3 Geological Maps

The Geological Survey of Japan/National Institute of Advanced Industrial Science and Technology (GSJ/AIST) has published most of geologic maps which cover the Japanese islands on scales of 1:50,000, 1:20,000, 1:1,000,000, 1:2,000,000 and 1:500,000.

A series of basic geologic maps published by GSJ/AIST is prepared on the scale of 1:50,000. This basic series was once prepared on the scale of 1:75,000 and the scale was changed to 1:50,000 in 1952. The number of publication of 1:50,000 scale geologic maps reached 615 sheets with explanatory texts at the end of 1999. This implies that the basic map series including those maps prepared on the scale of 1:75,000 covers 70% of the Japanese islands. Compiling these basic geologic maps and other geologic information, GSJ/AIST published smaller scale maps. At the end of 1999, 1:200,000 scale geologic maps cover 78% of the islands. Digital geoscience map series were also published as CD-ROM.

5. The National Atlas of Japan

The first edition of the National Atlas of Japan compiled by GSI was published in 1977. It has been

widely acclaimed. GSI continued to revise this by using the latest statistics and other source materials, and completed the National Atlas of Japan, Revised Edition, which was published in 1990. Furthermore, GSI has developed an Electronic Atlas System for the computer use, and a CD-ROM Atlas was published in 1997. Now, GSI makes the base map data on the scale of 1:3,000,000 toward next generation atlas based on Web GIS.

6. National Land Survey

The National Land Survey of Japan has been carried out under the direction and guidance of the National Land Agency (NLA) till 2000 and the Ministry of Land, Infrastructure and Transport (MLIT) since 2001. The objective of the survey is to contribute to the promotion of effective use and conservation of national land. To reveal the present condition of national land, such as land ownership and its utilization, is another objective of this survey. It is expected to be based on the National Land Survey Act which was enacted in 1951, when the survey was initiated. Three major items form the core of this survey; the land classification survey, the water use survey and cadastral survey.

6.1 Land classification Survey and Water Use Survey

A land classification survey is the survey of the topographical and geological features, soil, and present land use. The results are compiled into atlases and books. A water use survey aims at investigating the basic statistics of a river, such as annual rainfall, discharge, present water utilization for farming or drinking and groundwater.

In the land classification survey, NLA had developed a computerized mapping method in which a specific device, controlled by computer, can draw a colored map. By this method, one can easily identify various kinds of data related to land classification.

The above mentioned surveys are compiled into atlases and books as follows:

a) Land classification maps (Geomorphological map, Surface geology map, Soil map, Present land use map, Land use capability classification map), overlays (such as slope map) and an Explanatory data book.
b) Land conservation maps (Natural condition map, Present land use and vegetation map, Natural disasters map, Land use tendency and designated areas map, Control and designated area for disaster prevention map, Valuable natural and cultural assets distribution map, Basic conservation map) and Explanatory data book.
c) Water use maps and a descriptive catalogue of available information on major river system.
d) Groundwater maps and Explanatory data book.
e) Groundwater data ledger.

Table 8 Land Classification and Water Use Maps (1951–2002)

	Scale	Coverage
Land classification map	1:200,000	All prefectures
	1:50,000 (c.m.m.)	All prefectures
	1:2,500 - 1:5,000 (c.m.m.)	139 cities
Land conservation map	1:200,000 (c.m.m.)	32 prefectures
	1:50,000	15 regions
Water use map	1:50,000	55 regions
	1:25,000 - 1:50,000	14 regions
Ground water map	1:15,000 - 1:50,000	10 regions

*c.m.m. : computerized mapping method

6.2 Cadastral Survey

The cadastral survey aims at clarifying the location, boundary, ownership, lot number, acreage, and current status of land use of each parcel. Local governments, such as prefectural and municipal governments, carry out the survey. They transact such affairs as planning the survey project, making contact with a surveying company, and supervising. MLIT plays a role in the survey by giving local governments a 50% subsidy of the total cost and some technical guidance as well. The executive body only has to share 1/20 to 1/30 of the total cost, since a special grant is given to the survey by the Japanese government. Because of present austere budget conditions, the progress of the survey has suffered a sharp curb. 1,500 km^2 or more is the acreage that the cadastral survey has completed annually over the past five years. The progress of this survey at the end of F.Y.2002 is as follows:

