CARTOGRAPHY IN JAPAN
2015-2019

NATIONAL REPORT TO THE 17th GENERAL ASSEMBLY OF
THE INTERNATIONAL CARTOGRAPHIC ASSOCIATION

Tokyo 2019

NATIONAL COMMITTEE FOR CARTOGRAPHY, SCIENCE COUNCIL OF JAPAN

JAPAN CARTOGRAPHERS ASSOCIATION

CONTENTS

PREFACE *3*

I. ACTIVITIES OF THE NATIONAL COMMITTEE FOR CARTOGRAPHY AND RELATED ACADEMIC ASSOCIATIONS *4*

1. Activities of the National Committee for Cartography (NCC) 4
2. Activities of the Japan Cartographers Association 4
3. Certification of GIS engineer organized by the GIS Association of Japan (GISA) 6

II. ACTIVITIES OF NATIONAL MAPPING ORGANIZATIONS *7*

1. Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism (GSI/MLIT) 7
2. Hydrographic and Oceanographic Department, Japan Coast Guard, Ministry of Land, Infrastructure, Transport and Tourism 9
3. Ministry of Land, Infrastructure, Transport and Tourism (MLIT) 13
4. Ministry of Agriculture, Forestry and Fisheries (MAFF) 15
5. Geological Survey of Japan / National Institute of Advanced Industrial Science and Technology (GSJ/AIST) 16

III. ACTIVITIES OF LOCAL GOVERNMENT *19*

1. Mapping Activities 19
2. Open Innovation 20

IV. ACTIVITIES OF PUBLIC CORPORATIONS, FOUNDATIONS, MUSEUMS AND LIBRARIES *22*

1. Public Corporations and Foundations 22
2. Museums and Libraries 24

V. ACTIVITIES OF PRIVATE SECTOR *25*

1. Digital Services 25
2. Car Navigation and LBS 26
3. Trends in Map Publication 28

PREFACE

This is the National Report of Japan to the 17th General Assembly of ICA and the 29th International Cartographic Conference in Tokyo, Japan, 2019.

The purpose of this report is to introduce the cartographic activities that have taken place in Japan from 2015 to 2019. The contents describe the following:

1. Activities of the National Committee for Cartography and related academic associations
2. Activities of national mapping organizations
3. Activities of local government
4. Activities of public corporations, foundations, museums and libraries
5. Activities of the private sector

The cartographic works carried out in Japan over the past four years have been rather remarkable. Not only have various kinds of digital maps and GISs been published or built, but also mobile or ubiquitous map information systems including digital map signage installed on site have been developed. In the state-of-the-art technology, machine-readable digital maps are used for automatic driving, and in the event of a disaster, a drone is used to take a picture of the ground surface from the sky and immediately map it and use it in combination with various attributes.

We hope that the many cartographers among the ICA members will be able to better understand the cartographic activities in Japan through this report.

MORITA Takashi
Chairman, National Committee for Cartography, Science Council of Japan
President, Japan Cartographers Association

I. ACTIVITIES OF THE NATIONAL COMMITTEE FOR CARTOGRAPHY AND RELATED ACADEMIC ASSOCIATIONS

1. Activities of the National Committee for Cartography (NCC)

The National Committee for Cartography (NCC) is a branch of the Science Council of Japan (SCJ). The SCJ which is a governmental organization established in 1946 and reformed in 2006, directs Japanese academic research (http://www.scj.go.jp/en/index.html). The SCJ is therefore a member of the International Cartographic Association (ICA), and NCC is a national committee for the ICA.
The members of the NCC are nominated by the SCJ on the basis of co-optation by the members and associate members of the SCJ. The committee currently has nine members. The chairman for the current term is Prof. Takashi MORITA, whose term runs from 2017 to 2023.

1) Activities for the 16th General Assembly of the ICA, and the 27th International Cartographic Conference in Rio de Janeiro, Brazil, in 2015

A Japanese delegation of 13 members headed by Prof. Takashi MORITA attended the conference. Nine papers were presented and around 19 maps were shown at the International Map Exhibition. Six maps were exhibited at the Children's World Map Exhibition. Continuation of the Commission on Ubiquitous Mapping proposed by Japan was agreed by the general assembly, and Prof. Masatoshi ARIKAWA was nominated as the chairman of the commission. Japan presented the candidacy of host country for the 29th International Cartographic Conference in Tokyo and it was accepted by the vote against Florence (Italy) at the general assembly. A booth was served for promotion activities of Tokyo as proposed host country.

2) Activities for the 28th International Cartographic Conference in Washington D.C., U.S.A., 2017

A Japanese delegation of 26 members headed by Prof. Takashi MORITA attended the conference. Fourteen papers were presented. Fourteen maps were shown at the International Map Exhibition, and six maps were exhibited at the Children's World Map Exhibition. To make the ICC2019 in Tokyo known, a booth and a reception were served at the conference site by the Local Organizing Committee of the ICC2019Tokyo. At the closing ceremony, the ICA flag was handed over from LOC chair of Washington D.C.(U.S.A.) to Tokyo (Japan).

(MORITA Takashi)

2. Activities of the Japan Cartographers Association

The Japan Cartographers Association (JCA) is the only Japanese scientific association whose aims are for advancement of cartography in Japan. JCA is one of the cooperative academic societies of the Science Council of Japan (SCJ) and has close partnership with the National Committee for Cartography of the SCJ.

JCA was established in November 1962 at the time of the First International Cartographic Conference in 1962 in Frankfurt am Main. In 2013, JCA held a ceremony to celebrate the 50th anniversary. There are currently about 800 members and the secretariat's office is located in the Japan Map Center Building in Tokyo. The president is Emeritus Prof. Takashi MORITA of Hosei University.

The activity plan and budget of JCA are decided annually at the general assembly, which is usually held in late February. Actual actions are operated by the standing committee, which is consisting of 18 members and chaired by Prof. Katsuhiko URABE of Nihon University.

The regular activities of JCA are as follows:
(1) Annual Scientific Conference

A two- or three-day conference including a special lecture is held annually in summer or autumn in Tokyo and local city alternately, with about 200 attendees. The mean number of presentations in aural session, poster session and symposia of 2015-2019 conferences is about 40. Proceedings are distributed to participants of the conference. Maps, geographic information systems and cartographic materials are exhibited at the conference. Exhibitors are the Geospatial Information Authority of Japan (GSI), the Hydrographic and Oceanographic Department of the Japan Coast Guard and other government organizations as well as private sectors.

(2) Regional Conference and JCA Workshops

The regional conference is held once a year, usually in autumn, in a city excluding Tokyo. The number of attendees of a conference is 40-60. JCA Workshops, mostly a half-day program, are also held three to four times a year.

(3) Excursions

A one-day or two-day excursion is held in conjunction with the annual scientific conference and the regional conference. The workshops occasionally include an excursion or a technical tour.

(4) Commissions

JCA has eight commissions (see below), some of which correspond to ICA commissions. Each commission has its own activities directed by the leadership of chairperson. They sometimes plan symposia of the annual scientific conference or the regional conference, excursions and JCA workshops as well as the commission workshops.

- Commission on Archives and History of Cartography
- Commission on Cartographic Terminology
- Commission on Cartographic Education
- Commission on Marine Cartography
- Commission on Outreach activities of Cartography
- Commission on Ubiquitous Mapping
- Commission on School GIS Education
- Commission on Maps and Toponymy

(5) Publications

JCA publishes a quarterly journal “Chizu -- Kukan Hyogen no Kagaku (Map, Sciences of Spatial Representation)”. It is composed of scientific papers, various reports, book reviews and news. Each issue has a paper map (occasionally a CD) as an appendage. Since the appendages are selected from unique and not-easy-to-get materials, JCA members get many interesting maps in this way.

(6) Website and Mailing List

JCA makes its activities public through website (http://jcacj.org). JCA also operates a mailing list, which is useful for exchange of information.

(7) Collection of Maps and Relating Materials

Maps and various materials relating to maps are collected principally by way of donation or exchange including those from foreign institutions.

(8) Commendation

JCA made a regulation of commendation 'JCA Award' in 2006. Since then JCA members whose scientific papers in Chizu are excellent, a map-publishing company, a high school teacher, and JCA members who contributed specifically to the promotion of JCA are awarded every year.

(9) Cooperation with Other Scientific Organizations

JCA is a member of the Japan Geoscience Union (URL: http://www.jpgu.org/) which is composed of 51 scientific societies in Japan covering geophysics, geology, geography and relating sciences. JCA conducts “GIS and Cartography” session as one of the regular sessions of the annual meeting of the Japan Geoscience Union. JCA also a member of both the Japanese Geographical Union (URL: http://www.ajg.or.jp/JOGS/) and the Committee on the Cooperation of Societies of Human and Economic Geography and Geography Education (URL: http://hgsj.org/renkei/kyougikai/). JCA takes actions for the promotion of cartography and its education through these unions. JCA supports many events of map exhibition, map contest, workshop, training course, etc. organized by GSI, Japan Map Center, scientific societies, local organizations, etc.

