The 10th Session of the SPECA Thematic Working Group on Knowledge-based Development & the Regional Capacity Building Workshop: Innovation Policies, Technology Applications and Infrastructure for SDGs

Baku, Azerbaijan
4-5 July, 2018

Geospatial Infrastructure as a promoter of Innovation on Geospatial Information Technology and Application

- Japan's examples

Jun Sato

Geospatial Information Authority of Japan(GSI),

Ministry of Land, Infrastructure,
Transport and Tourism, Japan

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UN-GGIM-AP: Introduction and Role

UN-GGIM-AP

- Regional Committee of UN-GGIM.
- Established :1 November 2012
- Member:
  National Geospatial Information Authorities of 56 countries and regions in Asia and the Pacific
- Current Chair: Dr. Hiroshi Murakami (Japan)
- Current Secretariat: China

Vital Role in

(Relevant to geospatial information management)

- Resolves regional issues
- Facilitate regional capacity building
- Promote globally the unique needs and interests of the region
- Contribute to the discussions in UN-GGIM

UN-GGIM (at the Global level)

↓

UN-GGIM-AP

Technical and substantive activities at the regional level

- Organize WGs
- Take Actions/Projects
- Capacity Building
- Regional Issues
- Check Activities

↓

Activity Report to UN-GGIM

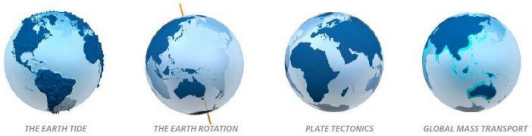
(Reference)
ECOSOC Resolution entitled ***"Strengthening institutional arrangements on geospatial information management"***, E/RES/2016/27

UN-GGIM-AP: Working Groups (1)

WG1 : Geodetic Reference Framework for Sustainable Development

Chair: Dr. John Dawson (Australia)

- This WG aims to support Asia and Pacific countries to respond to the General Assembly Resolution on a Global Geodetic Reference Frame (GGRF) for Sustainable Development, and to facilitate regional geodetic cooperation.



WG2: Disaster Risk Management

Chair: Mr. Toru Nagayama (Japan)

- This WG aims to enhance the capability of NGIAs in Asia and the Pacific region for contributing to disaster risk reduction by applying geospatial information for effective implementation of Sendai Framework for Disaster Risk Reduction (SFDRR).

UN-GGIM-AP: Working Groups (2)

WG3: Regional SDI

Chair: Dr. Jiang Jie (China)

- This WG aims to investigate and assess the status of NSDI development of the member countries in the Asia and Pacific region, and to identify common data and service standards for regional sustainable development.

WG4: Cadastre and Land Management

Chair: Dr. Byung-Gul(BG) Lee (Korea)

- This WG aims to promote land administration framework and good practices for the Asia and Pacific region. Main work steps are to identify land issues in the region, propose affordable framework and good practices for the region, and disseminate good practices and enhance training and capacity development..

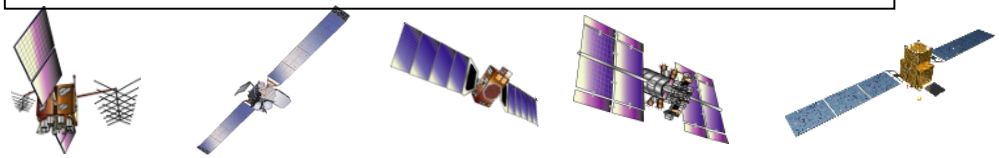
Contents

Revolutionary Innovation in Surveying and Positioning

We are now witnessing **a Revolutionary Innovation in Surveying and Positioning,** empowered by the combination of Positioning Satellites and CORS networks

Multi GNSS

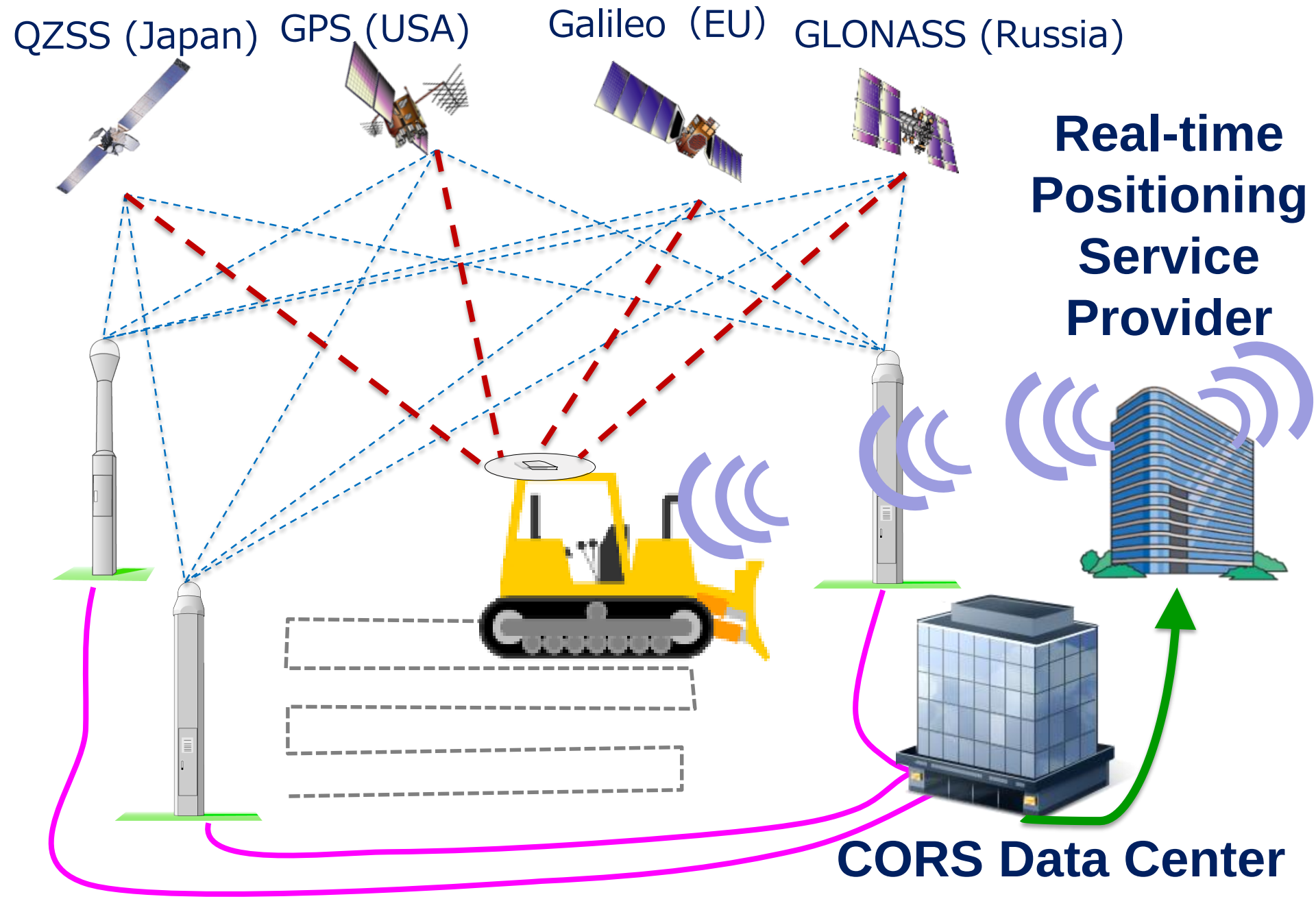
CORS Network



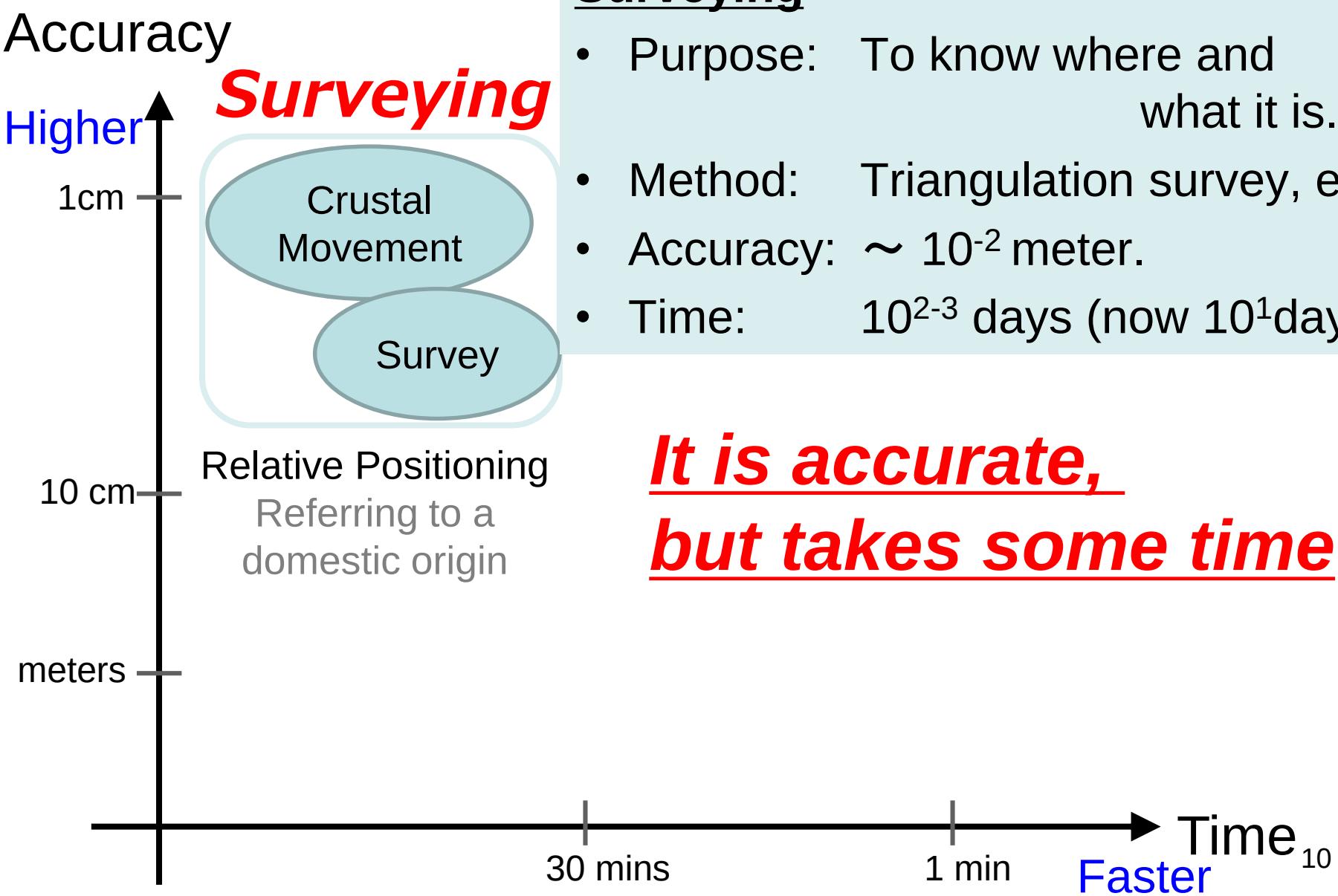
GNSS: Global Navigation Satellite System(s)

CORS: Continuously Operating Reference Station(s)

Applications: Real-time Positioning Services



Surveying and Positioning so far (1)