Completed cadastral survey: 129,061 km^2 (1951–2002)

Progress ratio: 45.1% (Target acreage of the survey: 286,200 km^2)

The cadastral survey consists of the following stages; supplementary survey, detailed on-the-spot survey, measuring the acreage of each parcel, and making atlases and books. The supplementary survey comprises the control point survey which is to set up control points for cadastral surveying. The establishment of these control points is carried out by GSI. Scales of cadastral atlases differ from case to case depending on the mean acreage of a parcel. Scales of 1:250, 1:1,000, 1:2,500, or 1:5,000 are used. Of these, the scales of 1:500 and 1:1,000 are the most commonly used. The required accuracy of measurement is classified into six types depending on the land use pattern. For a residential area, for example, the highest degree of accuracy is demanded. On the other hand, the accuracy level for a forest area is the lowest.

Copies of cadastral maps and books are bound to be sent to registry offices after having been checked for accuracy and obtaining the legal approval of MLIT, or, in some cases, from the prefectural governor, to replace the old maps which were prepared about 100 years ago and are still used for levy and land registration.

The cadastral survey had not been promoted well, and in an attempt to do so, the acceleration Act, named The Act on Special Measures for Promotion of the National Land Survey was enacted in 1962. Under this Act, a target acreage for the survey for a period of 10 years was clearly established. Now the survey has being carried out based on its fifth, the Ten-year National Land Survey Plan stage (2000 – 2009). According to the Plan, the target acreage is 34,000 km^2.

7. Marine Geology

GSJ/AIST has been engaged in marine geological and geophysical investigation of the sea around the Japanese Islands, the western and central Pacific Ocean and the Antarctic sea, chartering the geological survey vessel R/V Hakurei-maru, R/V Hakurei-maru II, and others. The investigation comprises basic studies of marine geology, mineral resources and geophysical prospecting, including sedimentological and environmental study of lacustrine and coastal areas. Marine geological maps on the scale of 1:1,000,000 covering the Japanese islands were published and a series of marine geological maps on the scale of 1:200,000 has been published around the main Japanese Islands. Since 2002, marine geological maps on the scale of 1:200,000 have been published as CD-ROM. International cooperation is actively promoted in the fields of marine geology, mineral resources and environmental study of coastal areas.

8. Hydrographic Work

8.1 Hydrographic Surveying and Charting

The datum of Japanese nautical charts were converted from the Tokyo Datum (TD) into the World Geodetic System (WGS) during the period from April 2000 to March 2002.

a) The number of various hydrographic surveys carried out are as follows:

Table 9 Hydrographic Surveys

Type of survey	2000	2001	2002
Harbor	1	2	3
Updating	195	194	210
Coastal	14	11	9
Basic Maps of the Sea	5	5	1
Earthquake prediction	7	9	11

b) The results of these surveys were used for production of nautical and other charts, as shown in Table 10:

Table 10 Nautical and Other Charts

Type of chart		2000	2001	2002
New Charts	Nautical charts	189	421	2
	Miscellaneous charts	1	0	1
	Basic Maps of the Sea	5	15	11
	Aeronautical charts	0	0	0
New Editions	Nautical charts	2	9	110
	Miscellaneous charts	0	4	2
	Basic Maps of the Sea	0	0	0
	Aeronautical charts	0	0	0
Reprints		0	0	13
Total		197	449	139

Note: The charts whose datum were converted into WGS-84 are included in Nautical charts of New Charts.