(WAKABAYASHI Yoshiki)

3. Certification of GIS engineer organized by the GIS Association of Japan (GISA)

GIS Association of Japan (GISA) established GIS Certification Association (GISCA) under the corporation of related academic societies including JCA in October 2006. The roles of GISCA are the certification of "GIS Expert" and "GIS Expert Emeritus" to the professional individuals and the certification of GIS education to the academic and social education organizations. More than about 400 people were certified as GIS Expert since the certification has started. GISCA draws upon the method of GISCI in US and modifies it for Japan to evaluate GIS professionals. The title "GIS Expert Emeritus" is presented to the people who have been taking leadership to the field of GIS more than 25 years, if the certification committee decides the certification by the nomination from GIS related organizations. 9 people shown under have been celebrated since 2015.

2017
Keiji Yano (Professor, Ritsumeikan University)
Akira Hoyano (Professor Emeritus, Tokyo Institute of Technology)
Atsushi Suzuki (Professor, Rissho University)
Shinichi Kikuchi (Technical Advisor, Japan Hydrographic Association)

2019
Yoshiki Wakabayashi (Professor, Tokyo Metropolitan University)
Yota Kumaki (Professor, Senshu University)
Venkatesh RAGHAVAN (Professor, Osaka City University)
Yoichi Kayama (Principal Researcher, Aero Asahi Corporation)
Hidenori Tamagawa (Professor, Tokyo Metropolitan University)

GISCA also certifies GIS educations provided by academic and industrial organizations. (http://www.gisa japan.org/eng/index.html)

(NAKAJIMA Madoka)

II. ACTIVITIES OF NATIONAL MAPPING ORGANIZATIONS

In the Japanese government, several organizations are responsible for fundamental surveying, mapping and charting projects. Basic geodetic surveys are carried out mainly by the Geospatial Information Authority of Japan (GSI) and the Hydrographic and Oceanographic Department (JHOD), and various cartographic works are conducted by the GSI, the JHOD, the Forestry Agency, the Geological Survey of Japan of the National Institute of Advanced Industrial Science and Technology (GSJ, AIST), and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and other organizations.

1. Geospatial Information Authority of Japan, Ministry of Land, Infrastructure, Transport and Tourism (GSI/MLIT)

GSI conducts national surveying and mapping activities, which provide a basis for the land management.
In the year 2019, GSI celebrates the 150th anniversary of the founding of the government office that handled cartographic affairs, as the originator of modern survey and mapping in Japan. Historically it dates back to 1869 when Cadastral Registration Map Section was established in the Ministry of Civil Service. Later in 1888 it was reorganized as Japanese Imperial Land Survey, and finally in 1945 it became the Geographical Survey Institute, "GSI". In 2010, the official English appellation was changed to "Geospatial Information Authority of Japan".
Role of GSI is to advance utilization of geospatial information through policies related to land surveying and mapping, and to contribute to the improvement of people's lives and the sound development of the national economy. In order to fulfill this role, GSI emphasizes the following four initiatives.

1: "Survey" - Determining the Position of Japan -
Based on the accurate position obtained from VLBI*, with 1,300 GNSS** CORSs***, GSI provides the Japanese Geodetic Datum and accurate reference positions. People can know the precise positions anywhere in Japan.

* Very Long Baseline Interferometry
** Global Navigation Satellite Systems
*** Continuously Operating Reference Stations

2: "Portray" - Mapping Japan –
GSI develops a base map for all maps. GSI provides both Basic Maps and Thematic Maps as digital form as well as on paper.

3: "Safeguard" - Preparing to Fulfill the Mission at the Time of Disaster -
GSI promotes disaster response-related measures employing the latest geospatial technology to protect national land and people's lives and assets.
GSI acquires geospatial information necessary for grasping the disaster situation by emergently taking aerial photographs and conducting surveys and then promptly disseminating the information.

4: "Transmit" - Clearly Explaining National Land Characteristics to all Residents -
GSI provides "Geographic Information for Disaster" that is consisted in "Topographic Feature Information" and "Disaster History Information" and is useful for "preparing" disaster prevention and mitigation. As a new attempt, GSI is preparing to display the map symbol of "Monuments for natural disaster memorial" on topographic maps (see Fig. 1).
GSI also transmits the exact figure of Japan through Web map "GSI Maps" (see Fig. 2), and supports Geography education and Disaster Prevention education.

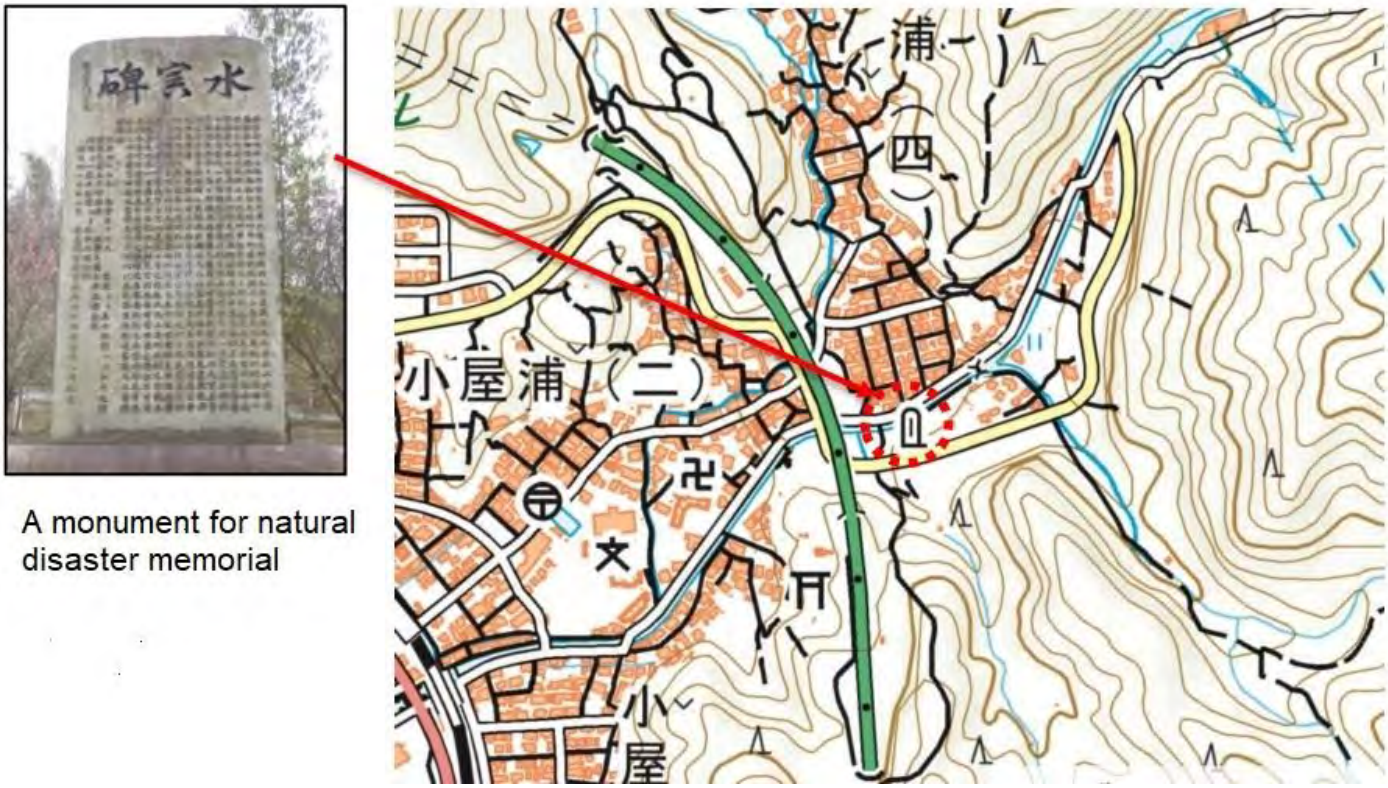


Fig. 1 The latest attempt by GSI to display a new map symbol of "Monuments for natural disaster memorial" on topographic maps

Fig. 2 GSI's web map, "GSI Maps"; the experimental release of Japan map in English notation

Visit GSI's website as below;
https://maps.gsi.go.jp/multil/index.html
http://www.gsi.go.jp/kokusaikoryu/kokusaikoryu-e31025.html

GSI official website: http://www.gsi.go.jp/ENGLISH/index.html
Several sample products of GSI: http://www.gsi.go.jp/ENGLISH/page_e30034.html

(SATO Jun)

2. Hydrographic and Oceanographic Department, Japan Coast Guard, Ministry of Land, Infrastructure, Transport and Tourism

(1) Publication of nautical charts and other charts

Revisions and corrections of nautical charts are based on the results of hydrographic surveys. The publication from 2015 to 2018 is as follows (Table 1).

1) Nautical chart
Middle and larger scale charts are published, mainly for ships under international trades to access to harbors.
2) Electronic navigational chart (ENC)
To cater for the phased mandatory carriage requirement of ECDIS to the ships under international navigation in and after 2012, the existing ENCs has been supplemented with the data that improves convenience and reliability. Electronic Notices to Mariners are edited to update such ENCs.