Surveying

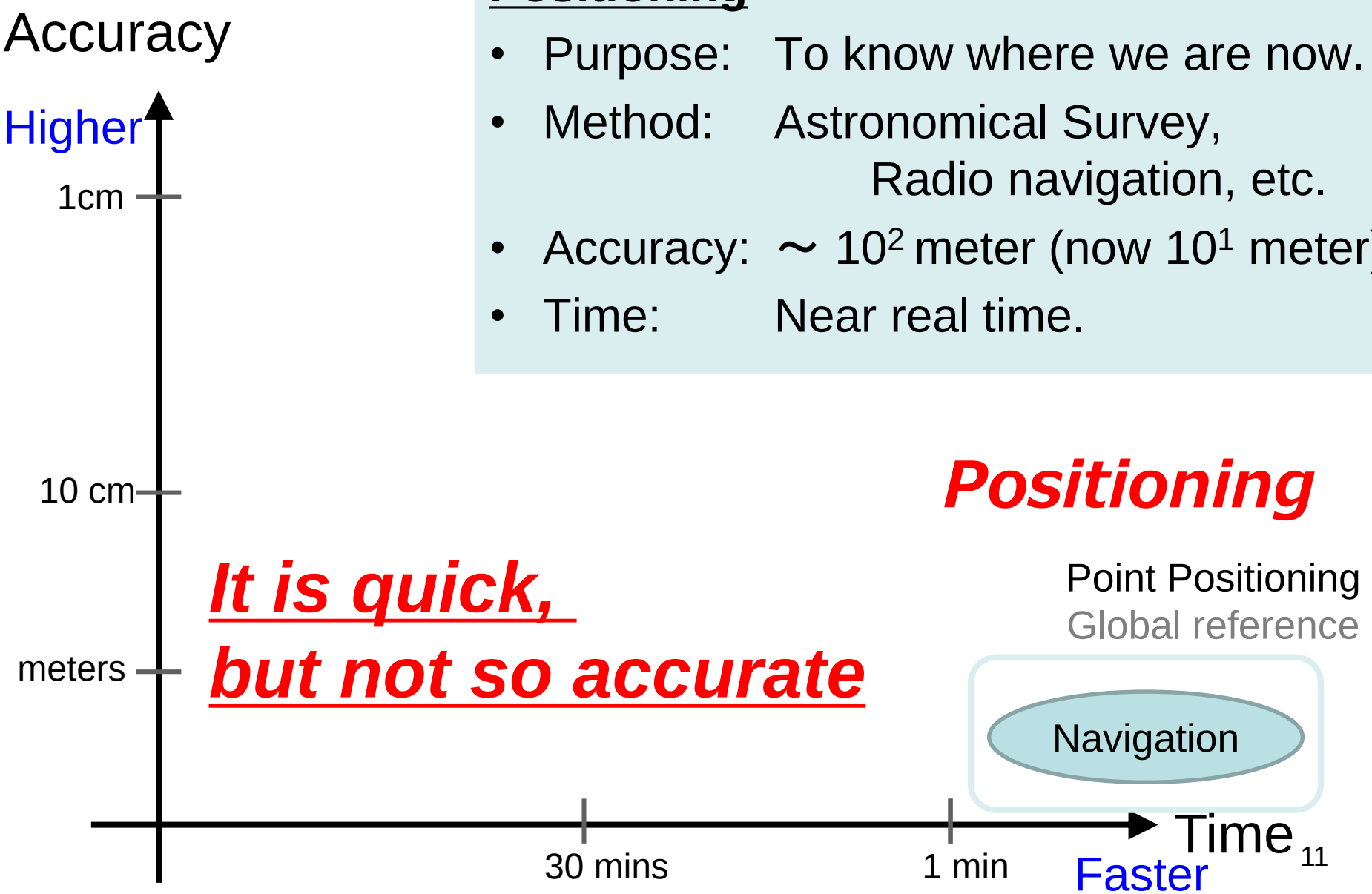
- Purpose: To know where and what it is.
- Method: Triangulation survey, etc.
- Accuracy: ~ 10^{-2} meter.
- Time: 10^{2-3} days (now 10^{1}days).

It is accurate, but takes some time

Surveying and Positioning so far (2)

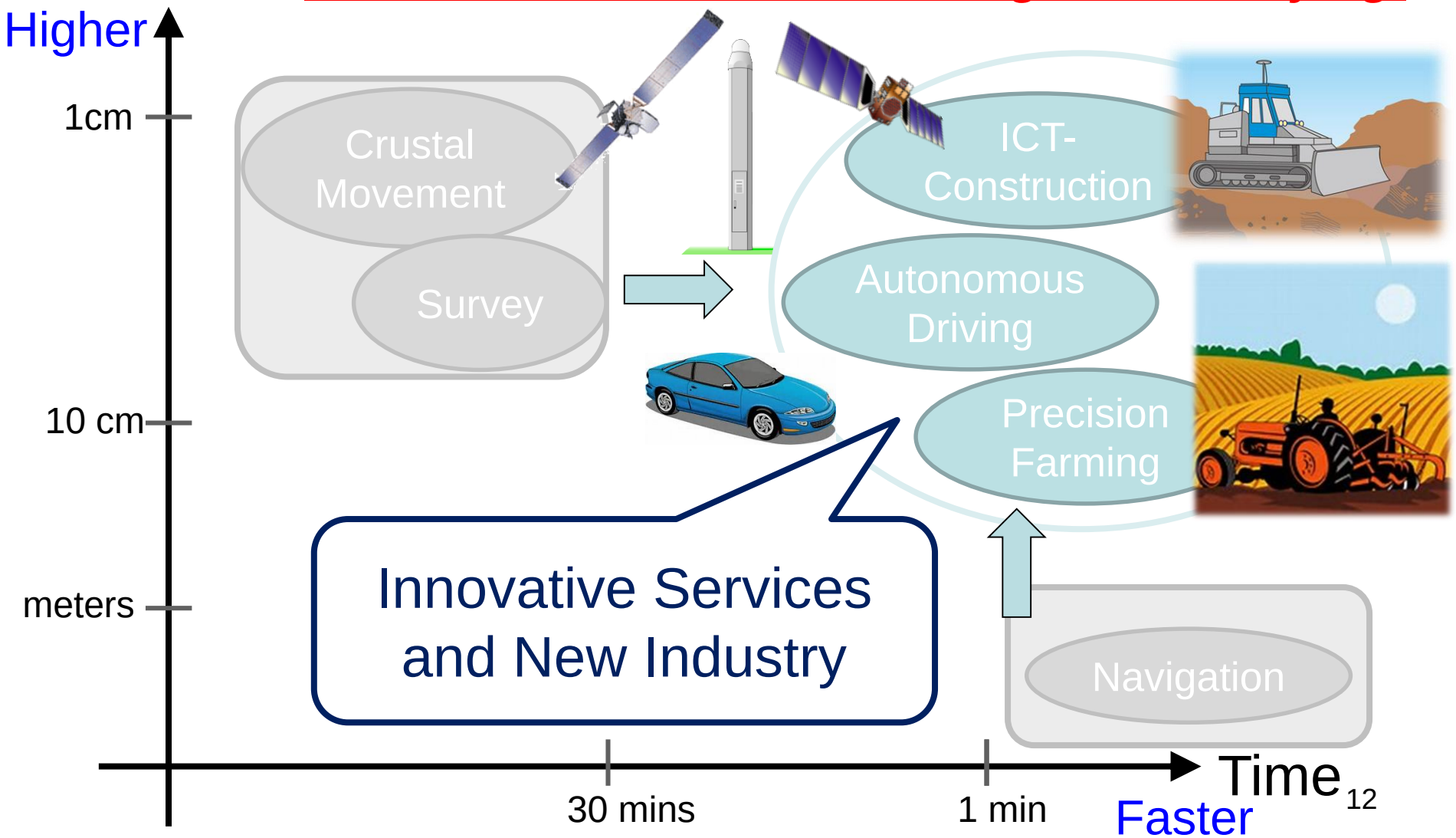
Positioning

- Purpose: To know where we are now.
- Method: Astronomical Survey, Radio navigation, etc.
- Accuracy: ~ 10^2 meter (now 10^1 meter).
- Time: Near real time.



Fusion of Positioning and Surveying

Combination of GNSS and CORS enables Real-time, Accurate Positioning and Surveying.



UN General Assembly Resolution

In February 2015, the UN General Assembly adopted a resolution “A Global Geodetic Reference Frame for Sustainable Development” – the first resolution recognizing the importance of globally-coordinated approach to geodesy.

Many countries realized the importance of their national CORS network since the adoption of the UN resolution.

Background of the resolution

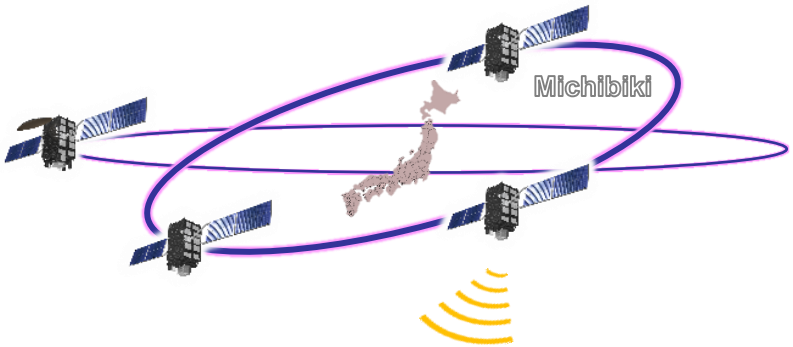
- ○ Some countries still use local coordinate systems that are not consistent with the global geodetic reference frame.
- ○ GNSS satellites provide coordinates based on a global geodetic reference frame.
- ○ Geospatial information has been and will be increasingly acquired with GNSS.

Resolution requests the Member States to:

- **Improve their global geodetic infrastructures,**
- **Implement open data sharing, and**
- **Engage in Education, Training and Capacity Building.**

Contents

Image of G-spatial Society in Japan



As a concept of Japan's basic law and basic plan on NSDI, keyword is "Realization of G-spatial society".

Everyone can use the necessary geospatial information anytime, anywhere, and can obtain accurate information based on sophisticated analysis

Expected Benefits

Protect the country, Save each person's life

Disaster prevention measures system

Traffic system & distribution system

Logistics network to remote island

Diverse and rich lifestyles

Stress free environment

Accelerate regional creation

i-Construction | IT agriculture

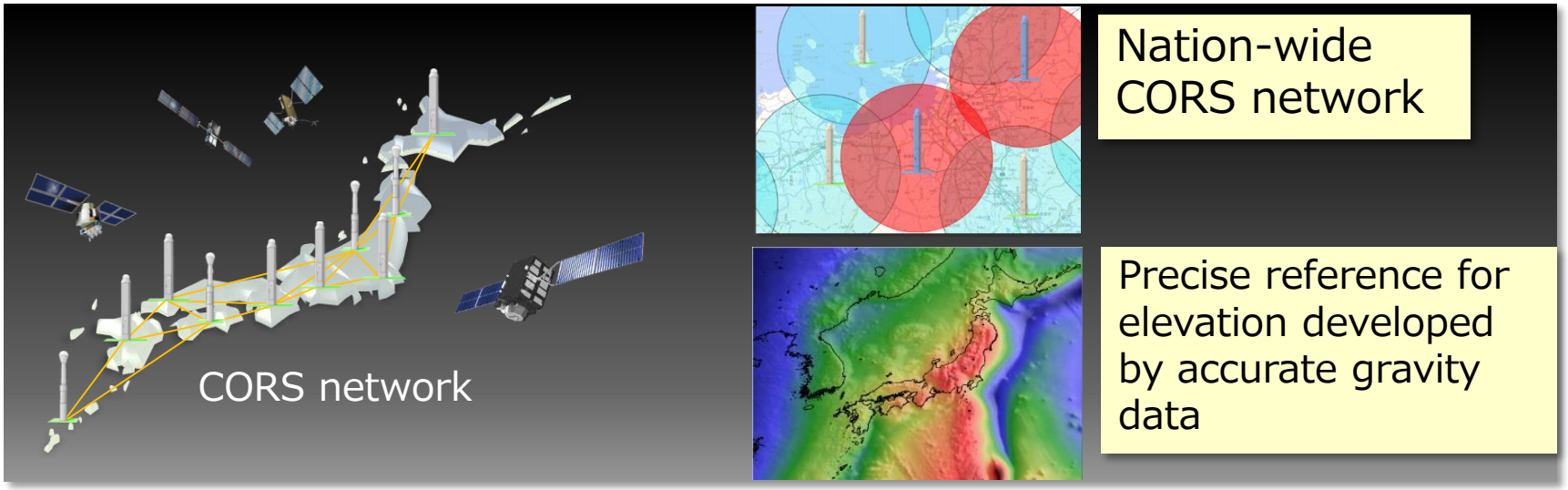
GSI's contribution to G-Spatial Society

- Map infrastructure:

Fundamental Geospatial Data promotes wider map-application.

