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COUNTRY REPORTS

**CARTOGRAPHIC WORKS IN JAPAN 2003 - 2006**

**Submitted by Japan \*\***

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\*\* Prepared by Government of Japan.

# Cartographic Works in Japan 2003 – 2006

## Government of Japan

Most of the cartographic works in Japan is carried out under the Survey Act. Main objectives of the act are to coordinate various survey works efficiently, to standardize accuracy and to avoid duplicated work.

Survey work is mainly classified into two categories by the act. The first one is the Fundamental Survey executed nationwide by the Geographical Survey Institute (GSI), 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 charts and nautical publications is carried out by the Hydrographic and Oceanographic Department (HOD) of the Japan Coast Guard.

### **Geographical Survey Institute of the Ministry of Land, Infrastructure and Transport (MLIT)**

#### **1. Geodetic Work**

GSI principally executes fundamental geodetic works in Japan.

The Japanese national geodetic network consists of 4 VLBI stations, about 1,200 permanent GPS stations (GEONET: GPS Earth Observation NETWORK system), about 100,000 triangulation points, and 20,000 km of precise leveling routes.

##### **1.1 Precise Geodetic Network Surveying Project**

GSI started the Precise Geodetic Network Surveying Projects in 1974 in order to obtain more precise new data by trilateration, using optical EDMs (Electro-optical Distance Measuring instruments) and GPS (since 1990's). GSI started a new one in 2004 to maintain the geodetic framework based on the Japanese Geodetic Datum 2000. The work is done by the continuous observation of GEONET and periodic surveys of 2400 triangulation points evenly distributed over the country. The latter is named Densified Precise Geodetic Network using GPS.

##### **1.2 Leveling**

The ninth revision leveling along the first order leveling routes has been carried out since April 1997. About 2,000 km are surveyed every year. In addition, GSI is annually conducting 2,000 km of re-leveling in the Specified Observation Areas and the Intensified Observation Areas designated in the National Earthquake Prediction Program.

153 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 1231 GEONET stations plays a main role in crustal deformation monitoring in GSI. 2 more stations will be added in 2006. Besides from continuous observations, GPS is used for periodic surveys of triangulation points and control surveys in Japan.

##### **1.4 Very Long Baseline Interferometry (VLBI)**

GSI has been operating four permanent stations at Shintotsukawa with 3.8m, at Aira with 10m, at Chichijima with 10m, and at Tsukuba with 32m antenna. The major purposes of GSI's VLBI activities are:

a) Connecting Japanese geodetic reference frame to International Terrestrial Reference

Frame (ITRF).

b) Establishment of a terrestrial reference frame in Asia and the Pacific in cooperation with other countries.

c) Precise measurement of plate movements and the variation of the earth rotation.

d) Monitoring the orientation of the Earth for geosciences, space development and time control.

### **1.5 Gravity Survey**

Gravity surveys are executed on land by GSI. GSI is repeating fundamental and 1st order gravity surveys at their stations to detect gravity changes associated with crustal movements. Since 1992, GSI has been measuring absolute gravity at the fundamental gravity stations with FG-5 absolute gravimeters. GSI and other organizations have been conducting intercomparison of their FG-5s annually since 2002 in order to detect the instrumental differences.

In 2004, GSI conducted the forth absolute gravity measurement at Syowa Station as an activity of the 45th Japanese Antarctica Research Expedition (JARE).

### **1.6 Geomagnetic Survey**

GSI has been conducting land geomagnetic surveys at 20 1st order geomagnetic stations at two year intervals, and at 11 continuous observation stations throughout Japan from 1996. Geomagnetic continuous observation has also been carrying out in the Kanozan, Mizusawa and Esashi observatories. 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.

### **1.7 Geoid Survey**

GSI has provided the precise geoid model throughout Japan with accuracy of 10cm. Almost all Japan areas have been covered except some part of peninsulas and islands, where the survey is being conducted.

### **1.8 Synthetic Aperture Radar Interferometry**

In order to obtain high resolution surface displacement over a large area, GSI conducts synthetic aperture radar (SAR) interferometry with JERS-1 (Japanese Earth Resources Satellite-1), ENVISAT and RADARSAT SAR data. GSI has been preparing data analysis system for the new L-band SAR satellite ALOS (Advanced Land Observing Satellite), which was launched on January 24, 2006.