3) Aeronautical chart
1/1,000,000 series of international aeronautical charts and 1/1,000,000 series of aeronautical route charts are published according to the standard of International Civil Aviation Organization.

4) Basic map of the sea (BMS)
In addition to the production of nautical charts, which is the principal function of HOD, the Basic Maps of the Sea series has also been produced and published since 1976 to provide fundamental data necessary for various maritime activities, including sea bottom and ocean development. The BMS series has been produced as shown in Table 2.

Table 1 Number of Nautical Charts and Other Charts

Type of Chart	Type of Publication	2015	2016	2017	2018
Nautical Chart	New Chart	4	1	2	4
	New Edition	61	54	63	75
Electronic Navigational Chart	New Chart	9	7	5	8
	New Edition	395	318	546	390
Aeronautical Chart	New Chart	0	0	0	0
	New Edition	1	1	1	1
Basic Map of the Sea	New Chart	0	1	3	1
	New Edition	1	0	1	1
Miscellaneous Chart	New Chart	2	1	0	0
	New Edition	15	0	0	1

Table 2 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	1:200,000 1:500,000 1:1,000,000	Continental Margin	Full	Bathymetry; Submarine Structure; Geomagnetic Anomaly; Gravity Anomaly
BMS in Ocean Areas	1:3,000,000	Ocean Area	Full	Bathymetry; Geomagnetic Anomaly; Gravity Anomaly

5) Miscellaneous chart
Miscellaneous charts include Mariners' Routeing Guide*), Charts Showing the Position of Set Net Fisheries, Magnetic Charts, Gnomic Charts for Facilitating Great Circle Sailing, Pilot Charts, Current Charts, Tidal Current Charts, Position Plotting Sheets, and others.

*): Traffic rules based on Maritime Traffic Safety Law etc. are provided to prevent shipwreck, and the understanding promotion of these rules is important in the congested waters. Therefore, a new kind of charts "Mariners' Routeing Guide", in which the traffic rules and notes needed in the navigation planning were plainly written in English, were

issued. The first one was published for Ise-Wan on March 2015 and followed by two for Tokyo-Wan and Seto-Naikai. New editions of Mariners' Routeing Guide for Tokyo-Wan published twice until March 2019 because of the revisions of Maritime Traffic Safety Law.
The number of charts issued as of April 2019 is shown below (Table 3):

Table 3 Number of Charts Issued

Type of Chart	Number of Issued
Nautical Chart	781
Electronic Navigational Chart	789
Aeronautical Chart	16
Basic Map of the Sea	464
Miscellaneous Chart	90
Total	2,140

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

(2) Hydrographic surveys

Hydrographic surveys by JHOD from 2015 to 2018 for chart publication are as follows (Table 4).

Table 4 Number of Hydrographic Surveys

Type of Survey	FY2015	FY2016	FY2017	FY2018
Coastal Survey	3	8	5	7
Harbour Survey	1	0	1	2
Correction Survey	46	55	43	32

1) Coastal survey
Coastal surveys aim to obtain data for new publication or new edition of coastal charts.
2) Harbour survey
Harbour surveys aim to research progress of harbour improvement and to obtain data for new publication or new edition of harbour charts.
3) Correction survey
Correction surveys aim to obtain data for chart updates such as local depths, low tidal lines or cancellation of report soundings.

(3) Others

1) Eruption of Nishi-no-Shima Island
Nishi-no-Shima is one of the volcanoes of Izu Mariana Arc. Since volcanic eruptions started near the old island in November 2013, lava flows formed and expanded the new island largely swallowing the old island. Although JHOD published the new edition of the chart “Nishi-no-Shima” in June 2017 based on the result of the hydrographic survey until January 2017, the new eruptions since April 2017 enlarged the new island further. JHOD surveyed by airborne-laser in July 2018 and published the newest chart in May 2019. The chart contributes to safety of navigation and low-water lines, which are boundaries of the land and the surface of the water at the time of the lowest tide, in the chart are defined as baselines of the national jurisdiction.

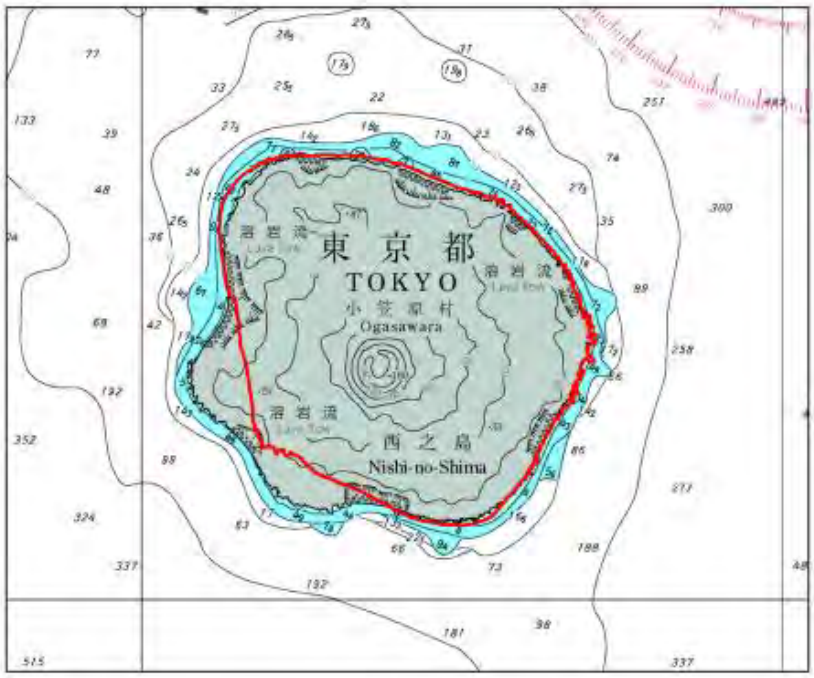


Fig. 3 Image around the Island in the Chart "Nishi-no-Shima" published in May 2019.
The red line is the coastline of the island in the previous version of the chart published in June 2017.

2) MDA Situational Indication Linkages (MSIL)
JHOD has been operating a new Web-GIS service "MDA Situational Indication Linkages (MSIL)" since April 2019. MSIL collects global information from all over the world and real-time information such as sea surface temperature, ocean currents and weather information. It enables users to choose from various kinds of marine-related information possessed by the Government and government-affiliated organization based on their purpose and overlay the information on maps. This service is expected to be utilized for ship operation, fisheries, disaster prevention, and ocean development. Users can make their own original maps with the combination of various marine-related information.
URL = https://www.msil.go.jp/

3) Achieved 40,000 Satellite laser ranging observations
The Shimosato Hydrographic Observatory, central Japan, has been carrying out "Satellite Laser Ranging observation" since 1982 to determine the position of the mainland reference point which is the reference of the positional information for nautical charts. Through the observation, JHOD decided the transformation parameters from the local reference used from Meiji period (Tokyo Datum) to the global reference using GPS (the World Geodetic System). Additionally, JHOD grasped the displacement of intercontinental plates, as well as conducted precise position measurement of the positions of isolated islands. From these results, JHOD has published the nautical charts based on the World Geodetic System, which contributes to safe navigation of ships sailing around Japan. On October 31, 2017, the day of the 35th anniversary, this observatory achieved the 40,000th successful observation.

Fig. 4 Laser observation being performed

(KAJIMURA Toru)

3. Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

(1) National Land Survey Service

The National Land Survey in Japan has been implemented by the national and local governments. The objective of the survey is to contribute to developing and conserving the national land, and to advancing its use. Also, the survey on the actual condition of the national land is conducted scientifically and comprehensively in order to clarify the cadastral data. The survey has been implemented from 1953 based on the National Land Survey Act (1951) and the Act on Special Measures for Promotion of the National Land Survey (1962). Initially, the main purpose of the survey was increase in food production but it has been varied across the ages, such as access to industrial water and daily life water, environment preservation, and safety and security of people's life.

The National Land Survey consists of three key surveys; the Land Classification Survey, the Water Use Survey and the Cadastral Survey. The national government implements basic surveys for each survey conducted by the local governments with an aim to facilitate them. The survey is characterized by making results into basic maps, explanations and ledgers.

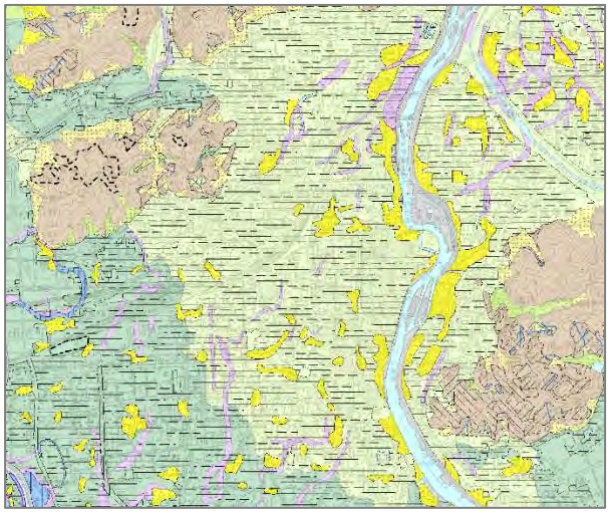
1) Land classification Survey and Water Use Survey

A land classification survey is the survey of the status of utilization of the land, soil texture, physical and chemical properties of soil texture, the status of erosion and other natural factors, and the productivity for the purpose of classifying the land by the possibility of its use. In recent years the land history survey consists of landform

classification, land use history classification and disaster record survey, which illustrates the records of past disasters and potential risk, is promoted intensively in order for disaster prevention.