- Establishing a National Geodetic Reference Frame:

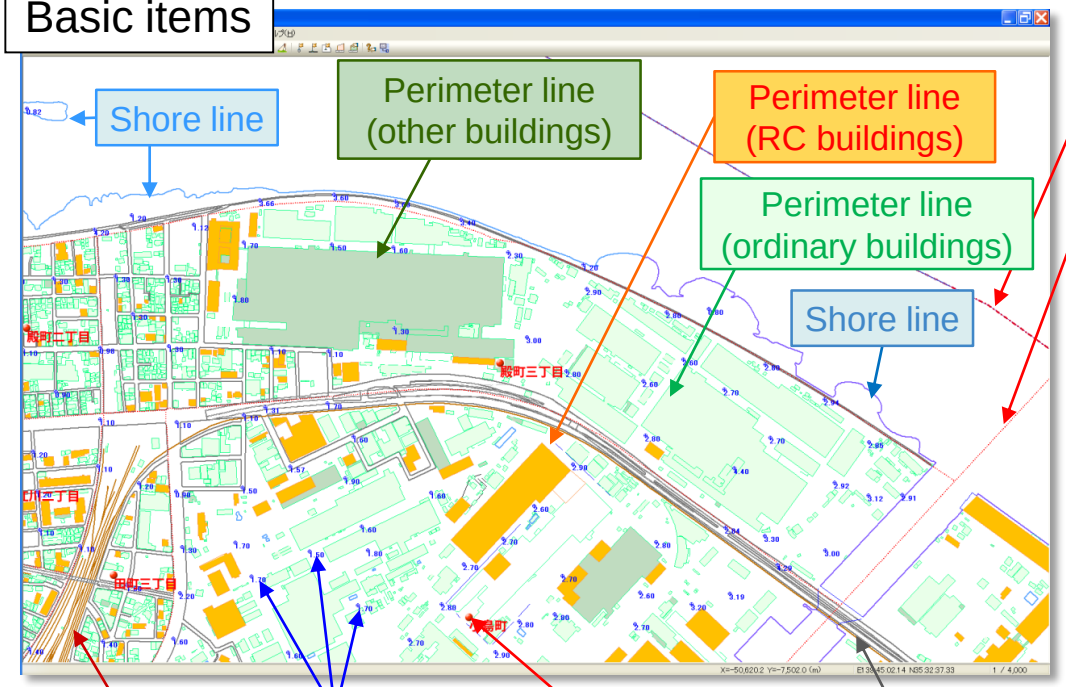
Infrastructure of a Society with a Highly Precise Satellite Positioning



Fundamental Geospatial Data

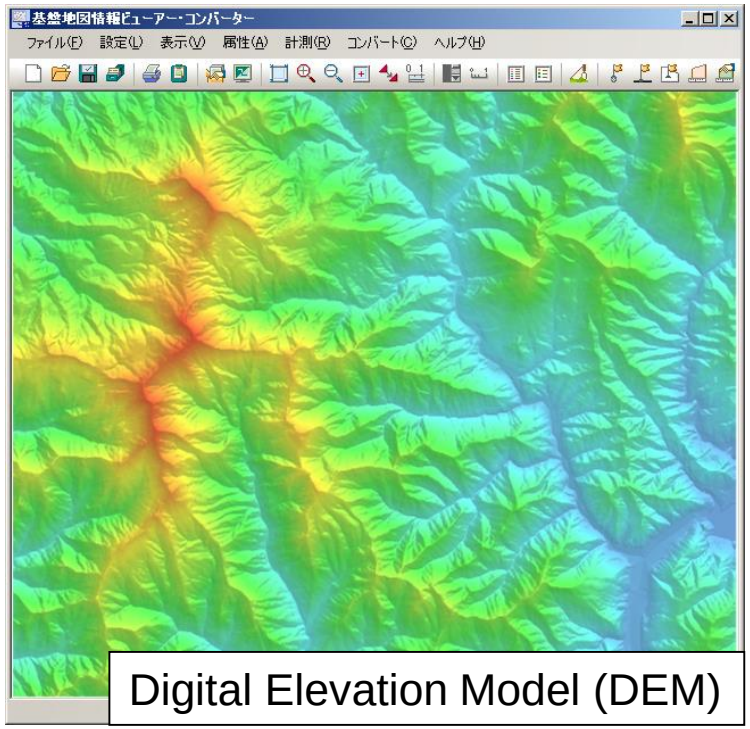
- Reference for positioning on digital maps
- Free download available for anyone to use at any time
- Scales are 2,500 (City Planning Area) and 25,000 (Other areas)
- Mostly completed in FY2011

Basic items



Demarcation line between administrative districts

Demarcation line between towns/local sections

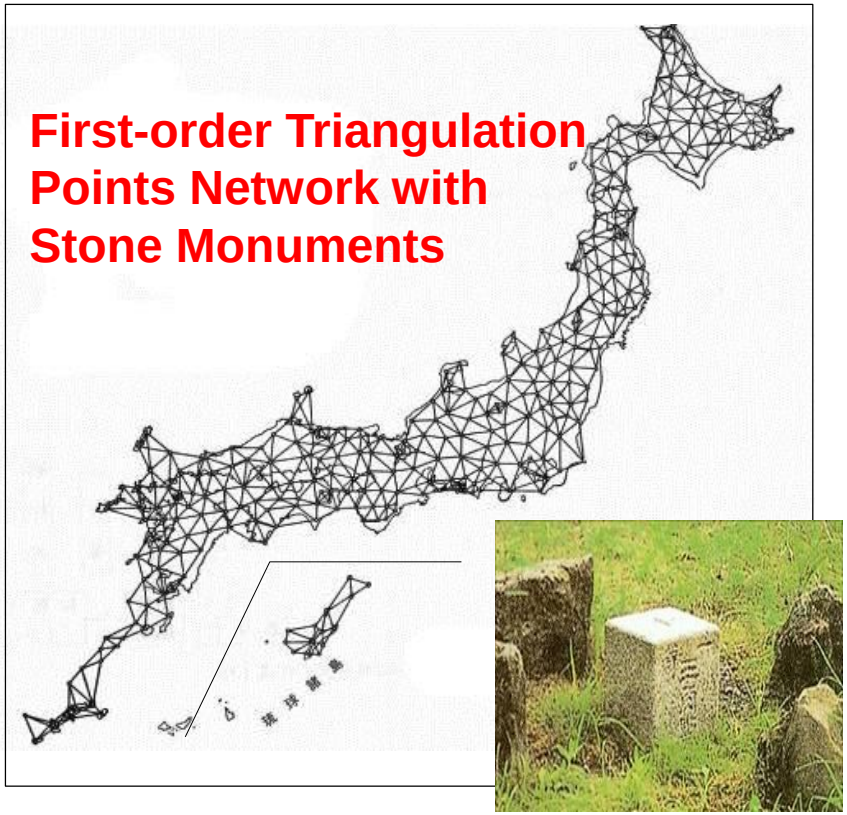


Digital Elevation Model (DEM)

Download basic map information from http://www.gsi.go.jp/kiban/

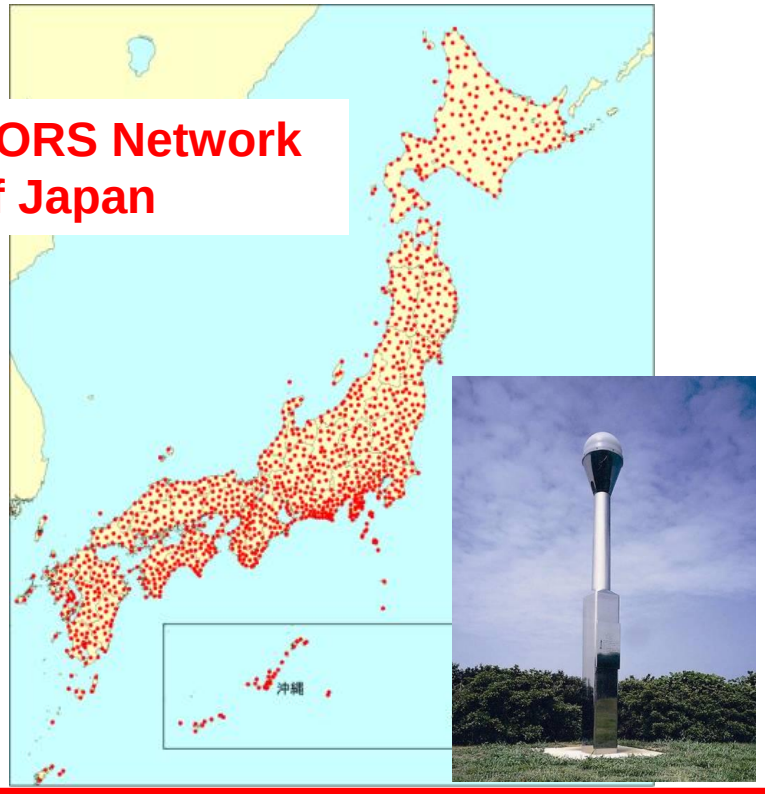
Establishing a National Geodetic Reference Frame

It took Japan **several decades** to establish its national geodetic network with triangulation points in the late 19th century.



A total of over 110,000 triangulation points were built and surveyed to establish the national geodetic coordinate system.

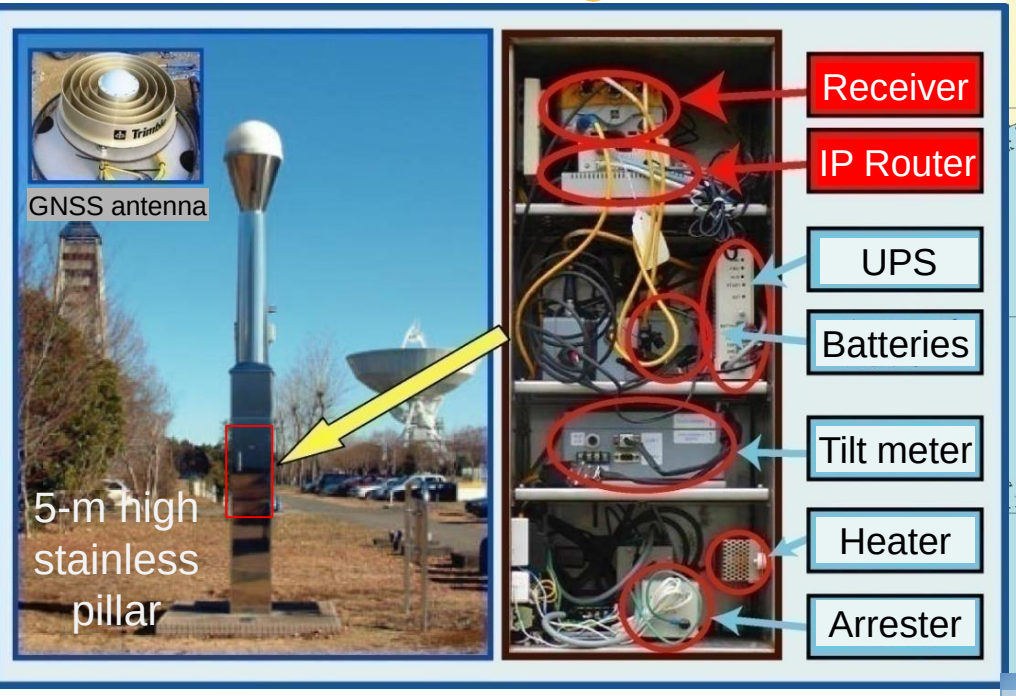
GNSS CORS networks enable countries to develop a **National Geodetic Network** and launch **real-time positioning services in a few years** .