### **1.9 Mobile Observation**

GSI has been carrying out observation of crustal movements in Mt.Usu, Miyake and Asama volcanic area with mobile GPS continuous stations and automated polar systems (APS) since the volcanic activities of each area evolved.

### **1.10 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.

The analysis on the GEONET observation results has contributed to re-determine the possible source region of expecting Tokai earthquake. GSI also carried out the analyses on the characteristics of the major earthquakes occurred recently, such as The Tokachi-oki Earthquake (2003), The Mid Niigata Pref. Earthquake (2004), Off-shore West of Fukuoka Pref. Earthquake (2005) and Off-shore of Miyagi Pref. Earthquake (2005). GSI revealed crustal movements associated with those earthquakes by analyzing the GEONET, SAR

interferometry and other geodetic survey results. The detection of Tokai silent earthquake (slow slip event) by GEONET is one of the most important results for the investigation on earthquake occurrence cycle in Tokai area.

GSI has also been conducting leveling survey and distance measurement survey with a short interval in the Intensified Observation Area and the 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.

## 2. Topographic Mapping

### 2.1 Medium Scale Topographic Maps

The first national base map series covering the entire country of Japan was 1:50,000 Topographic Maps, whose preparation began in 1895 and was completed in 1925 by GSI. In 1964, GSI adopted 1:25,000-scale Topographic Maps as the national base map, and have been replacing 1:50,000-scale maps by 1983.

Taking advantage of the vector database, GSI developed and implemented New Topographic map Information System (NTIS), a vector-based map revision system in 2001. NTIS has the following five design concepts:

- Introduction of time series management of each vector object
- Realization of a seamless database for all Japan
- Adoption of implicit topology data structure
- Separation between data model and map drawing method

GSI now collects change information for map revision from local governments and public corporations through its ten regional branches to achieve near real-time map database revision for Topographic Maps.

GSI is also developing software to revise 1:50,000 Topographic Maps using NTIS database.

### 2.2 Large Scale Topographic Maps

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 1 shows the coverage of large and medium scale topographic maps prepared by GSI during the past three years.

Table 1. Coverage of Large and Medium Scale Topographic Maps by GSI

Title		Fy2003	Fy2004	Fy2005
1:10,000	New edition	83 sheets	-2	-
	Revision	26 sheets	25 Sheets	46 sheets
1:25,000	Revision	170,166 km <sup>2</sup>	372,863 km <sup>2</sup>	372,863 km <sup>2</sup>
1:50,000	Revision	58 sheets	-	54 sheets
	Recompilation	-	8 sheets (trial)	-

### 2.3 Small Scale Maps

Small scale maps and others published by GSI are shown in Table 2 and Table 3 (April, 2006).

Table 2. Publication of Digital Maps

Title	Area
DM 2500 (Spatial Data Framework)	Urban Planning Area
DM 5000 (Land use)	Kinki Area
DM 25000 (Spatial Data Framework)	All Japan

DM 25000 (Map Image)	All Japan
DM 25000 (Administrative Boundaries)	All Japan
DM 25000 (Geo. Names, Pub. Facilities)	All Japan
DM 25000 (Land condition)	All Japan
DM 50000 (Map Image)	All Japan
DM 200000 (Map Image)	All Japan
DM 5000000(Combined)	All Japan and Surroundings
DM 5m Grid (DEM)	Saitama, Tokyo, Nagoya, Kyoto&Osaka, Fukuoka
DM 10m Grid (DEM (Volcanic Areas))	13 Volcanic Areas
DM 50m Grid (DEM)	All Japan
DM 250m Grid (DEM)	All Japan
The National Atlas of Japan	All Japan