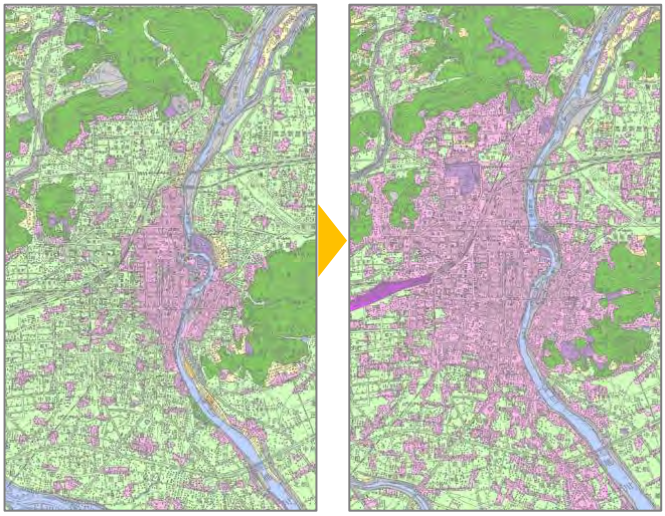
Landform and Land use history classification map (1/25,000 to 1/50,000)

Artificial and natural landform classification map



Survey of artificially changed (e.g. landfill, cut) and original landforms (e.g. original river channels, before the change), comparing past and current topographic map data, etc.

Land use history classification map (100/50 years ago)

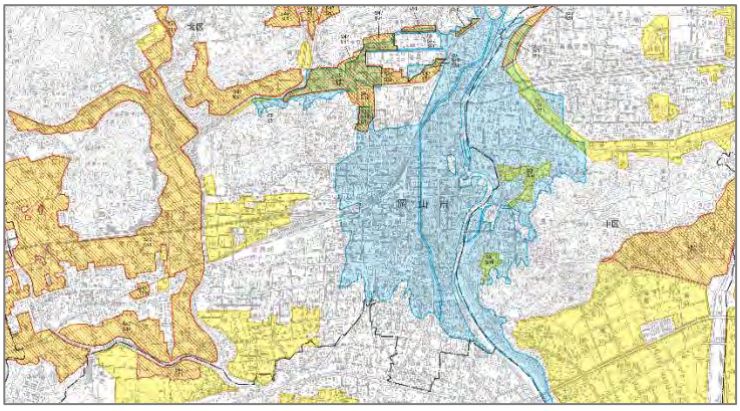


Survey of land use status, generally looking at 2 times, about 100 years ago and 50 years ago, using past topographic map data, etc.

Fig. 5 Landform and land use history classification map

Disaster record map
（1/50,000）

Disaster record information held by the government agencies is widely aggregated and put together on disaster record map.
The whereabouts of disaster chronology and disaster information are also researched.



Distribution of flood damage, seismic damage and sediment damage, etc.

Fig. 6 Disaster record map

A water use survey is the survey of meteorological phenomenon, flow volume of the land water, water quality, the status of running sand, quantity of water intake, capacity of pump, drainage volume and custom of water use for the purpose of contributing to water control and water utilization. Regarding the surface water, the surveys on the

major water systems are almost completed, the surveys on deep well in terms of groundwater that is difficult to be visualized and its mapping are now studied.
The above mention surveys are compiled into the following products (maps and books):

a) Land classification survey (Landform classification map, Surface geology map, Soil map, Present land use map, Nature environment condition map, Disaster record map, Land use trend map, Explanatory book and Survey book)
b) Water use survey (Present water use map, (First-class water system and Second-class water system), Major water system survey report, Prefectural water survey report, National groundwater information ledger, Groundwater map, Groundwater information map and Description)

2) Cadastral Survey

The Cadastral Survey in Japan aims to clarify location, boundary, owner, lot number, lot area and land use of each parcel. The Cadastral Survey is mainly implemented by local municipalities.
In order to facilitate the Cadastral Survey operated by local municipality, MLIT provides a subsidy for the operational cost, based on the ten-year period National Survey Plan. MLIT also gives standard operating regulations and guidelines to local municipalities and others concerned.
In general, the Cadastral Survey contains the following key operations: drawing up operational planning, detailed survey on the spot, measuring areas of each parcel, making cadastral maps and compiling cadastral information. In addition, control point survey (making up forth-order triangulation) for smooth implementation of the Cadastral Survey are carried out by GSI prior to operations of the Cadastral Survey, if it is necessary.
At the stage of the detailed survey on the spot, all the boundaries are basically confirmed by landowners in attendance. After that, boundary signs are set on the each point of the boundary corners and the coordinates of each point are measured. Then, area of each parcel is calculated from the each corner point. The scale of cadastral maps and its required accuracy of measurements are decided according to type of survey areas. For instance, the scale of 1:250 and 1:500 are usually applied in urban areas.
The results of the Cadastral Survey will be sent to registry office of the Ministry of Justice, then registry office modifies registration information by the results.
The progress of the cadastral surveys at the end of FY2017 is 52%. (Subject area: 286,200 km^2, Completed area: 148,597 km^2)

4. Ministry of Agriculture, Forestry and Fisheries (MAFF)

(1) Large Scale Topographic Maps

The Forestry Agency began a nationwide project in mountainous areas for the purpose of elaborating Basic Forest Maps (BFMs) as the basis for forest planning in accordance with the Forest Act in 1939. The project covering mountainous areas was completed in 1980. Currently the Forestry Agency and the Prefectural Governments are carrying out revision work of the existing Basic Forest Maps.
Forest Planning Maps, with forest inventory information attached on BFMs, are updated almost every five years. The Forestry Agency is responsible for Forest GIS of national forest, in which digitized Forest Planning Maps are incorporated, and respective local governments are responsible for the ones of private forest. Both Forest GIS provide a tool for forest owners to make a better forest management plan.

(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^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. Most of national forests have been covered by this series. A 1:50,000 scale map series of soil types for many private forests has been elaborated as well.

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

(1) Introduction

The Geological Survey of Japan (GSJ) conducts geological surveys on land and sea as a part of development of intellectual infrastructure and promotes continuous and systematic improvement of various geoinformation. GSJ has been publishing many kinds of geological maps of Japan. Based on these results, GSJ carries out scientific researches for realizing safe and sustainable society: studies concerning natural hazards to the land and people such as earthquakes and volcanic eruptions, geological disposal of radioactive wastes, environmental preservation and stable supply of energy and mineral resources.

GSJ also promotes international scientific cooperation including geological surveys with overseas geological surveys and geoscience research institutions. In cooperation with NASA and USGS, ASTER satellite imageries are archived and used in GSJ's researches and surveys for volcanic activities, urban mapping, vegetation change, and so on.

(2) Geological maps

1) Basic geological map series

Series of basic geological maps are prepared on the scale of 1:50,000 (1:75,000 before 1952) and 1:200,000. The 1:50,000 scale geological maps are drawn based on detailed field surveys and the latest research techniques. The 1:200,000 scale geological maps are compiled from the published geological maps with additional supplementary geological surveys. The 1:200,000 geological map series completed in 2010, covering the whole country.

Nationwide geological maps were published only in small-scale such as 1:1,000,000 or 1:2,000,000 until the end of the last century. The first version of the 1:200,000 scale seamless digital geological map of Japan was completed and released on the website in 2005. The second version (V2) was completed and released on the website in 2017. It provides much more detailed information (more than 2,400 geologic units) than the previous one (386 geological units).

GSJ has also been engaged in marine geological and geophysical surveys around Japan. The results have been published as the "Marine Geological Map" series since 1975, which include geological maps and sedimentological maps.

Aiming to mitigate geological disasters in coastal urban areas, surveys have been carried out in an integrated way, covering the sea, coastal, and land areas since 2008. These outcomes are compiled as seamless land and sea geological maps. Analyzing a vast number of borehole logs in the Tokyo metropolitan area, the subsurface 3D geological maps have been compiled and published on the website since 2018.

2) Geophysical map series

GSJ has been conducting gravity and high-resolution aeromagnetic surveys onshore and offshore all over Japan. The

results have been published as the “Gravity Map” series and “Aeromagnetic Map” series since 1972. The offshore gravity data have been published in the appendices of the “Marine Geology Map” series. Recently, high-resolution aeromagnetic surveys are mainly undertaken to elucidate the activities of onshore volcanoes or fault systems.

3) Geological map of volcanoes

To improve the accuracy in predicting volcanic eruptions, GSJ conducts researches on active volcanoes in Japan. The research outcomes are published as the Geological Maps of Volcanoes.