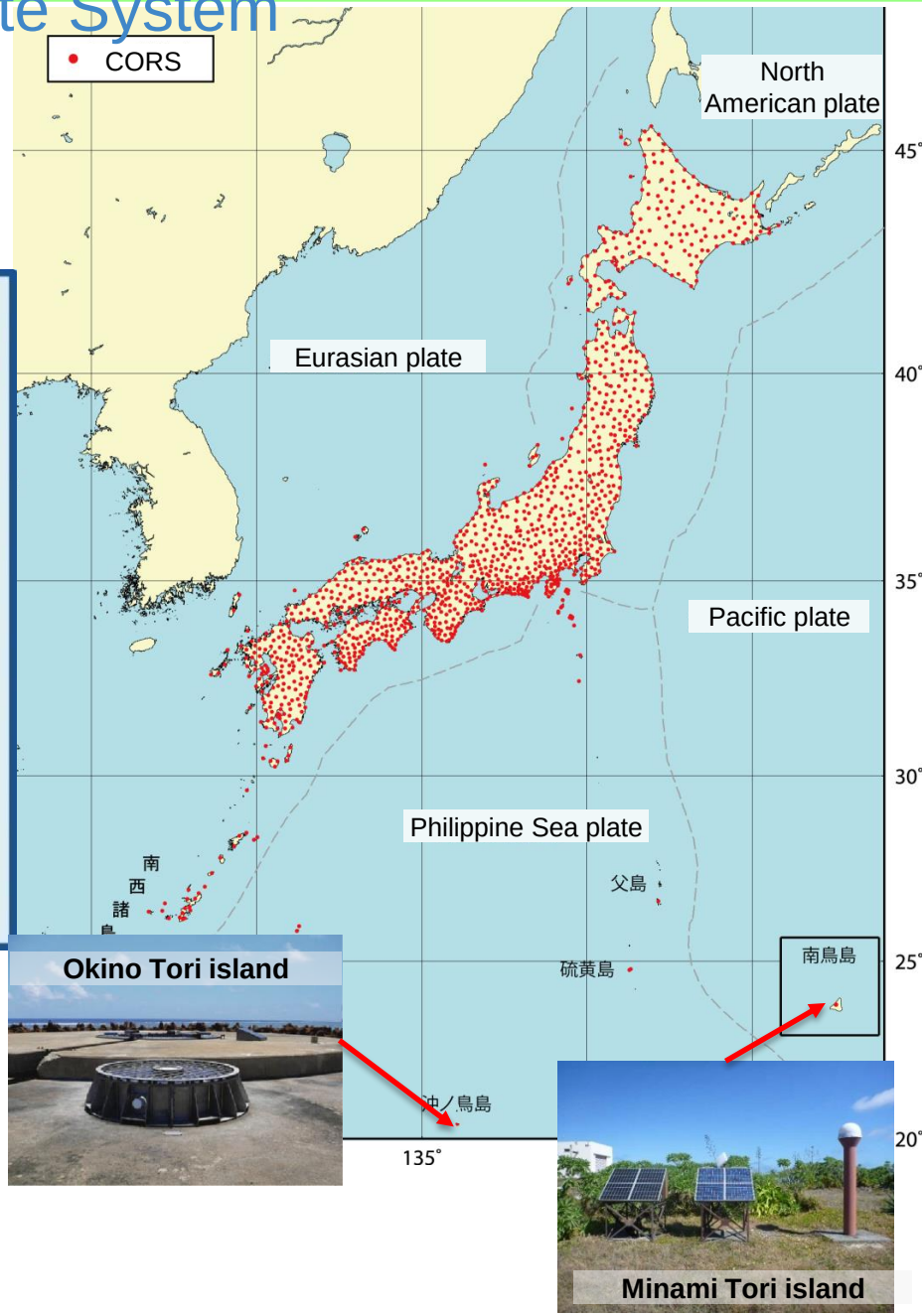


GNSS CORS：
Crucial Infrastructure in the Era of Satellite Positioning.

GNSS Continuously Operating Reference Stations (CORS)

GNSS: Global Navigation Satellite System

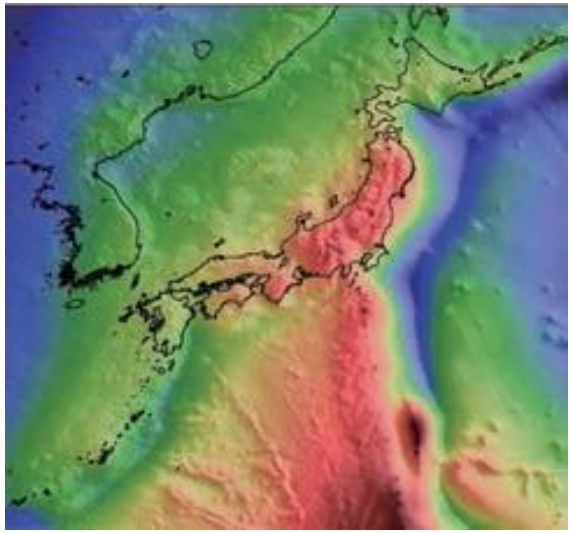




- The CORS network has 1318 stations over the whole country (at ~20 km interval).
- The continuous GNSS observation enables accurate measurement of crustal deformation.

GSI Innovates the Elevation System in Japan

GSI is realizing a society where anyone can use elevation anytime and anywhere by GNSS.



Low High

Figure Showing Elevation Reference (Preliminary Estimate)

GSI will conduct air-borne gravity survey to grasp area-wide gravity anomaly on the surface.

- GNSS enables us to easily and quickly obtain accurate horizontal positions (longitudes/latitudes), whereas elevations cannot be obtained so accurately yet.
- In order to obtain accurate elevations by using GNSS, it is required to measure gravity data densely nationwide to develop an elevation reference.
- The elevation reference is developed according to gravitational data. (Leveling is still used in some parts of Japan including certain urban areas.)
- More than 1,300 CORSs continuously monitor changes in elevation.

A Society with a Highly Precise Satellite Positioning

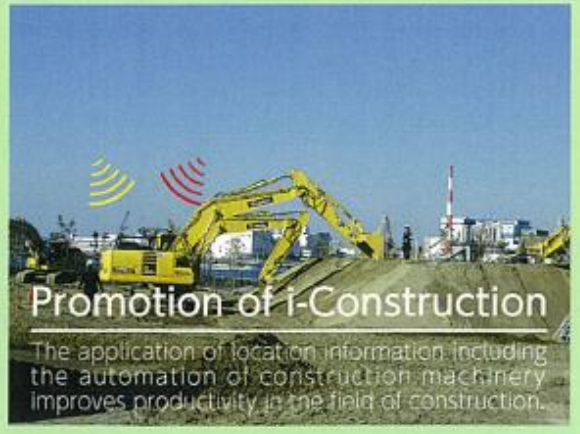
Realization of a Society Where Highly Precise Positional Information Can Be "Surveyed" Anytime and Anywhere

GNSS surveying

Surveyors conduct surveys efficiently in real time.

Vehicle-mounted laser scanning

Digitized data for mapping are obtained efficiently by running a vehicle equipped with a laser scanner to measure ground surfaces.



Promotion of i-Construction

The application of location information including the automation of construction machinery improves productivity in the field of construction.

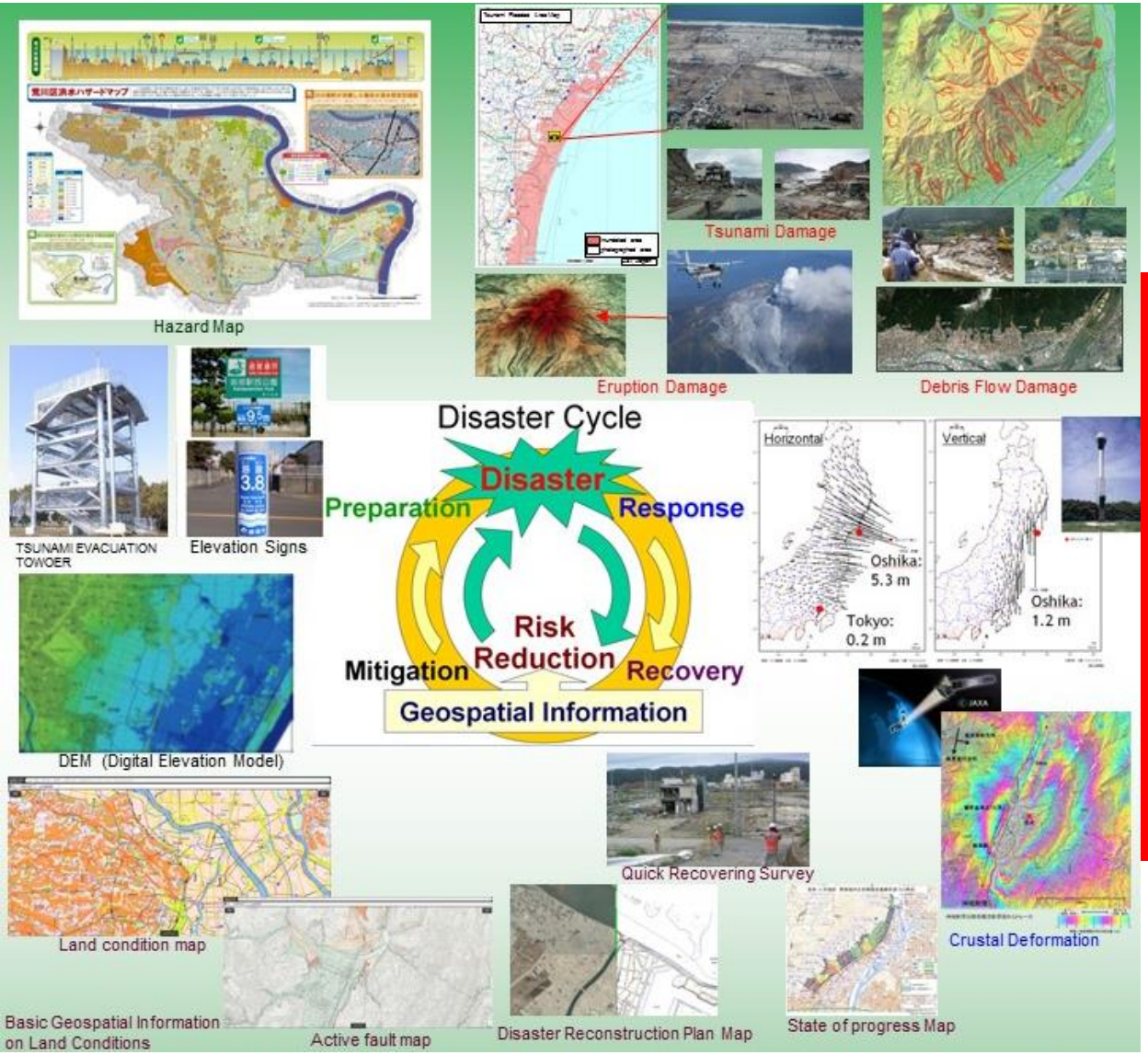
Autonomous driving of farming machinery

Precise positioning enables the autonomous driving of framing machinery and improves the efficiency of farm work in response to a shortage of labor.

Credit: Brochure of the Geospatial Project, Secretariat of the National Spatial Data Infrastructure (NSDI) Committee

Contents

Disaster Cycle and Geospatial Information

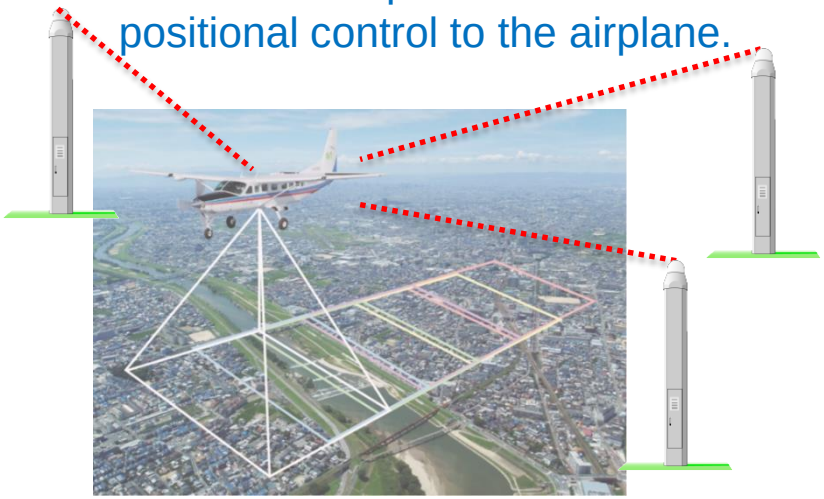


Surveying technique and geospatial information are precious technology and information that can contribute to disaster risk reduction and reconstruction.

Aerial Photos

The 2016 Kumamoto Earthquake (M7.3)

GNSS CORS provides accurate positional control to the airplane.