The Basic Maps of the Sea (BMS) currently produced are classified as follows:

Table 11 Classification of the Base Maps of the Sea

Series	Scale	Coverage	Size	Type
BMS in Coastal Waters	1:10,000 1:50,000	Within 12M of the coast	Full 1/2	Bathymetry; Submarine structure
BMS on Continental Shelf Areas	Mainly 1:200,000	Continental margin	Full	Bathymetry; Submarine structure; Total magnetic intensity; Gravity anomaly
BMS in Ocean Areas	1:3,000,000	Ocean Area	Full	do. (except Submarine structure;)

c) The number of paper charts issued as of March 2003 is shown below:

Table 12 Number of Paper Charts Issued

Type of Chart	Number of Issues
Nautical charts	705
Miscellaneous charts	96
Basic Maps of The Sea	494
Aeronautical charts	25
Total	1,320

Note: The International Charts of the IHO under the responsibility of Japan as the produce nation, i.e. six of the 1:3,500,000 series and two of the 1:10,000,000 series have been published.

d) Electronic Navigational Charts (ENCs)

Table 13 Number of ENCs Issued as of March 2003

Type of Chart	Number of Issues
Electronic Navigational Charts	15

8.2 Other Publication Activities

Table 14 Other Publications of HOD

Type of publication			2000	2001	2002
New publications	Sailing Directions	(Japanese)	1	1	1
		(English)	1	3	2
	Specialpublications		6	6	6
New Editions	Sailing Directions	(Japanese)	6	5	5
		(English)	0	1	2
	Special publications		3	7	3
Notices to Mariners	(Japanese)		4,965	5,524	6,065
	(English)		4,533	5,194	5,543
Japan Navigational Warnings (Japanese)			2,403	2,656	2,682
NAVAREA XI navigational warnings (English)			799	947	950
NAVTEX navigation warnings (Japanese)			2,030	2,180	2,095
NAVTEX navigational warnings (English)			2,030	2,180	2,095
Information of Ocean Conditions	Quick Bulletin of Ocean Condition		24	50	51
	Ocean Current Forecasting		50	51	51

8.3 Marine Survey

a) Survey of coastal Area

In order to cope with the establishment of 200-mile exclusive economic zone (EEZ) in accordance with the United Nations Convention on the Law of the Sea (UNCLOS), HOD is carrying out detailed surveys of low-water lines, topography and geological structure of the sea-bed in coastal area, particularly in those important areas around baseline defining the Japanese territorial sea. Japan concluded UNCLOS in 1996.

b) Survey of Continental Shelf Areas

HOD is carrying out hydrographic surveys south of Japan by using the large-type survey vessel "TAKUYO and SHOYO" equipped with modern survey instruments such as multi-beam echo sounder in order to obtain basic data required for the promotion of utilization and development of the continental shelf of Japan.

c) Promotion of Marine Geodetic Survey

Nautical charts of each country are constructed based on its own geodetic system. With the recent development of the geodetic satellite survey technique, however, a difference in geodetic systems has turned out to be a problem. Accordingly, the IHO recommends that the meridians and parallels given on the chart should be shown on the basis of the World Geodetic System. Therefore, in Japan also, it becomes necessary to locate the mainland and remote islands on the basis of the World Geodetic System, and HOD has been conducting geodetic satellite observations by laser ranging to the geodetic satellite LAGEOS, in cooperation with the United States National Aeronautics and Space Administration (NASA) to obtain the precise location of the mainland on the basis of the World Geodetic System.

8.4 Provision and Supply of Oceanographic Data and Information

HOD has been engaged in collecting, managing and supplying oceanographic data and information for 38 years as a comprehensive oceanographic data bank established in accordance with a resolution adopted by the Intergovernmental Oceanographic Commission (IOC) of UNESCO and a report made by the Council for Ocean Development of Japan. The Oceanographic Data and Information Division of HOD is registered as the Japan Oceanographic Data Center (JODC) at the IOC under the International Oceanographic Data and Information Exchange (IODE) promoted by the IOC, and is taking active part in internationally exchanging oceanographic data and information for their effective utilization as the Japanese representative in the field of oceanographic data exchange.