4) Other map series

Other thematic geological map series and digital geoscience maps (CD-ROM) are published by GSJ. Several of them have come to an end of new publication, but they have been turned to web services such as databases and on-demand viewing systems.

(3) Providing geological data on the Web

1) Data policy and license

GSJ adopted the Government of Japan Standard Terms of Use (version 2.0; CC BY 4.0 compatible) in October 2016 following the Government's open data policy. GSJ uses the Government of Japan Standard Terms of Use or the Creative Commons Attribution-No Derivatives 2.1 Japan License (CC BY-ND 2.1 JP) as our terms of use for geological information. The CC BY-ND license prohibits derivative works to the original. However, GSJ allows users to make minor changes without submitting application for permission in two cases stated below.

- Changing format (including translation) and extracting parts for use
- In a case that parts of derivative works are clearly separated from the original

Generally, the geological information on the GSJ’s website can be used by indicating the credit of GSJ, without obtaining the permission beforehand.

2) Data services

Most of the published (paper) geological maps have been openly available as raster data on the GSJ’s website. GeomapNavi, a viewer application, provides users with easy handling of the maps: zooming in, zooming out, overlaying, changing the transparency, etc. It assists them in searching literature about geology and earth science around the shown location. Moreover, users can overlay data provided by other institutes, for example, the Landslide Distribution Maps by the National Research Institute for Earth Science and Disaster Resilience (NIED) and the Historical Agro-Environment Web Map Service by the National Agriculture and Food Research Organization (NARO), and examine how such data relate with geology.

The 1:200,000 scale seamless digital geological map of Japan V2 has its own viewer application which enables smooth and speedy browsing in 2D or 3D.

The OGC (Open Geospatial Consortium) web map services are available from the GSJ website in WMS (Web Map Service) or WMTS (Web Map Tile Service) in every service such as nation-wide geological maps, Bouguer gravity anomaly maps, geochemical maps, and a geological map of East and Southeast Asia.

Map data download services have been arranged for the quadrangle series of the 1:50,000 scale geological maps with all the published areas as raster data (GeoTIFF and jpeg). Vector data processing of 1:50,000 scale geological maps is ongoing, and download service of vector data (shape file and kml) is presently available for several areas.

GSJ provides a 1:1,000,000 scale geological map of Japan and a geological map in East and Southeast Asia to the activity of worldwide geological map project "OneGeology".

Since April 2016, GSJ has provided processed ASTER data as a value-added product “ASTER-VA”. All the ASTER-

VA data can be downloaded from the GSJ's website https://gbank.gsj.jp/madas/ with free of charge.

3) Databases

In addition to the geological maps, various types of geological data are available online, for example, information about active faults, volcanoes, tsunami deposits, submarine seismic profiles, physical properties of rock samples, etc.

4) Other activities

GSJ has exchanged publications and journals including geospatial information with other geological survey organizations abroad, and provided them as useful reference materials to researchers, stakeholders and the public. Metadata of these literatures are available from the database of GEOLIS (Geological Literature Search System).

GSJ maintains the standards for geological map codes defined by the Japan Industrial Standard (JIS) and is responsible to renew the term of validity.

Geological information, unlike other geospatial information, is fairly difficult for those who are not familiar with geology to understand, due to the age data and technical terms to describe complicated characteristics of the earth. GSJ has published an online visual dictionary for such users, where many technical terms are explained with photos and/or illustrations.

URL: GSJ official website: https://www.gsj.jp/en/

Contact e-mail address: intl@gsj.jp

(SATO Jun)

III. ACTIVITIES OF LOCAL GOVERNMENT

1. Mapping Activities

Mapping using a drone is progressing. "The public survey manual using UAV" was released in 2016.Although the local government is producing various maps, improvement and the increase in efficiency of productivity are following it by ICT(s), such as a drone and a laser scanner.
"DRONEBIRD" is a project that surveys a disaster situation and supports mapping, the local government that concludes a disaster prevention agreement is increasing (see Fig. 7).

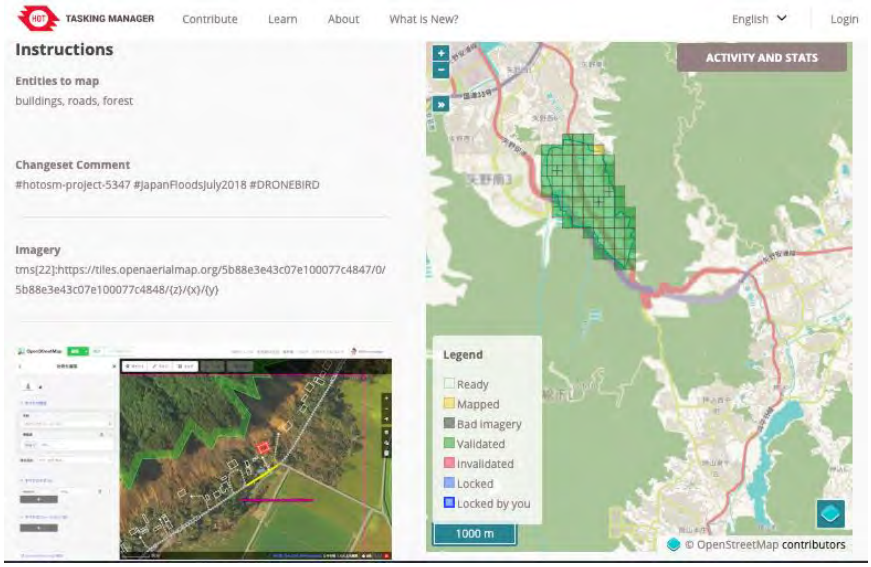


Fig. 7 Activity of DRONEBIRD

Creation of the autonomous hazard map is also progressing. The local government that is producing the hazard maps became about 77%.
In the "Kumamoto earthquake" in 2016, in addition to the hazard maps, the NIED (National Research Institute for Earth Science and Disaster Resilience) cooperated with the Geospatial Information Authority of Japan, local governments, and private companies, and released the map on the Web (see Fig. 8).

Fig. 8 Disaster support with a web map

Reference URL
DRONEBIRD: http://dronebird.org/
NIED CRS: http://crs.bosai.go.jp/

2. Open Innovation

Activity of an open innovation is continued still today.
Especially, the activity called a living lab prospers and it is getting the fruit in Yokohama and Kamakura.
The "Hiranuma living lab" held "Gulliver Map". It throws the charm and the subject of the Hiranuma area into relief by sticking the huge map in the Yokohama Hiranuma area on the floor whole surface, and writing in the information on the map (see Fig. 9).

Fig. 9 Gulliver Map

On the other hand, preparation of open data is also progressing. Open data is released in all the ordinance-designated cities now in March 2019, and the measure rate of the whole local government has become about 26%.
New map service is also produced from open data having many in which a map and geographic information are contained.

・WheeLog!: An app that uses GNSS and shares the way wheelchairs can pass.

・RESAS(Regional Economy and Society Analyzing System): A system that visualizes industrial structure, demographics and human behavior using open data(see Fig.10).

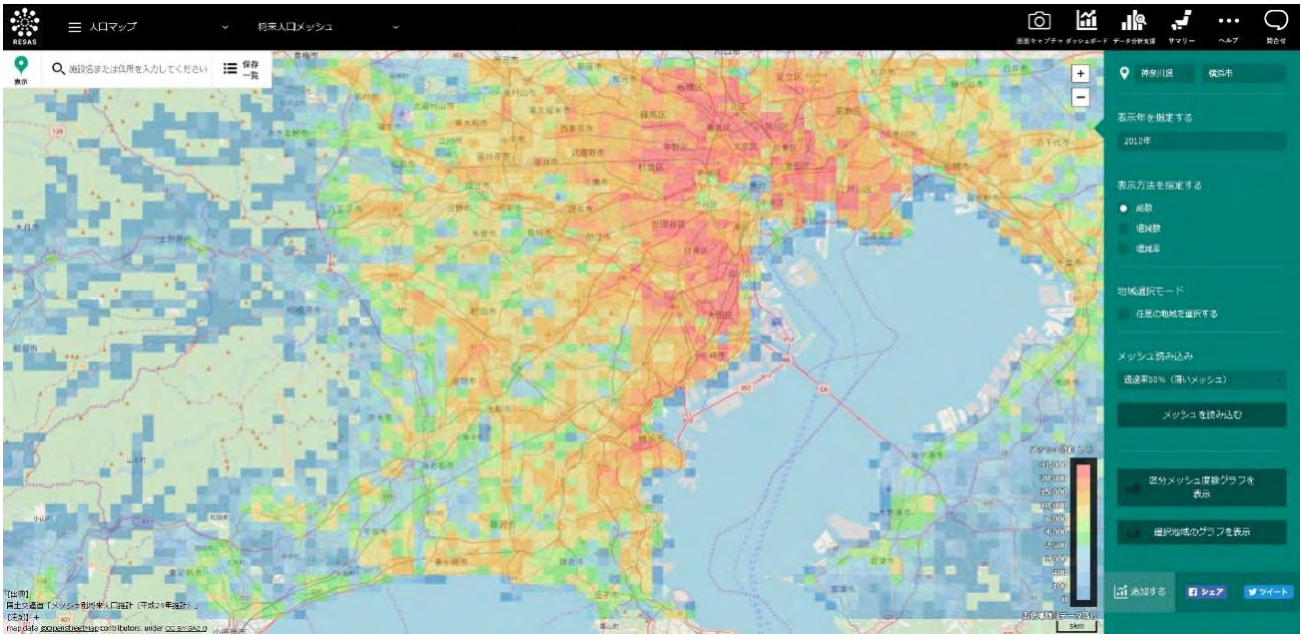


Fig. 10 RESAS

Reference URL:
Gulliver Map, http://beyondarchitecture.jp/magazine/urban-science/testdemo01/
WheeLog !, https://www.wheelog.com/hp/
RESAS, https://resas.go.jp/#/13/13101