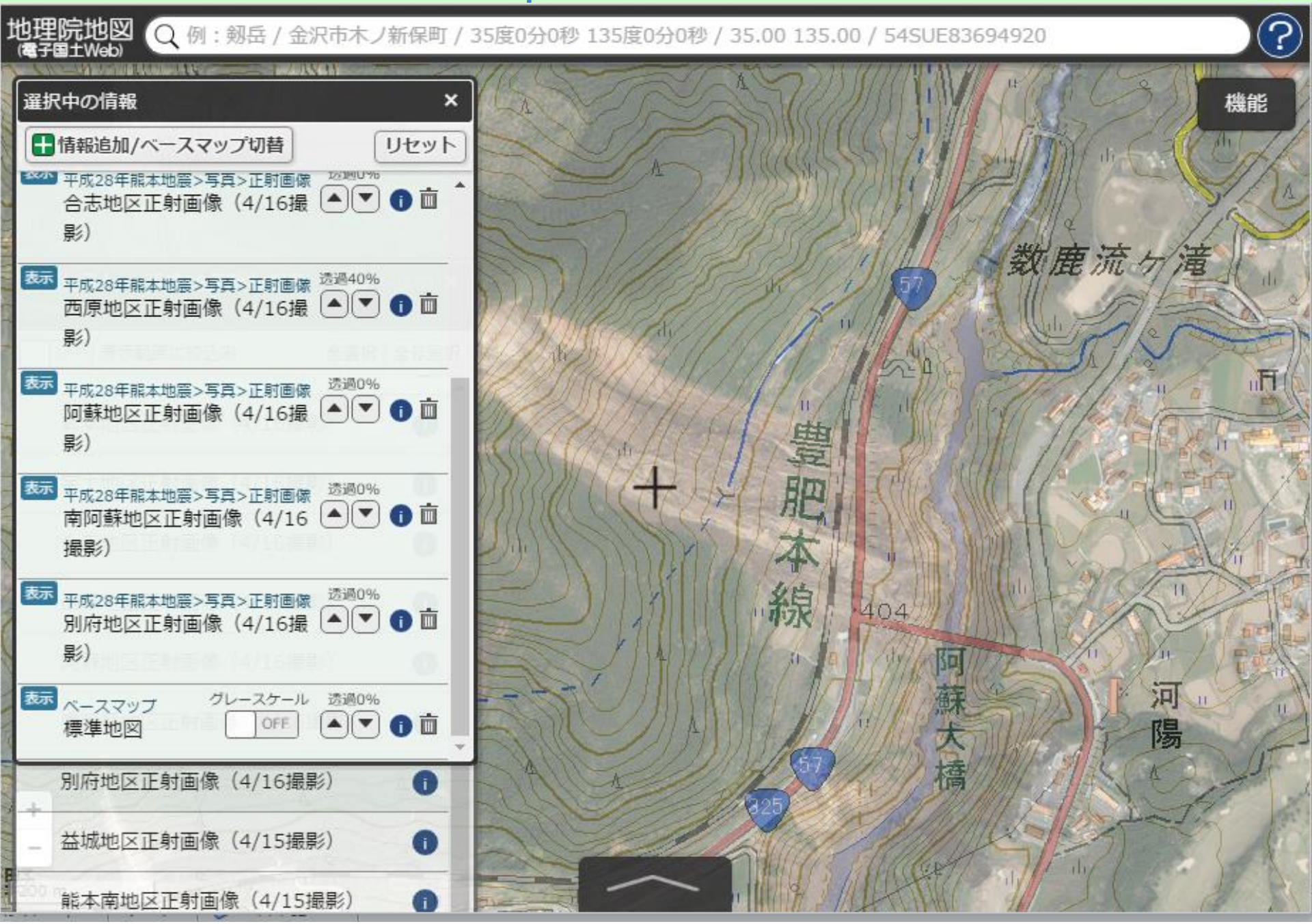
- Aerial photos were taken in cooperation with private companies.
- The photos revealed the impact and extent of damage caused by the earthquake in detail.

Drones (UAV: Unmanned Aerial Vehicle)

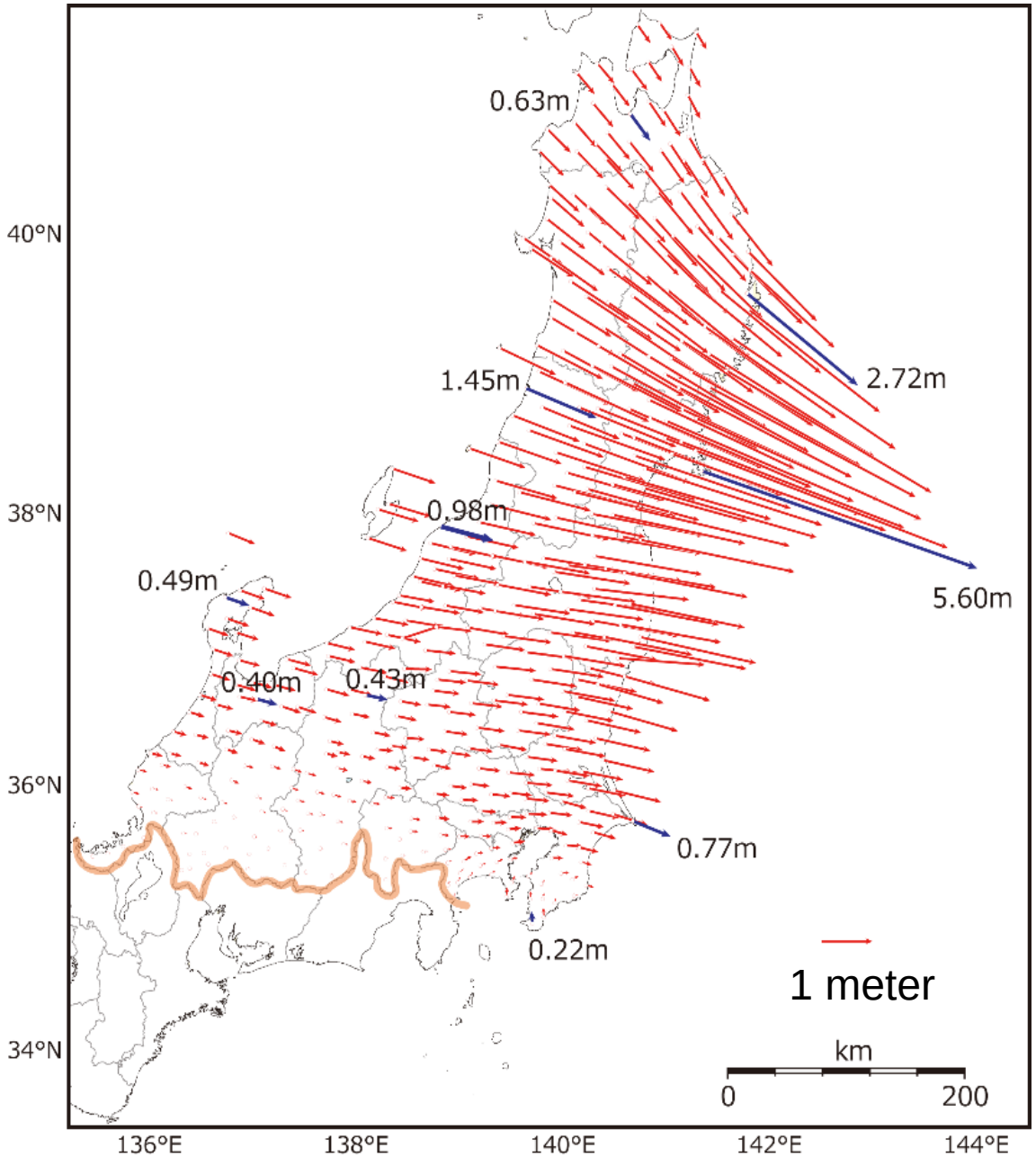
The 2016 Kumamoto Earthquake (M7.3)

- Drones allow a closer look at and acquire the images of inaccessible damaged areas (landslide sites, etc.).

Air Photos on Web Maps



GNSS CORS Revises Control Points Coordinates



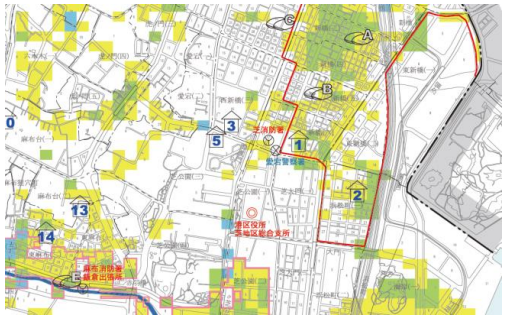
Due to the deformation caused by the Great East Japan Earthquake, the control point coordinates had to be transformed to new ones for reconstruction.

Hazard Maps prepared by Local Municipalities

Flood Hazard Map

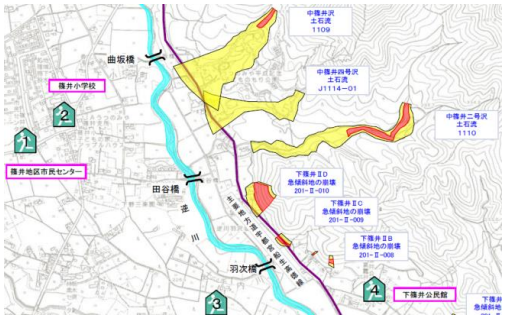
Ota-Ku, Tokyo

Inland Waters Hazard Map



Minato-Ku, Tokyo

Landslide Disaster Hazard Map

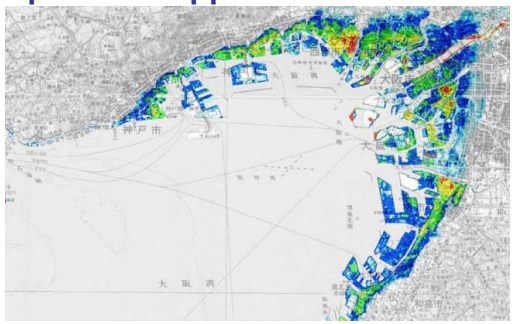


Utsunomiya City, Tochigi Prefecture

Height Tide Hazard Map

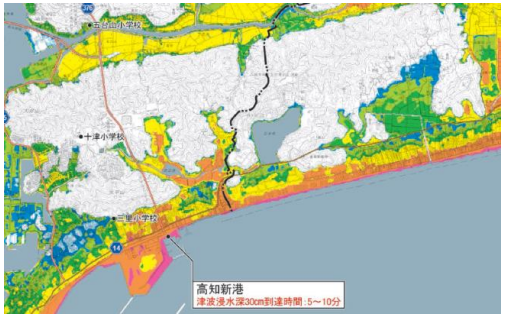
Shimonoseki City, Yamaguchi Prefecture

Map of the supposed inundation area



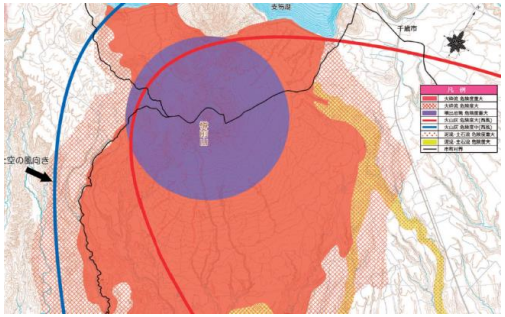
Osaka Bay

Tsunami Hazard Map



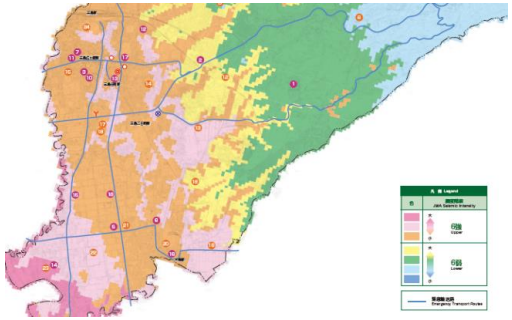
Kochi City, Kochi Prefecture

Volcano Hazard Map



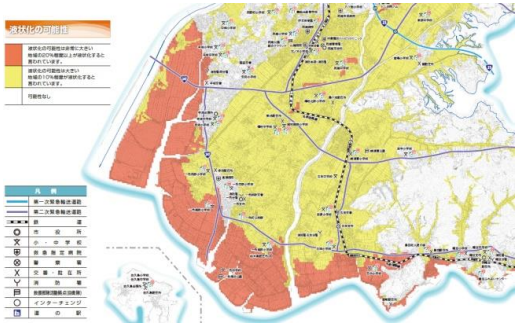
Mount Tarumae (Hokkaido)

Earthquake Damage Estimation Map



Mishima City, Shizuoka Prefecture

Ground Subsidence(Liquefaction) Map



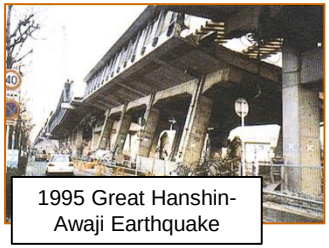
Nishio City, Aichi Prefecture

Hazard Map Portal

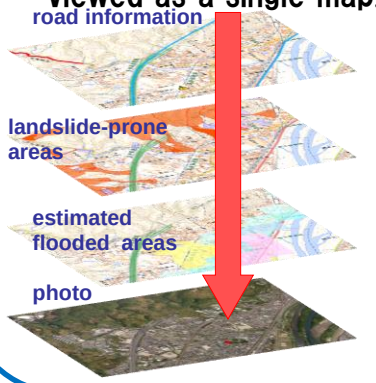
Information useful for evacuation and disaster preparedness is released

Heavy rain
- areas vulnerable to flooding
- landslide-prone areas
- roads that are likely to get blocked

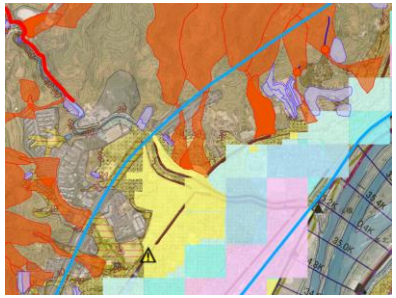
Earthquake
- areas prone to shaking
- locations of active faults
- massive developed land


1995 Great Hanshin-Awaji Earthquake

Overlaid hazard maps
Various information about anywhere in Japan, which is useful for disaster risk reduction, can be overlaid and viewed as a single map.