DM: Digital Map, DEM: Digital Elevation Model

Table 3. Publication of Paper Map Preparation

Title	Number of sheets	Size of sheets
1:10,000 Topographic Map	293 4	52.0 x 73.8 cm
1:25,000 Topographic Map	4,339 19	46.0 x 58.0 cm 59.4 x 84.1 cm
1:50,000 Topographic Map	42 1,249 4	46.0 x 58.0 cm 46.0 x 58.0 cm
1:200,000 Regional Map	130	46.0 x 58.0 cm
1:500,000 District Map	8 8	78.8 x 109.1 cm 78.8 x 109.1 cm
1:1,000,000 Nippon	3	78.8 x 109.1 cm
1:3,000,000 Japan and Her Surroundings	1	78.8 x 109.1 cm
1:5,000,000 Japan and Her Surroundings	1	78.8 x 109.1 cm
1:25,000 Composite Map	1	63.6 x 93.9 cm
1:50,000 Composite Map	2 1	63.6 x 93.9 cm
1:100,000 Composite Map	1 3 1	63.6 x 93.9 cm 78.8 x 109.1 cm
1:300,000 Composite Map	1	78.8 x 109.1 cm

### 3. Metadata and Clearinghouse

In Japan, Japanese Metadata Profile (JMP) is used for registering a metadata with the clearinghouse. JMP2.0 has been developed on May 2003 based on ISO 19115 issued on March 2003. JMP2.0 is composed of core metadata and some elements such as keywords, distribution information and so on which are necessary for clearinghouse activities.

GSI has operated the Japanese clearinghouse gateway under the Japanese language environment since 2000. JMP is adopted as the Metadata form, and ISO 23950 as the retrieval protocol.

Now there are twenty one clearinghouse nodes.

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

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

### 4. Geographical Thematic Maps

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 4 shows some typical thematic maps prepared and published by GSI during April 2003 - March 2006.

GSI generates digital thematic maps by both digital mapping method and digitization from existing maps. Table 5 shows some typical digital thematic maps prepared and published by GSI during April 2003 - March 2006.

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.

Table 4. Thematic Mapping by GSI (Fy 2003 – Fy 2005)

Type of Map	Scale	Number of sheets
Basic volcano map	1: 5,000, 1:10,000	14
Land condition map	1:25,000	3
Land condition map of volcano	1:30,000, 50,000	2
Topographic map of costal areas	1:25,000	1
Land condition map of coastal areas	1:25,000	1
Lake chart	1:10,000	1
Active fault map in urban area	1:25,000	24

Table 5. Digital Thematic Mapping by GSI (Fy 2003 – Fy 2005)

Title	Format	Item or explanation	Original Source
Detailed Digital Information (1981-, GSI)	10m grid	Land use for housing, covering the three main urban areas of Japan.	City Planning Map, Aerial Color Photograph, etc.
Digital Map 25000(Land condition)	JPGIS	Land condition	1:25000 Land condition Map

## 5. The National Atlas of Japan

The first edition of the National Atlas of Japan compiled by GSI was published in 1977. GSI revised the National Atlas of Japan, Revised Edition, 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. GIS Activities

### 6.1 GIS Action Program

The Liaison Committee of Ministries and Agencies Concerned with Geographic Information System (LCGIS) 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.

To meet the growing national needs for GIS and to ensure continuous efforts on GIS, the government formulated the “GIS Action Program 2002-2005” in February 2002, for the period of 2002-2005. 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, and provision of better services in the overall public services at a minimum cost.

In September 2005, the Committee on the Advancement of Satellite-Based

Positioning and Geographic Information System (CAPGIS) was established. The LCGIS was abolished, and the CAPGIS has succeeded to the tasks of the LCGIS. The CAPGIS is now drafting a new action program for GIS.

## **6.2 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.

To realize Digital Japan, GSI has launched "Denshi Kokudo Web System" in 2003, which enables us to overlap many kinds of geographical information on the data developed by GSI and some local governments on the Internet. There are over 300 sites using this system as of the end of May, 2006.

The portal sites' URL of this system is <http://cyberjapan.jp/>, in Japanese.

## **7. International Activities**

### **7.1 International Geodetic Survey**

GSI is actively participating in international cooperative projects in the field of geodesy, such as IGS (International GNSS Service), IVS (International VLBI Service) 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 IGS as one of the Operational Data Centers and the Regional Network Associate Analysis Centers.