(NAKAJIMA Madoka)

IV. ACTIVITIES OF PUBLIC CORPORATIONS, FOUNDATIONS, MUSEUMS AND LIBRARIES

1. Public Corporations and Foundations

(1) Japan Map Center (JMC)* *: Special Member of the Japan Cartographers Association

Main responsibilities of JMC are to distribute Japanese official maps and geo-spatial information produced by the Geospatial Information Authority of Japan (GSI), to provide information service and books on geo-spatial data, to hold and promote exhibition and training programs, and to conduct research and development on cartography and GIS. JMC and Japan Geographic Data Center jointly hold Proficiency Test on Cartography and Geography.

Fig.11 "Jiso-Chizu" the multi-layered map information, product from JMC.
http://www.jmc.or.jp/app/iphone/tokyo/

(2) Japan Hydrographic Association (JHA)*

JHA supplies services such as reproduction and distribution of the Japanese official nautical charts, aeronautical charts, electronic navigational charts and other hydrographic publications issued by the Hydrographic and Oceanographic Department of Japan Coast Guard (JHOD/JCG). It also promotes marine information services and conducts research and development on oceanography.

(3) Map Association*

The members of Map Association are wholesalers and retailers of the Japanese official maps that are produced by the Geospatial Information Authority of Japan. Cooperating with the Japan Map Center, it plays an important role in smooth and rapid distribution of the maps as well as promoting better utilization of maps.

(4) Mapping Technology Association*

Mapping Technology Association was established by mapping companies for the purpose of promoting sound development of mapping industry. It runs a web museum, "Mapping Museum", which displays the maps collected by the member companies.

(5) Japan Digital Road Map Association (DRM)*

DRM produces and provides digital road map database for administrative use and for car navigation. Digital road map database is vital for the basis for intelligent transport systems (ITS) as well as various systems for road management.

(6) Japan Association of Surveyors (JAS)*

JAS is an organization for survey technicians active in the Government, Academia and Industrial Corporations. The main purposes are contribution to, dissemination and advancement of surveying technology. It holds an annual exhibition on Geo-spatial Information.

(7) Association of Precise Survey and Applied Technologies (APA)*

APA carries out research and experiment of advanced survey and mapping technology, commits to deliberation for international standardization of digital geographic information, and examination of survey results. It is also entrusted with technical development projects from national organization in the field of survey and mapping.

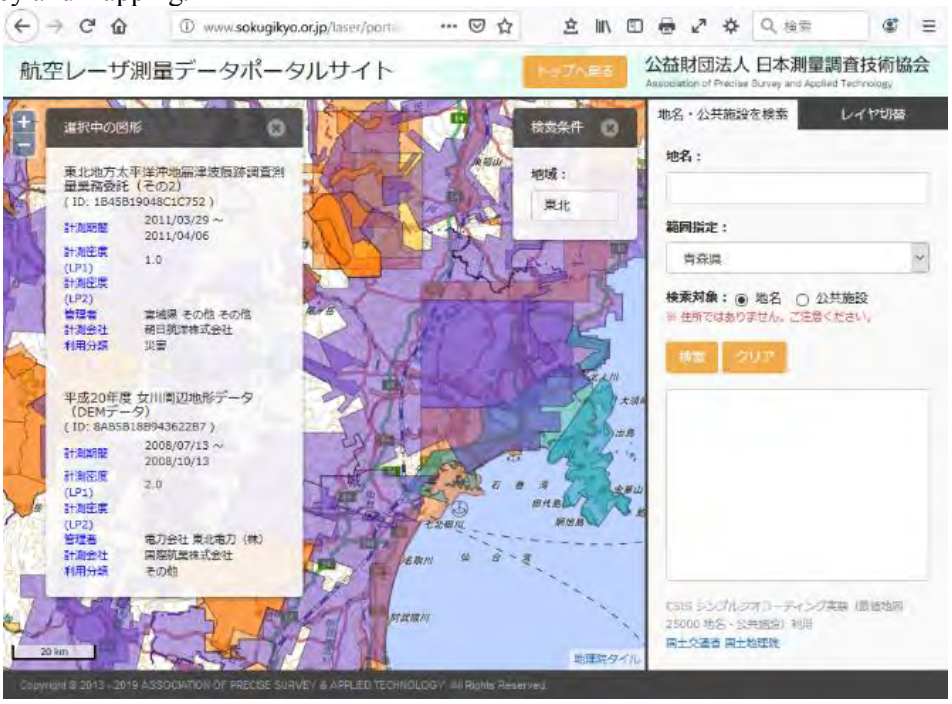


Fig.12 LiDAR data archives, provided by APA.
http://www.sokugikyo.or.jp/laser/

(8) Japan Geographic Data Center*

Japan Geographic Data Center collects information about geographic names and population data around Japan and provides them in the form of database and booklets. It also holds Proficiency Test on Cartography and Geography with Japan Map Center.

(9) Japan Construction Information Center (JACIC)

JACIC carries out surveys and research on information systems, including GIS, in the construction field and provides construction information service.

(10) Infrastructure Development Institute -Japan (IDI)

IDI promotes international assistance in the infrastructure development of developing countries including geospatial information development, which are essential to the nations' economic development as well as to the safety and comfort of their citizens.

(TSUZAWA Masaharu)

2. Museums and Libraries

(1) GSI / Science Museum of Map and Survey

Science Museum of Map and Survey was established in 1996. It is the adjunct facilities of the Geospatial Information Authority of Japan. It has three main facilities; Exhibition Hall, Information Service hall, and Earth Plaza. The Exhibition Hall consists of exhibition rooms, map gallery and orientation room. The Information Service Hall offers perusal and delivery service of the survey results and documents produced by the GSI. At Earth Plaza, a spherical model of the Japanese archipelago is on display to give visitors an idea of the roundness of the Earth. A retired survey aircraft is also displayed.

(2) Gifu Prefectural Library / World Distribution Map Center

The library collects, exhibits and provides the maps, distribution maps in particular, that were collected from all over the world. A special exhibitions and lectures for school children are carried out periodically.

(3) ZENRIN Map Gallery

ZENRIN Map Gallery is operated by ZENRIN co., Ltd., a leading mapping company in Japan. Its collections include antique maps collected from across the world and historic schoolbook atlas.

(4) Museum of Yokohama Urban History

Museum of Yokohama Urban History exhibits antique maps and documents to show the development and expansion of Yokohama-city.

(5) Yamanote Museum

Yamanote Museum exhibits mineral of Hokkaido and the world. On the wall, in addition to the world geological maps, the reprint of "Ino map" are on display. There is also a corner to showcase the legacy of surveying equipment.

(6) National Diet Library

Various original maps and reproductions of old maps are stored.

(7) Rissho University Library Keiji Tanaka Library

There is a collection donated by Prof. Keiji Tanaka, who is a geography master. A collection of about 14,000 valuable items, such as Japanese-style books from the Edo period, pre-war geography-related books, old maps, and drawings, are stored.

(ENDO Hiroyuki)

V. ACTIVITIES OF PRIVATE SECTOR

1. Digital Services

Before the 2020 Olympics, surveys, construction, and tourism have been a vibrant year.
There are many kinds of companies contributing in the fields of GIS and Mapping services in Japan.
A large part of building GIS data and Mapping services are done as the trustee business from national or the local government as a part of the infrastructure maintenance of the country. Main players of GIS and Mapping services in Japan are, a surveying company, a map preparation company, and a map publishing company.
The maintask of surveying company is the engineering survey, geographic data entry and maintenance, and cadastral survey under public organizations. Moreover, quite a few private companies have capability to consult, design and construct GIS for their clients such as national and local governments. Biggest companies such as Kokusai and Pasco contribute for the fields of GIS, photogrammetry, geological survey, civil engineering, overseas assistance, oceanographic survey, marketing, and so on. They keep more than 1000 employees and their annual incomes are more than 300 million US$.
In case of a map preparation company, it is said that business environment has been getting harder in these years despite of the 2020 Olympics ahead. The main cause are, increase of the number of competitors in mapping business, such as IT companies and office supplies companies, and decrease of budget cut of a country and the local government. Yet, not a few companies have been keeping solid business with on-going evolution.
The map publishing companies in Japan traditionally play an important roll to supply maps for transportations, sightseeing, shopping and for public organizations. Nowadays, their business expands to the field of car and human navigations not only Japanese users but for inbound people. Biggest companies in this field are, for example, ZENRIN, Shobunsha, and Incrementp. Recently, human navigation service provided by, for example, Navi-time Japan and NTT Docomo are growing rapidly. Such companies serve the direction to the destination and provide the information around the destination through smartphones and the internet.