JODC provides service of on-line data access. J-DOSS (JODC Data On-line Service System) is a data retrieval system, which provides oceanographic data and information managed by JODC through Internet.

9. Standardization of Spatial Data Framework (SDI)

9.1 Digital Japan

Digital Japan is a concept of a virtual space where users can utilize geographical information selecting from data sets stored and maintained by different organizations in the internet and integrating them for certain purpose based on the positional reference data. Digital Japan has various possibilities that enable us to search and analyze geographical information as an infrastructure, as well as to add information to them on demand of users.

In administration for example, Digital Japan may offer the essential information for daily life using maps in easy manner as follows: reflection of residents' opinion, dialogues with the residents, promotion of local activities and dissemination of disaster measures based on the latest geographical information.

GSI believes that Digital Japan can be applied to as great many fields as combinations of the value-added information and data infrastructure.

To realize Digital Japan, GSI will launch Digital Japan Web System in 2003, which enables us to overlap many kinds of geographical information on the data developed by GSI on the Internet.

GSI will continuously maintain geographical information infrastructure that is indispensable for Digital Japan and also for common use by citizens while actively develops procedures to make a smooth maintenance and distribution of positional reference data and geographical information possible.

9.2 GIS Action Program 2002 – 2005

The Liaison Committee of Ministries and Agencies Concerned with Geographic Information System has continued its efforts for infrastructure development after the end of the Long-term Plan for the Development of NSDI in Japan, acknowledging once again the importance of promoting efficient and high-quality activities based on GIS in various fields from administration, industrial development to the every-day life of the people.

Also GIS has come to be recognized as an indispensable tool for implementing IT related policies including the "e-Japan Strategy" the government endorses, as well as for creation of new business models and an improved quality of life of the people by an intelligent administration and better public services. The role of GIS is expected to gain further momentum in the years to come.

To meet the growing national needs for GIS and to ensure continuous efforts on GIS, the government formulated a new plan "GIS Action Program 2002 – 2005" in February 2002, for the period of 2002 – 2005. (The program was revised on April 2003 for additional measures and some amendments.) This Action Program aiming at an easier and a better utilization of GIS data envisions an IT society where the following are highlighted:

- efficiency, greater speed, better quality of the public services
- creation of new business models in the industrial sector and new employment
- provision of better services in the overall public services at a minimum cost

The latest program includes about 65 specific actions to be taken, which can be summarized as follows:

1) Creation of infrastructure environment for GIS utilization

1-1) Standardization of the national spatial data infrastructure and its priority use by the government

1-2) Development of guidelines and systems for promoting digitization and further distribution of the geographic information

1-3) Digitization of the national spatial data infrastructure items and its provision to users at large

1-4) In principle it is the responsibility of each municipality to develop its own geographic information, metadata, clearinghouse, and other related data

2) Higher efficiency and quality of administrative services based on GIS in every possible field of the government

10. International Activities

10.1 International Geodetic Survey

GSI is actively participating in international cooperative projects in the field of geodesy, such as IGS (International GPS Service), DOSE (Dynamics of Solid Earth) and IAGBN (International Absolute Gravity Basestation Network), in order to determine precise positions in global coordinate system and to contribute to the progress of geodesy and earth sciences. The IGS provides precise orbits of the GPS satellites. It is one of the most important information for precise GPS observation. GSI participates in the IGS as one of the Regional Data Centers and the Associate Analysis Centers.

DOSE is an international research project of NASA and GSI participates in it through intercontinental joint VLBI observation. GSI also participates in the international research of NASDA on Japanese Earth Resources Satellite-interferometric SAR.

Japan has four absolute gravity stations of IAGBN, Esashi, Kyoto, Tsukuba and one in Syowa station in Antarctic. Absolute determination of gravity in Australia in 1996, including IAGBN(A) station, was carried out for the purpose of establishment for mean sea level change monitoring in southwestern pacific. Absolute determination of gravity in Korea in 1999 was carried out for providing precise gravity standard value.