Overlaying information and viewing as one map



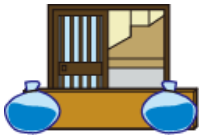
Local hazard maps
Hazard maps of municipalities across Japan are available.


Flood hazard map (Chiyoda Ward, Tokyo)


Tsunami hazard map (Fujisawa City)

Understanding various information is useful for evacuation planning and disaster preparedness


Evacuation route


Measures for flooding


Enhancing seismic safety

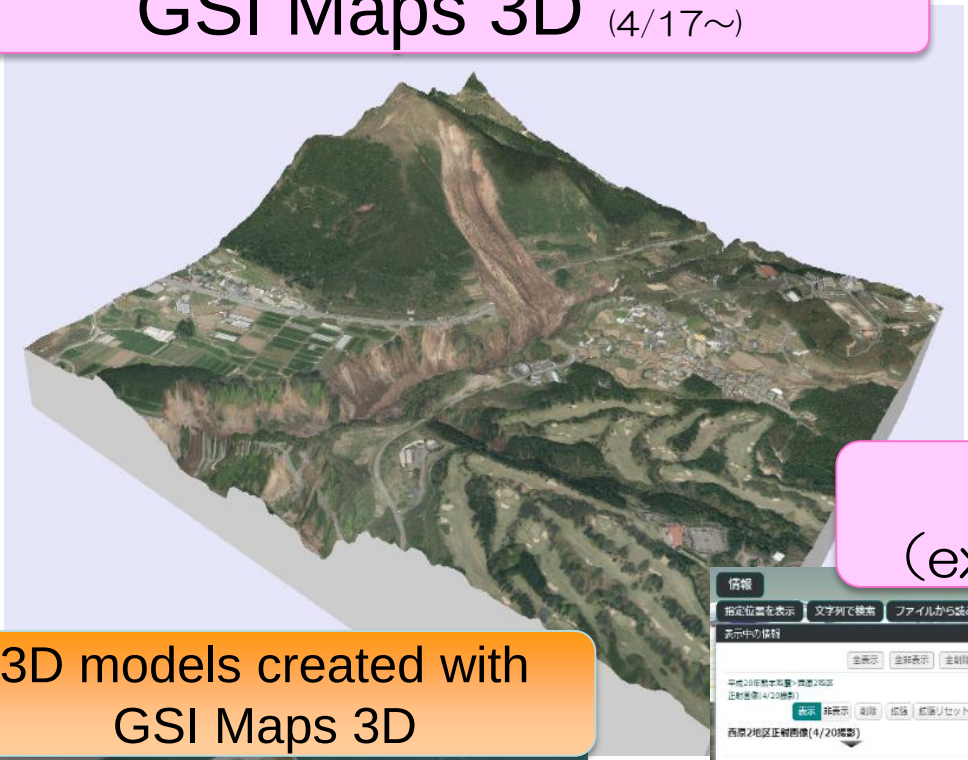

Measures for liquefaction

Hazard Map Portal Site : http://disaportal.gsi.go.jp/
(run by Ministry of Land, Infrastructure, Transport and Tourism of Japan)

ハザードマップ 検索

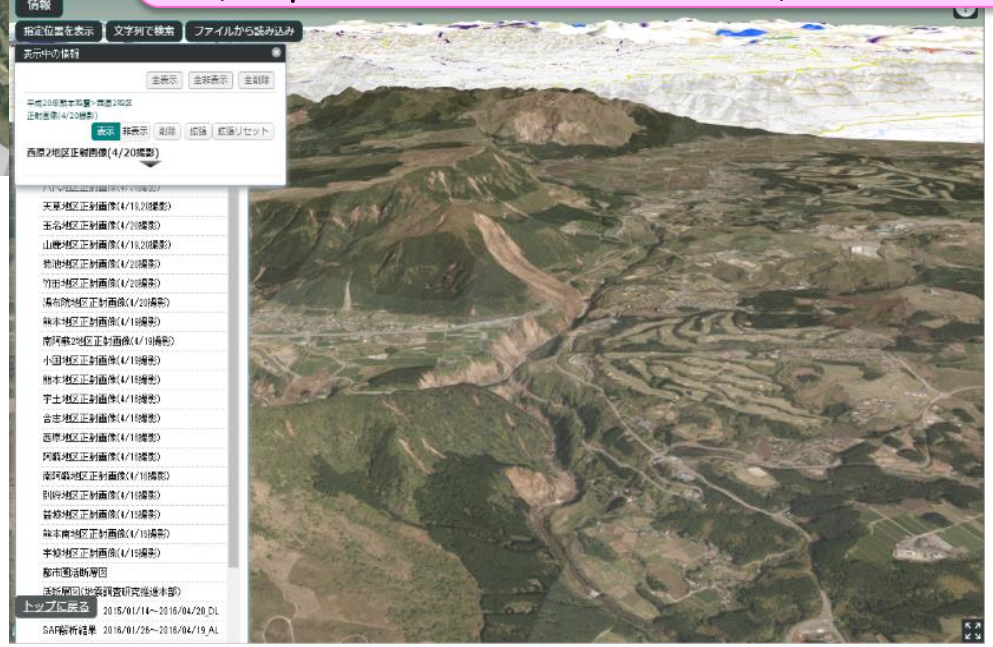
Providing Information through GSI Website

GSI Maps 3D (4/17～)



3D models created with GSI Maps 3D

GSI Maps Globe （experimental release） (4/21～)



Activities during the pre-disaster period

(Examples)

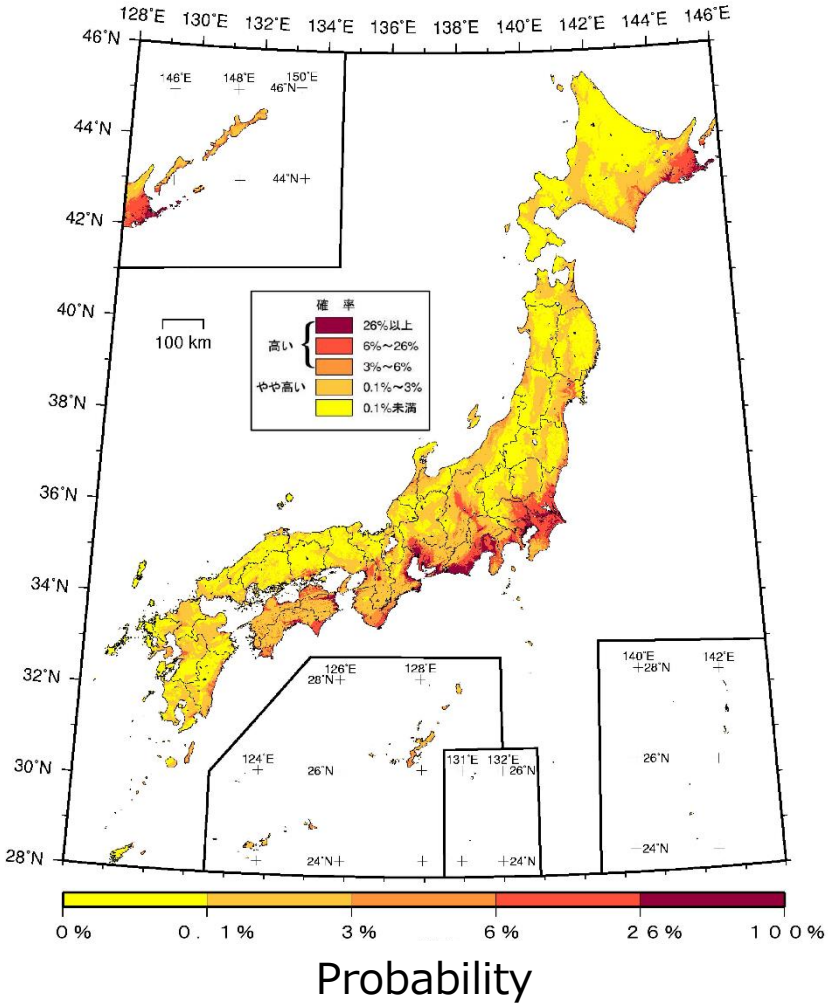
1. Outputs by the Headquarters for Earthquake Research Promotion

2. Recent activities by the Japan Meteorological Agency (JMA)

3. Hazard map Portal by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

The HQs for Earthquake Research Promotion

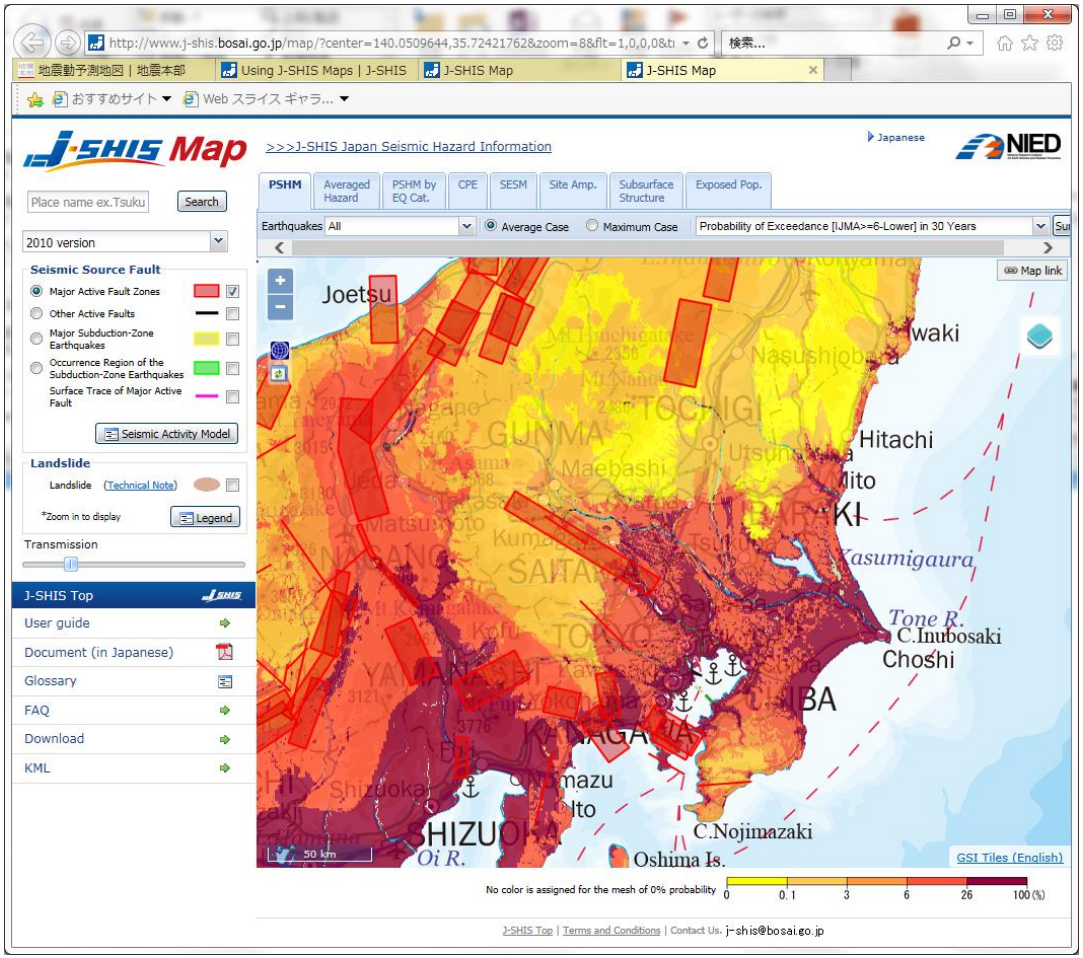
- The Headquarters for Earthquake Research Promotion (HQERP) is the Government Organization under the Ministry of Education, Culture, Sports, Science and Technology, established in 1995.