Table 5 Company and URL

Companies	URLs
Kokusai Kogyo	http://www.kkc.co.jp/english/index.html
Pasco	http://www.pasco.co.jp/eng/
ZENRIN	http://www.zenrin.co.jp/english/
Shobunsha	http://www.mapple.co.jp/en/
Incrementp	http://www.incrementp.co.jp/english/
NTT docomo	http://www.nttdocomo.co.jp/english/
Navi-Time Japan	http://corporate.navitime.co.jp/en/profile/index.html

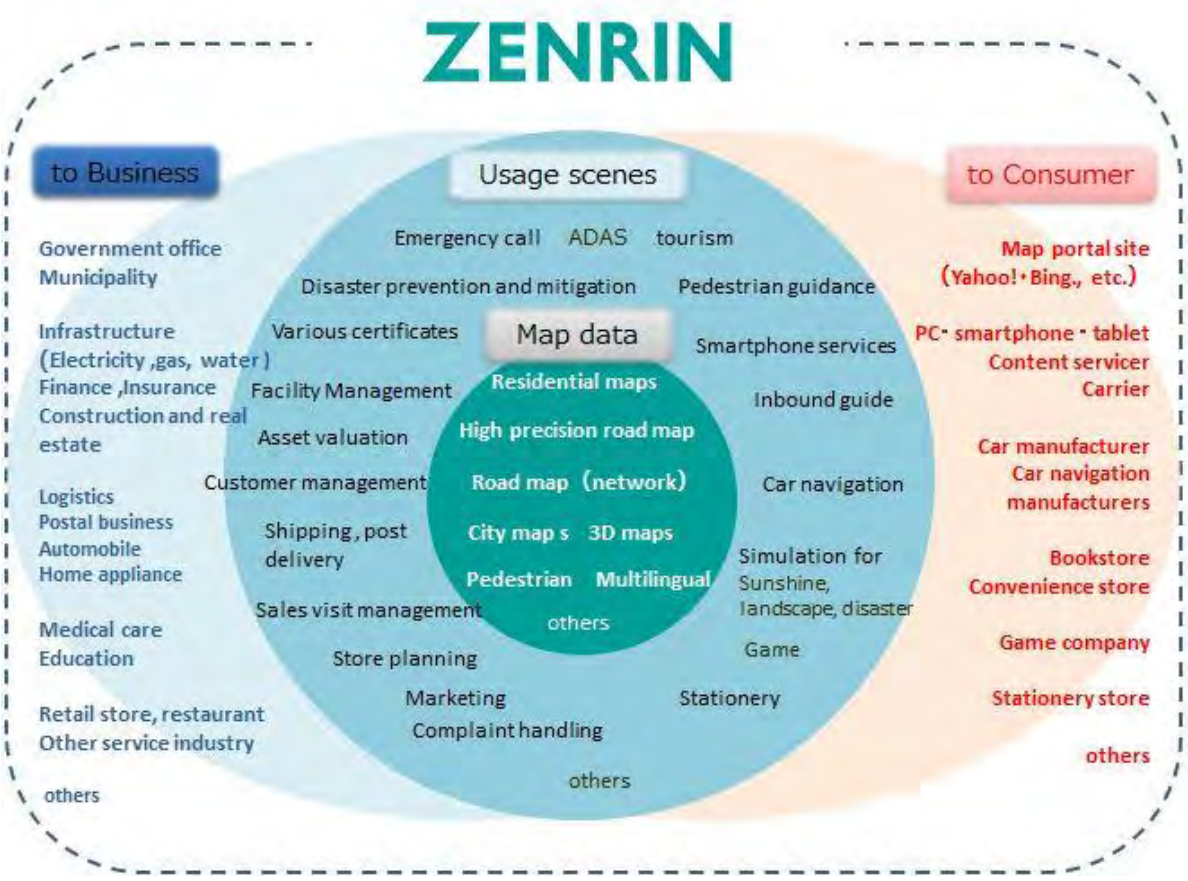


Fig. 13 The Image of the use of map data by Zenrin

(TSUKADA Nonoko)

2. Car Navigation and LBS

・Car Navigation

In recent years, car navigation has evolved to take on a variety of expanded roles beyond traditional destination guidance functions.

➢ Navigation

A noteworthy trend is the transition from in-car models to smartphone apps. Among other things, "Yahoo! Car Navi" (Yahoo Japan Corp.), released in 2014, has become popular for free and is a best-selling product with more than 15 million downloads as of March 2019.

➢ Connected car

Connected car is a car that has a function as an ICT device. It is expected that new value will be created by acquiring various data such as vehicle condition and surrounding road conditions by sensors and accumulating and analyzing through communication network.

➢ Automatic driving support

While automakers are developing automatic driving technology, a map called "dynamic map" is drawing attention. The “dynamic map”, which is the basis of automatic driving, is a digital map that combines static information based on high-precision three-dimensional maps in lane units with dynamic location It is not a map for humans to see, but a map used by cars for automatic driving. Dynamic Map Platform Co., Ltd. was established in 2016, with the investment of a surveying company, a mapping company, and an automobile manufacturer, and construction and maintenance of high-precision 3D map data are being promoted.

Table 6　Navigation system suppliers

Toyota	http://www.toyota.co.jp/en/tech/its/vision/index.html
Nissan	http://www.nissan.co.jp/en/navi.html
Honda	http://www.honda.co.jp/navi/
Panasonic	http://panasonic.jp/car/
Mapfan	http://www.mapfan.com/
Zenrin	http://www.zenrin.co.jp/product/carnavi/inquiry/index.html
Yahoo! JAPAN	https://carnavi.yahoo.co.jp/promo/
Dynamic Map Platform	https://www.dynamic-maps.co.jp/en/index.html

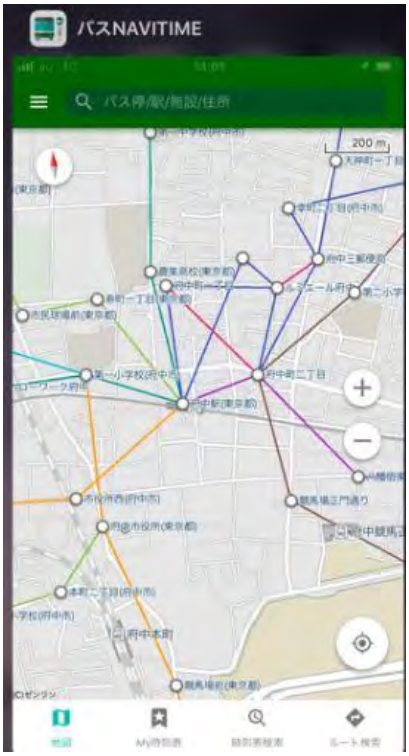


Fig. 14　Navigation map data on smartphone by Yahoo! JAPAN　　**Fig. 15　Bus NAVITIME**

・LBS Game and AR

The game using the LBS (Location-Based Services) on smartphone has been very popular.
Colopl, a game using geospatial information, has virtual money system called "Pl". You can gain "P1" by the distance you work or move to create your own virtual city called "Colony".
"Station Memories!" is a game where you can compete train station ownership by visiting stations around the country with your partner characters.
"Ingress" that appeared in 2013 and "Pokemon GO" that appeared in 2016 are location information games that combine AR (Augmented Reality) and location information. Both brought a big boom. In particular, "Pokemon GO" has been supported by a wide range of age groups and has overturned the conventional wisdom that it is the youth who play location information games.

Table 7　LBS Games

Colopl	http://colopl.co.jp/
Keitai Kunitori Gassen	http://kntr.jp/
Station Memories!	https://ekimemo.com/
Ingress	https://www.ingress.com/
Pokémon GO	https://www.pokemongo.jp/

3. Trends in Map Publication

According to the map utilization fact-finding conducted by ZENRIN CO., LTD in 2018, it has been shown that 84.1% of the users have used the map within the past year. While there are still many people using maps, only 21.4% of people use paper maps, which is decreasing year by year. On the other hand, the number of users of web maps continues to increase, and in particular, the use of smartphone maps at the time of travel has reached 62%.

・Web map service

Web map service plays a leading role in map usage. Its usage is expanding, such as using various information in piles like the "GSI Maps", and using "Street View" in "Google Maps", or browsing old maps using "Konjaku-map on the web". However, it brings a new problem as lots of reuse ignoring copyright increase. On the other hand, the use of an open map increases in voluntary such as Open Street Map.