IVS is an international collaboration of organizations which operate or support VLBI and GSI participates in it through intercontinental joint VLBI observation.

The Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) is operated under the purview of the United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP). It has undertaken Asia and the Pacific Regional Geodetic Project (APRGP) annually since 1997, which is one of PCGIAP's major activities to provide a reference frame for the region. GSI participates in VLBI observations and GPS campaign observations in the project.

GSI, cooperating with Kyoto University, has been conducting absolute gravity measurements in east Asia since 2003, in order to establish an absolute gravity network as a reference for gravity study in the region. The measurements were done in China, Malaysia, Indonesia and Philippines. The results will contribute to IAGBN.

### **7.2 Global Mapping Project**

Global Mapping Project is the international cooperation project of National Mapping Organizations (NMOs) and partners to develop a set of global geographic data with verified quality based on consistent specifications. The project has been steered and promoted through International Steering Committee for Global mapping (ISCGM) established in 1996. ISCGM Secretariat is situated at GSI. As of May 2006, 147 countries and 15 regions have participated in the project, and twenty-two countries' data have been already developed and are being public through the Internet from the ISCGM website (<http://www.iscgm.org>).

GSI is developing not only the Global Map Data of Japan but also the Global Map Data of developing countries mainly in Asia and the Pacific region in cooperation with respective NMOs. In 2003-2006, Global Map of the following countries have been developed with GSI assistance: Congo, Swaziland and Honduras in 2003; and Armenia, Azerbaijan, Bolivia, Oman and Tajikistan in 2005. GSI will continue to make efforts to implement Global Mapping Project as ISCGM Secretariat.

### **7.3 ISO/TC211 (Geographic information/Geomatics)**

GSI has actively participated in ISO/TC211 since the foundation in view of the importance of standardization of geographical information and has promoted to develop Japanese Standards for Geographic Information (JSGI) in accordance with ISO/TC211. The latest version of JSGI2.0 was published in March 2002. In addition, to promote use of standards, GSI developed the Japan Profile for Geographic Information Standards (JPGIS) in March 2005, as a practical profile of JSGI.

## **Hydrographic and Oceanographic Department (HOD) of MLIT**

### **1. Geodetic Work**

Fundamental geodetic works in Japan are principally executed by the Geographical Survey Institute (GSI) and the Hydrographic and Oceanographic Department (HOD).

#### **1.1 Satellite Positioning**

HOD has been carrying out EGS (Experimental Geodetic Satellite, nicknamed "AJISAI") observation since 1986. Observation of EGS are carried out also by JAXA and GSI.

In order to measure the precise position of the mainland and islands of Japan in the World Geodetic System, HOD has been conducting a 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. 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.

Both of these SLR observations are supported by the cooperative research provided by the U.S.A-Japan and other cooperation in the field of space development.

In order to watch the middle size crustal deformation (about 50km), 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, Koju Shima, Miyake Shima and Hachijo Shima.

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

#### **1.2 Astronomical Observation**

HOD is also carrying out the astronomical 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.

#### **1.3 Gravity Survey**

Gravity Surveys are executed on land by GSI and at sea by HOD.

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

#### **1.4 Geomagnetic Survey**

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.

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

### 1.5 Unmanned/manned Survey Launches

HOD has two unmanned/manned survey launches, “ JINBEI” and nicknamed “ MANBO ? ” , to investigate submarine volcanoes. “ JINBEI” was launched in 2002. “ MANBO ? ” 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 ? ” surveyed a submarine volcanoes Kita-Fukutoku-tai in 2003 for the volcanic eruptions prediction.

### 1.6 The Earthquake Prediction Program

HOD surveys for the earthquake prediction program. In order to obtain data and information necessary for the prediction of earthquakes, magnetic and gravity surveys were conducted in specific areas, like 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.

HOD has been carrying out seafloor geodetic observations using theGPS/Acoustic combination technique since 2000. 16 seafloor geodetic reference points have been deployed by 2005 mainly on the land-ward slope of the major trenches, such as Japan Trench and Nankai -Trough. The primary purpose is to detect and monitor the seafloor crustal movement affected by the subduction of oceanic plates. Observed results show the positioning precision of several centimeters. A time series of horizontal coordinates of a reference points off Miyagi prefecture has given an intraplate crustal velocity of about seven centimeters per year towards the WNW.