- Probability of suffering a ground motion with very strong seismic intensity within 30 years here-after (as of 2018)
- An example of Probabilistic Seismic Hazard Maps
- Source: National Seismic Hazard Maps for Japan 2018, HQERP (only in Japanese)

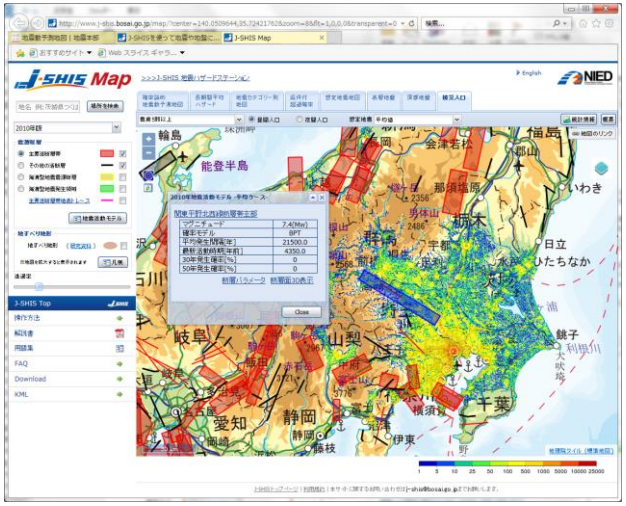
“J-SHIS Map” by National Research Institute for Earth Science and Disaster Resilience

J-SHIS was established to help prevent and prepare for earthquake disaster by providing a public portal for seismic hazard information across Japan.

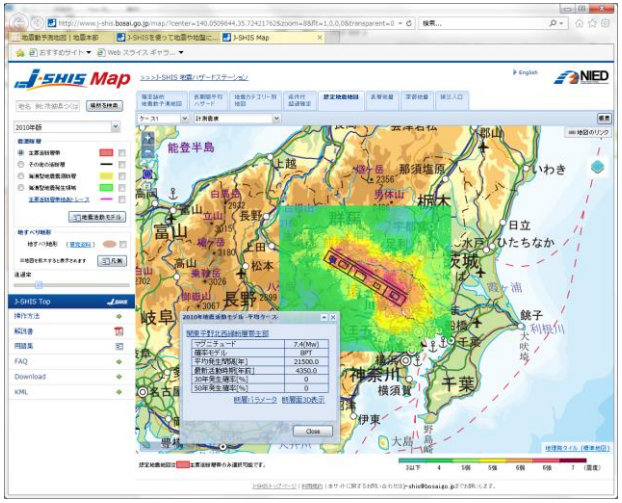


Probability of Exceedance [seismic intensity 6] in 30 years

Scenario Earthquake Shaking Maps



Affected Population



simulation result in seismic intensity

Recent Activities by Japan Meteorological Agency

Examples of municipal and resident responses to weather Warnings/Advisories

	Weather Warning/Advisory type								Municipal responses	Resident responses
		Heavy rain		Storm	Storm surge	High waves	Heavy snow	Snowstorm		
		Sediment incident	Inundation							
Emergency Warning (Significant likelihood of catastrophe)	Sediment Incident Alert	Heavy rain Emergency Warning (sediment incident)	Heavy rain Emergency Warning (inundation)	Storm Emergency Warning	Storm surge Emergency Warning	High wave Emergency Warning	Heavy snow Emergency Warning	Snowstorm Emergency Warning	• Immediately urge residents to take all possible steps for self-protection • Alert residents to the issuance of an Emergency Warning and highlight the exceptionally dangerous situation	• Take immediate action for self-protection (head to an evacuation center, or if it is dangerous to go outside, evacuate to a safer place within the building)
Warning (Chance of catastrophe)		Heavy rain Warning (sediment incident)	Heavy rain Warning (inundation)	Storm Warning	Storm surge Warning	High wave Warning	Heavy snow Warning	Snowstorm Warning	• Urge residents to evacuate • Issue evacuation advisories and orders to areas as necessary • Prepare for emergency response • Issue evacuation preparedness information to trigger evacuation of people requiring assistance • Establish evacuation centers • Disseminate Warnings to residents	• Start voluntary and early evacuation or follow evacuation advisories/orders • For Storm Warnings, evacuate to a safe place • Report abnormalities to municipalities and other authorities • Stay away from hazardous places • Prepare for evacuation
Advisory (Possible development of serious adverse conditions)		Heavy rain Advisory		Gale Advisory	Storm surge Advisory	High waves Advisory	Heavy snow Advisory	Snowstorm Advisory	• Patrol areas requiring caution • Advise residents to pay attention • Monitor weather bulletins and information on rainfall conditions • Prepare to call out relevant officials	• Check emergency supplies • Check evacuation routes and centers • Check windows and storm shutters • Monitor weather bulletins on TV, radio and JMA's website

- 3 stages of weather warnings / advisories by JMA

Recent Activities by JMA

- JMA started to release their forecast of the transition of the weather since July 2017, when a state of critical urgency is coming with approaching big storm, torrential rains, and so on.

<Example 1>

Released on 11:00, 28 August by Morioka Local Meteorological Observatory

- There is some possibility of issuing a warning of heavy rain in the northern coastal region within 30 hours.

	28 Aug.		29 Aug.		30 Aug.	31 Aug.	1 Sep.	2 Sep.
	until dusk	night time		from morning till midnight				
	12–18	18–6		6–24				
Heavy Rain	–	–	–	Middle	High	High	–	–
Storm	–	–	–	–	High	High	–	–
Waves (High Sea)	–	–	–	–	High	High	–	–

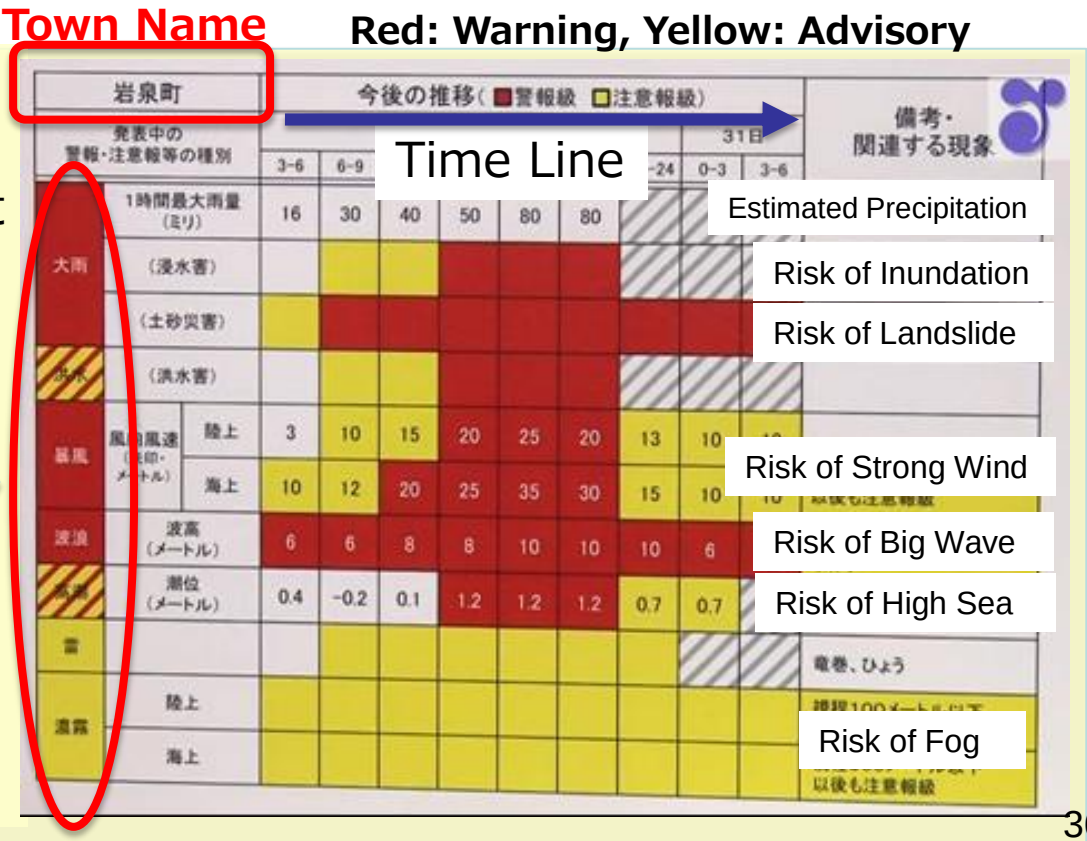
Recent Activities by JMA

- JMA started to release their forecast of the transition of the weather since July 2017, when a state of critical urgency is coming with approaching big storm, torrential rains, and so on.

<Example 2>

- Delivering information about forecasting of the transition of the weather at every local government by each Local Meteorological Observatory.

Weather phenomena, such as heavy rain, storm, thunder, fog, and so on.

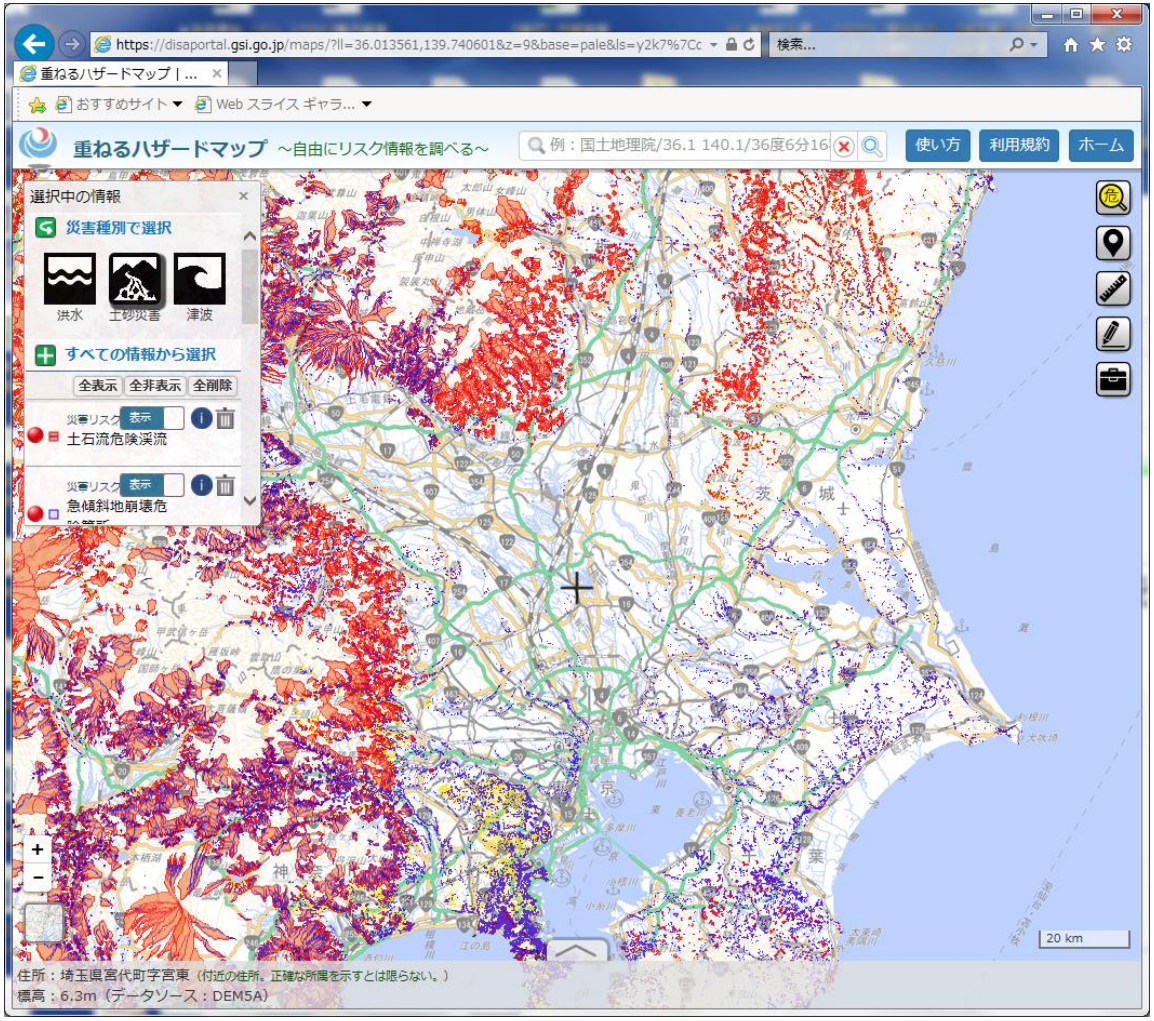


Recent Activities by JMA

- JMA started to open river data about real-time-forecast of flux over 20,000 rivers in Japan since July 2017.

Hazard Map Portal by MLIT

- The MLIT is running a website named Hazard Map Portal since 2007.
- Estimated flood area, road information, risk area can be shown with maps and aerial photos.



This example shows distribution of potential areas suffering from landslide, debris flow and slope collapse.