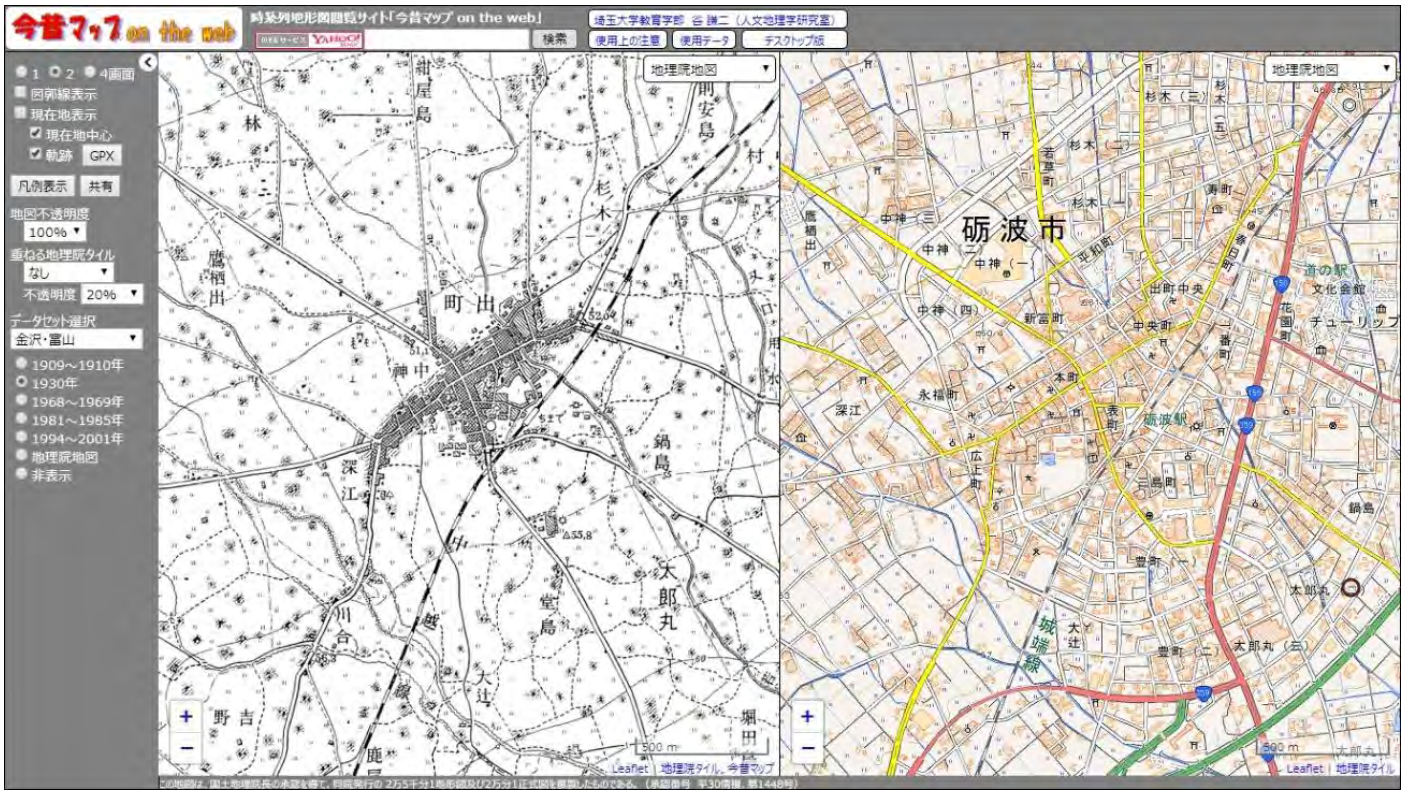


Fig. 16 "Konjaku-map on the web" http://ktgis.net/kjmapw/index.html

・Smartphone apps

Map applications for smartphones and tablets are growing in use instead of paper maps, and their use is also expanding. Other than the general map application, there are various type of map application, such as those that appeal to young women's sensibility, those that can view old maps and illustration maps on the spot, and those that show topography dynamically.

In addition, with the improvement of the positioning environment by the introduction of "Quasi-Zenith Satellite System", further high precision and high functionalization of the location information application is expected from now on.

Fig. 17　Characteristic maps app for smartphones and tablets

・Map-themed publications

Paper maps are declining, but map-themed publications are in vogue. There are various themes, such as those based on topography, those that delve into the geographical features of the area, and walking maps which follows some old river traces and underdrains. Recently, books that interpret the functions of cities based on fictional maps have become popular. Contents with the theme of maps and topography have become popular in general magazines. Also, a book describing a popular program "Bratamori" where famous celebrities excurse various lands is also attracting attention.

Fig. 18　Map-themed publications

・Bird’s-Eye View

Publication of traditional manually drawn bird’s-eye views has sharply dropped. However, the bird's-eye view by the automatic processing with the computer came to be made from DEM easily. In late years it is not unusual for these bird's-eye views to be sold as a souvenir at mountains resorts.

・Atlas

In private sectors, the mainstream products are revised editions of school atlas and their arrangement of compact atlases of B5 and A4 sizes. Road maps and urban maps formerly published in the form of single sheet are now published in a book-format and a style of city atlas by Prefecture. However, with the spread of Web maps, sales of such atlas have recently declined.

Under these circumstances, relatively strong sales have been maintained by various information maps that explain the economy, culture, and history of Japan and the world. These atlases are published annually from publishers specialized in practical articles and drawing wide interests.

・Residential Map

In a residential map, the ground plan of individual housing and building can be identified and each building is provided with such information as occupants’ name and name and address of the building. In addition to such information as names of the building and tenants, road traffic information such as locations and names of bus stop, traffic signals, crossings, street names and one-way traffics are also indicated.

The scale of those maps is usually large as ranging from 1:1,000 to 1:5,000. The residential map covers all more than 2,800 local governments across the country. They are drawn up and sold by several private firms and usually made into a bound book edited for each city, town or village.

All basic data for those maps are solely collected by a private field survey. Data update by a field survey is usually done annually for cities where changes are frequent, and once every 2 to 5 years for the rest of areas.

As the information update is done regularly, those maps are used in wide applications such as delivery service and moving industry, ambulance, police, and security service works and marketing researches.

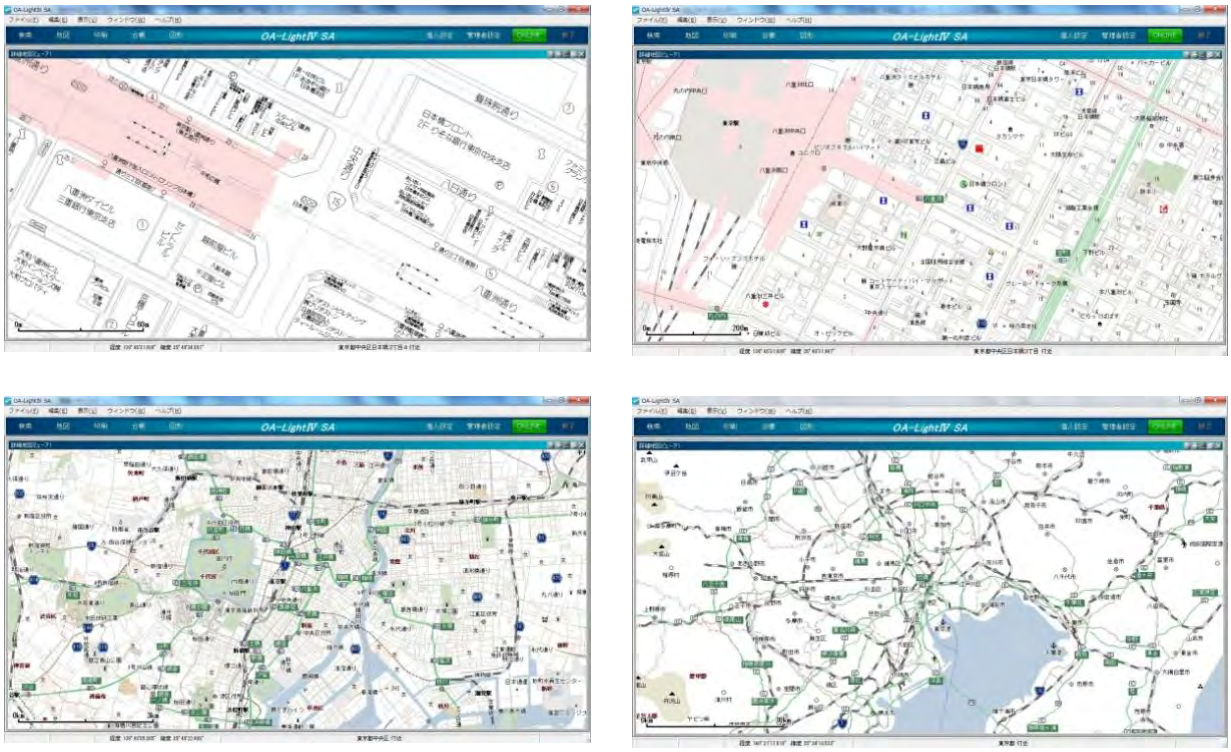


Fig.19 Residential Map and smaller scale Data by ZENRIN Co., Ltd.

(ENDO Hiroyuki)