Furthermore, another reference point off Miyagi prefecture has detected a crustal movement of as large as 10 centimeters associated with the 2005 Off Miyagi Prefecture Earthquake (M7.2).

Table 6. Geodetic Work for the Period from 2003-2005

		2003	2004	2005	Total
Satellite Laser Ranging	Mainland	Since1982			1
GPS	Islands/land	12	12	12	36
Gravity Survey	Island/Harbors	1	1	0	2
	Sea	4	1	1	6
Geomagnetic Survey	Island	1	0	0	1
	Sea	3	1	1	5
Aeromagnetic Survey	Land/Sea	1,100	2,100	2,100	5,300km

\*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.

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

## 2. Hydrographic Work

### 2.1 Hydrographic Surveying and Charting

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

Table 7. Hydrographic Surveys 2003-2005

Type of survey	2003	2004	2005

Harbor	1	1	1
Updating	231	210	189
Coastal	9	9	7
Basic Maps of the Sea	0	0	0
Earthquake prediction	13	12	1

b) The results of these surveys were used for production of nautical and other charts, as shown in Table 8:

Table 8. Nautical and Other Charts 2003-2005

Type of chart		2003	2004	2005
New Charts	Nautical charts	15	36	18
	Miscellaneous charts	0	7	8
	Basic Maps of the Sea	0	0	0
	Aeronautical charts	0	0	0
New Editions	Nautical charts	100	97	113
	Miscellaneous charts	0	3	3
	Basic Maps of the Sea	1	0	0
	Aeronautical charts	4	6	2
Reprints	1	1	3	
Total	121	150	147	

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

Table 9. Classification of BMS

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 April 2006 is shown below:

Table 10. Number of Paper Charts Issued

Type of Chart	Number of Issues
Nautical charts	765
Miscellaneous charts	95
Basic Maps of The Sea	494
Aeronautical charts	25
Total	1,379

Note: The International Charts of the International Hydrographic Organization(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 11. Number of ENCs Issued as of April 2006

Type of Chart	Number of Issues
Electronic Navigational Charts	547 cell

Note: The kind of cell are 25 Degree,8 Degree,4 Degree,1 Degree,30 Second and 15 Secind.

## 2.2 Other Publication Activities

Table 12. Other Publications of 2003-2005

Type of publication			2003	2004	2005
New publications	Sailing	(Japanese)	1	1	1
	Directions	(English)	2	1	1
	Special publications		5	5	5
New Editions	Sailing	(Japanese)	5	5	5
	Directions	(English)	3	4	4
	Special publications		5	3	3

## 2.3 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) Airborne Laser Hydrography

HOD and 6th Regional Japan Coast Guard Headquarters (RJCGH) has been carrying out airborne laser hydrography operations since 2004 for the mapping of very shallow waters. In 2005, HOD and 6th RJCGH surveyed the Island Sea, Setonaikai.

### c) 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.

### d) Surveys for Earthquake Prediction Program

HOD surveys for the earthquake prediction program. In order to obtain data information necessary for the prediction of earthquake, HOD has been carrying out surveys and investigations for submarine topography and/or active sea-bottom structures at specific areas off Miyagi, near Nankai trough, Tokachi and off Shimane.

## 3. International Activities

### 3.1 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 (TSMAD)
- 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)
- r) East Asia Hydrographic Commission (EAHC)
- s) IHO Capacity Building Committee (CBC)

### **3.2 Intergovernmental Oceanographic Commission (IOC)**

HOD has also been working as a member of IOC which is the subsidiary body of UNESCO and has been participating in international joint projects are as follows:

- a) International Oceanographic Data and Information Exchange (IODE) National Coordinator
- b) International Bathymetric Chart of Western Pacific (IBCWP)
- c) North East Asian Regional GOOS (Global Ocean Observing System)/Co-ordinating Committee (NEAR-GOOS)
- d) IOC Sub-Commission for the Western Pacific Region (WESTPAC)

### **3.3 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.

## **Ministry of Land, Infrastructure and Transport (MLIT)**

### **1. National Land Survey**

The National Land Survey of Japan has been carried out under the direction and guidance of the Ministry of Land, Infrastructure and Transport (MLIT). 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. This 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. Three major items form the core of this survey; the land classification survey, the water use survey and the cadastral survey.