10.2 Global Mapping Project

Global Mapping is a cooperative project of NMOs and partners to develop a set of global geographic data with known and verified quality based on consistent specifications. As of May 2003, 129 countries and regions have participated in the project, and twelve countries' data have been completed and are downloadable through the Internet from the ISCGM website. The project has been promoted through International Steering Committee for Global mapping (ISCGM) which was established in 1996.

The need of the Global Map for addressing global

environmental problems has been well confirmed at the United Nations. The Plan of Implementation adopted at the World Summit on Sustainable Development (WSSD) emphasizes the necessity for promoting development and wider use of earth observation technologies, including global mapping and calls for encouraging initiatives and partnerships for global mapping. Also, Global Mapping became a registered WSSD Type 2 initiative (a sustainable development initiative with an emphasis of partnership aspects) with the goal of completion of global coverage by the year 2007.

GSI is developing not only the Global Map of Japan but also the Global Map of developing countries mainly in Asia and the Pacific region in cooperation with respective NMOs. To date, data of the following countries have been developed: Thailand, the Philippines, Vietnam and Kazakhstan in 1998; Mongolia Kyrgyz and Bangladesh in 1999; Laos and Nepal in 2000; Myanmar and Sudan in 2001; and Senegal and Liberia in 2002. GSI will continue to make efforts to implement Global Mapping Project as ISCGM Secretariat.

10.3 ISO/TC211 (Geographic information/Geomatics)

GSI has actively participated in ISO/TC211 since the foundation in view of the magnitude of standardization of geographical information and promotes it developing Japanese Standards for Geographic Information (JSGI) in accordance with ISO/TC211.

GSI published JSGI2.0 in March 2003 in accordance with the international standards. The JSGI2.0 is based on JSGI published in 1999 and reflects examinations of practical concerns for the implementation in Japan through a joint research with 38 private enterprises titled “Study for practical Standards for Geographic Information.”

“GIS Action Program 2002 – 2005” states that Japanese government takes the initiative to utilize JSGI at maintenance, dissemination of data and other occasions, and to promote implementation of JSGI and provide technical assistance.

10.4 International Hydrographic Organization (IHO)

IHO Commissions, Committees and Working Groups in which Japan (HOD) has been participating are as follows:

a) Finance Committee (FC)
b) IHO Commission on Promulgation of Radio Navigational Warnings (CPRNW)
c) IHO Worldwide Electronic Navigational Chart Data Base Committee (WEND)
d) IHO Committee on Hydrographic Requirements for Information Systems (CHRIS)
e) CHRIS Data Quality Working Group (DQWG)
f) CHRIS Transfer Standard Maintenance and Application Development Working Group (TSMADWG)
g) CHRIS Standardization of Nautical Publications Working Group (SNPWG)
h) IHO Chart Standardization and Paper Chart Working Group (CSPCWG)
i) IHO/IEC Harmonization Group on MIO (HGMIO)
j) IHO-IAG-IOC Advisory Board on the Law of the Sea (ABLOS)
k) Joint IHO-IOC Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO)
l) GEBCO Sub-Committee on Digital Bathymetry (SCDB)
m) GEBCO Sub-Committee on Undersea Feature Names (SCUFN)
n) IHO Working Group on Standards for Hydrographic Survey - S-44
o) IHO Tidal Committee (TC)
p) IHO Hydrographic Committee on Antarctica (HCA)
q) IHO Strategic Planning Working Group (SPWG)

10.5 International Lunar Occultation Centre

HOD conducts astronomical observation under international cooperation and makes efforts to improve the accuracy of ephemeris. Particularly from April 1981, upon the request of the International Astronomical Union (IAU), HOD took over the activities performed by the Royal Greenwich Observatory as the International Lunar Occultation Centre and started to collect and analyze observations all over the world in a homogeneous manner.