#### **1.1 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, MLIT 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, and 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.

## 1.2 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 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. The progress of this survey at the end of FY2005 is as follows:

Completed cadastral survey: 134,136 km<sup>2</sup> (1951-2005)

Progress ratio: 47% (Target acreage of the survey: 286,200 km<sup>2</sup>)

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, 1:500, 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.

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.

## Ministry of Agriculture, Forestry and Fisheries (MAFF)

### 1. Large Scale Topographic Maps

The Forestry Agency began promoting a similar project in mountainous areas as the National Large Scale Topographic Mapping Project by GSI, 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.

Currently Forestry Agency is promoting Forest GIS (Geographic Information System) and digital mapping work of Forest Planning Maps. Table 13 shows the basic forest mapping work during the same period.

Table 13. Basic Forest Mapping

Title	2003	2004	2005	2006
1:5,000 Photomaps	859km <sup>2</sup>	899km <sup>2</sup>	554km <sup>2</sup>	496km <sup>2</sup>
1:5,000 BFM Revision	2,428km <sup>2</sup>	2,172 km <sup>2</sup>	1,044 km <sup>2</sup>	777km <sup>2</sup>

### 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 productivity of cultivated lands has been prepared by the Agricultural Production Bureau since 1959, and the entire area of

cultivated land, 51,000 km<sup>2</sup> 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<sup>2</sup> were covered by this series. This agency has also prepared a 1:50,000 scale map series of soil types for many private forests.

## **Geological Survey of Japan / National Institute of Advanced Industrial Science and Technology (GSJ/AIST)**

### **1. Geodetic Work**

#### **1.1 Gravity Survey**

GSJ/AIST has conducted gravity surveys for the coverage of regions scarce of data, Chugoku and Shikoku districts, southwestern Japan, during the period from 2003 to 2006. The results are being published as "Gravity maps (Bouguer Anomalies) at 1:200,000 scale", and 23 maps of this series have been published by April 2006. A gravity-tectonic map of Fukui district was published using precise gravity survey data in 2006. GSJ/AIST also compiled "Gravity Map of Japan (Bouguer Anomalies)" using total of about 400,000 land data and about 1,000,000 marine data, and the digital data for the map was published in 2004 with CD-ROM, "Gravity CD-ROM of Japan, 2nd edition".

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 cruises until 2006 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 scale

#### **1.2 Geomagnetic Survey**

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. 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 or active fault system. High-resolution aeromagnetic maps of "Usu Volcano" (2003), "Kobe-Kyoto Area"(2004), and "Asama Volcano" (2005) are the recent publications in the aeromagnetic map series. The compilation of existing aeromagnetic survey data since 1968 was conducted to build an aeromagnetic database covering the Japanese islands and surrounding sea areas. A CD-ROM publication of "Aeromagnetic Database of Japan" (2005) was issued.

### **2. Geological Maps**

GSJ/AIST has published most of geologic maps which cover the Japanese islands on scales of 1:50,000, 1:200,000, 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 coverage over the land becomes 927 sheets published out of 1274 (72.8%) at scale of 1:50,000 and 106 sheets published out of 124 (85.5%) at scale of 1:200,000.

In addition, 15 thematic maps and 18 digital geoscience maps (CD-ROM) were also published in 2003-2005. Compiling these basic geologic maps and other geologic information, GSJ/AIST published smaller scale maps. The representative products are "Rupture probability map of major active faults in Japan" as Tectonic Map No.14 and "Interactive Geological Hazard Map of East and Southeast Asia, GeoHazardView version 2" as Digital Geoscience Map G-11.

### **3. 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. 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 (8 sheets) 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 (25 sheets of geological map and 21 sheets of sedimentological map) has been published around the main Japanese Islands. Since 2002, marine geological maps on the scale of 1: 200,000 (1 sheet of geological map and 1 sheet of sedimentological map) have been published as CD-ROM.