Base map data and the platform for web map are offered by GSI.

Ministry of Land, Infrastructure, Transport and Tourism of Japan

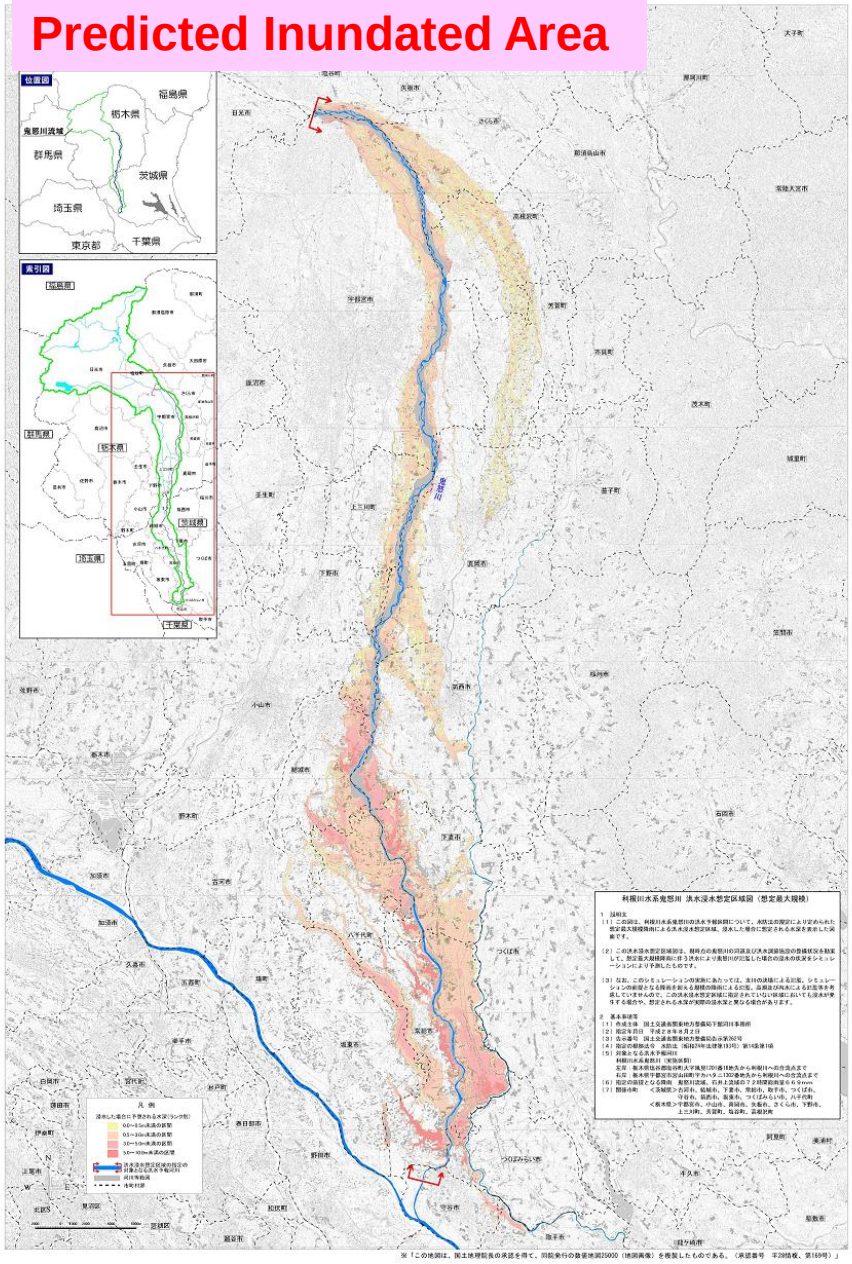
Hazard Map Portal by MLIT

Regions River Names

(平成29 月2日現在)

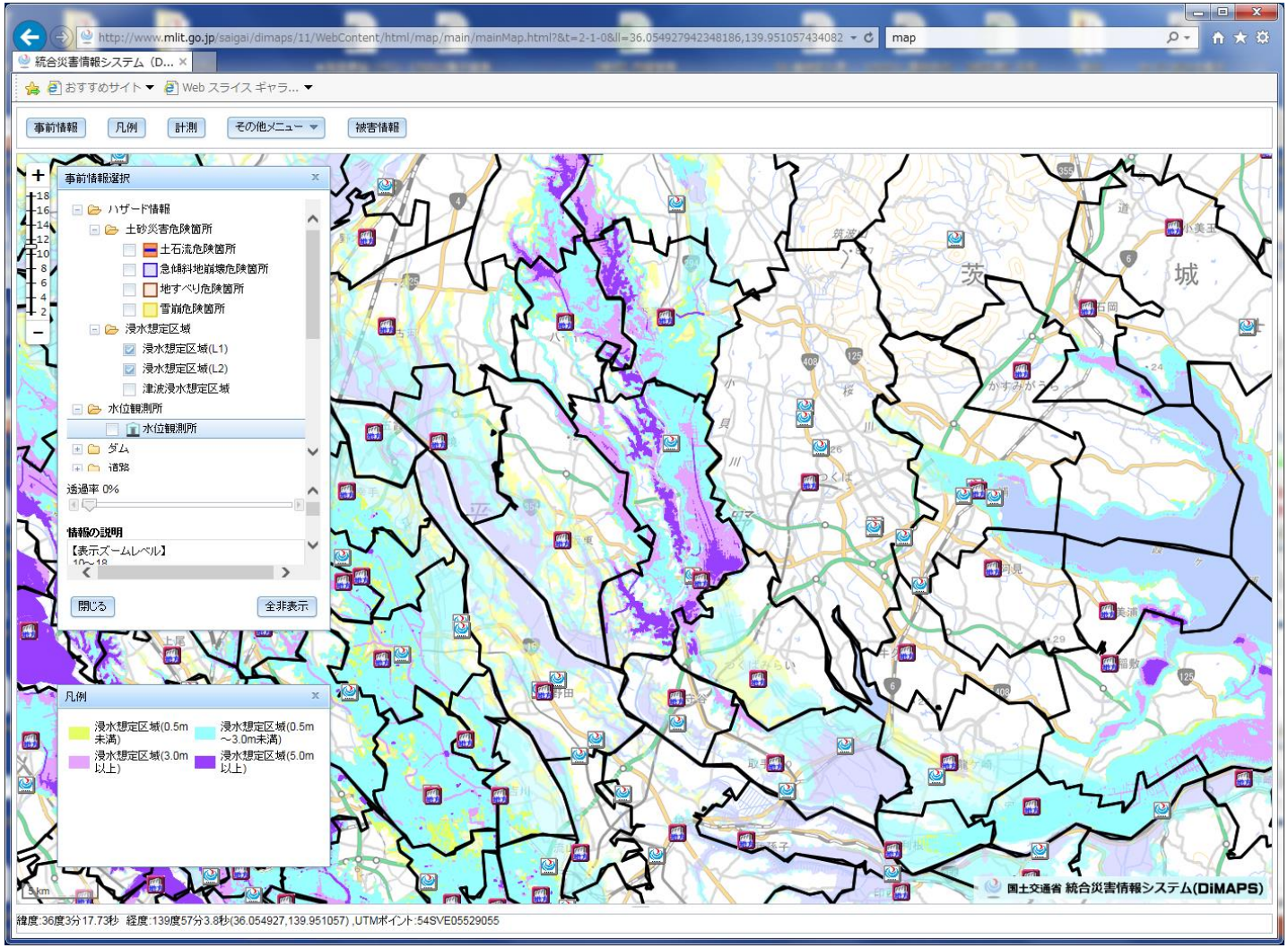
管轄地方整備局	水系名
北海道開発局	石狩川 尻別川 後志利別川 鵡川 沙流川 天塩川 留
東北地方整備局	阿武隈川 名取川 鳴瀬川 北上川 馬淵川 高瀬川 岩
関東地方整備局	利根川 荒川 那珂川 久慈川 鶴見川 多摩川 相模川
北陸地方整備局	荒川 阿賀野川 信濃川 関川 姫川 黒部川 常願寺川
中部地方整備局	狩野川 安倍川 大井川 天竜川 菊川 豊川 矢作川
近畿地方整備局	新宮川 紀の川 大和川 淀川 加古川 揖保川 円山川
中国地方整備局	千代川 天神川 日野川 斐伊川 高津川 江の川 吉井
四国地方整備局	吉野川 那賀川 物部川 仁淀川 渡川 肱川 重信川
九州地方整備局	遠賀川 山国川 大分川 大野川 番匠川 五ヶ瀬川 小

Predicted Inundated Area



DiMAPS (Integrated Disaster Information Mapping System)

DiMAPS by MLIT.
Disaster information and relevant information is displayed on the web map.

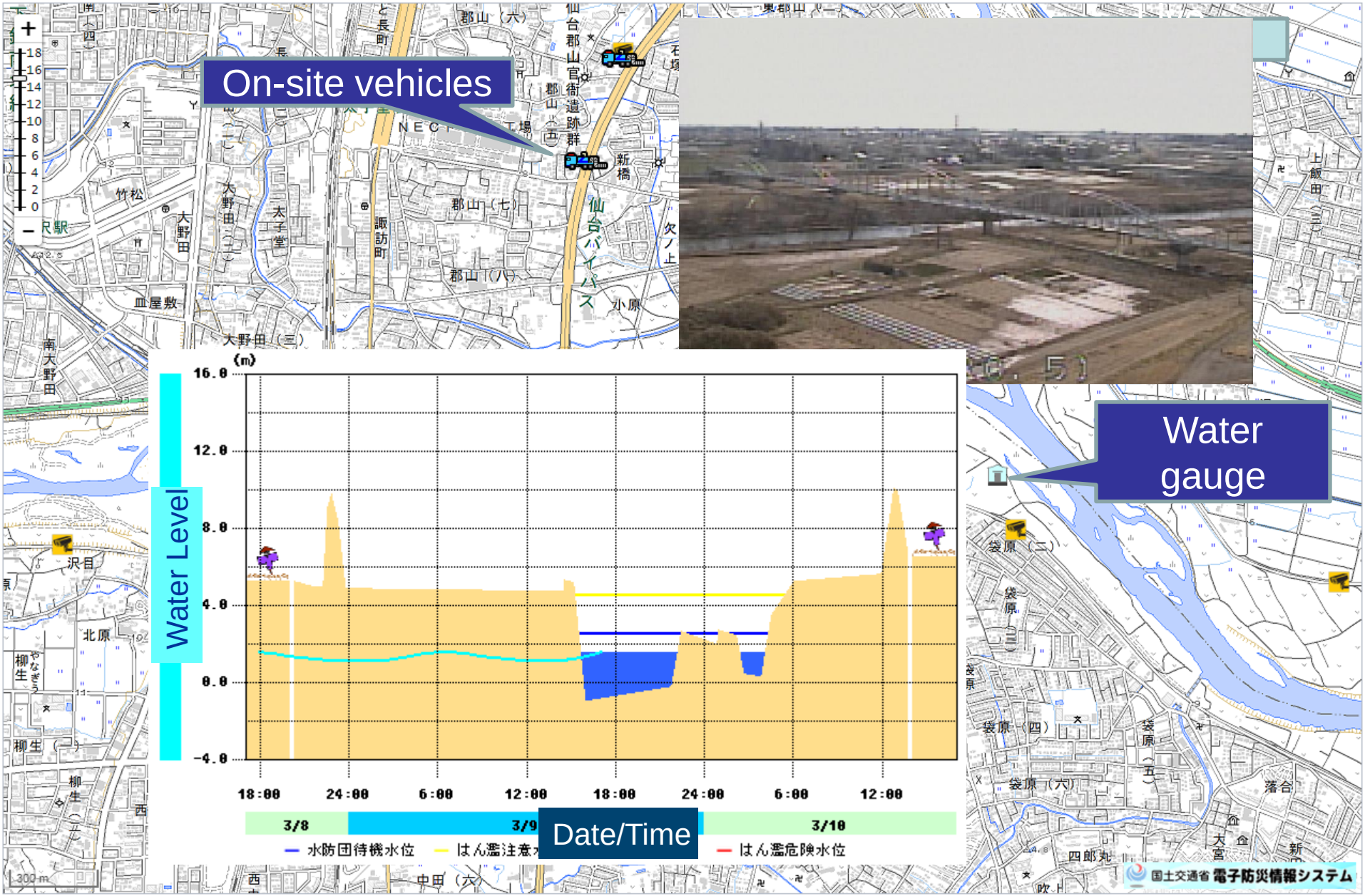


This example shows distribution of potential areas suffering from river flood.

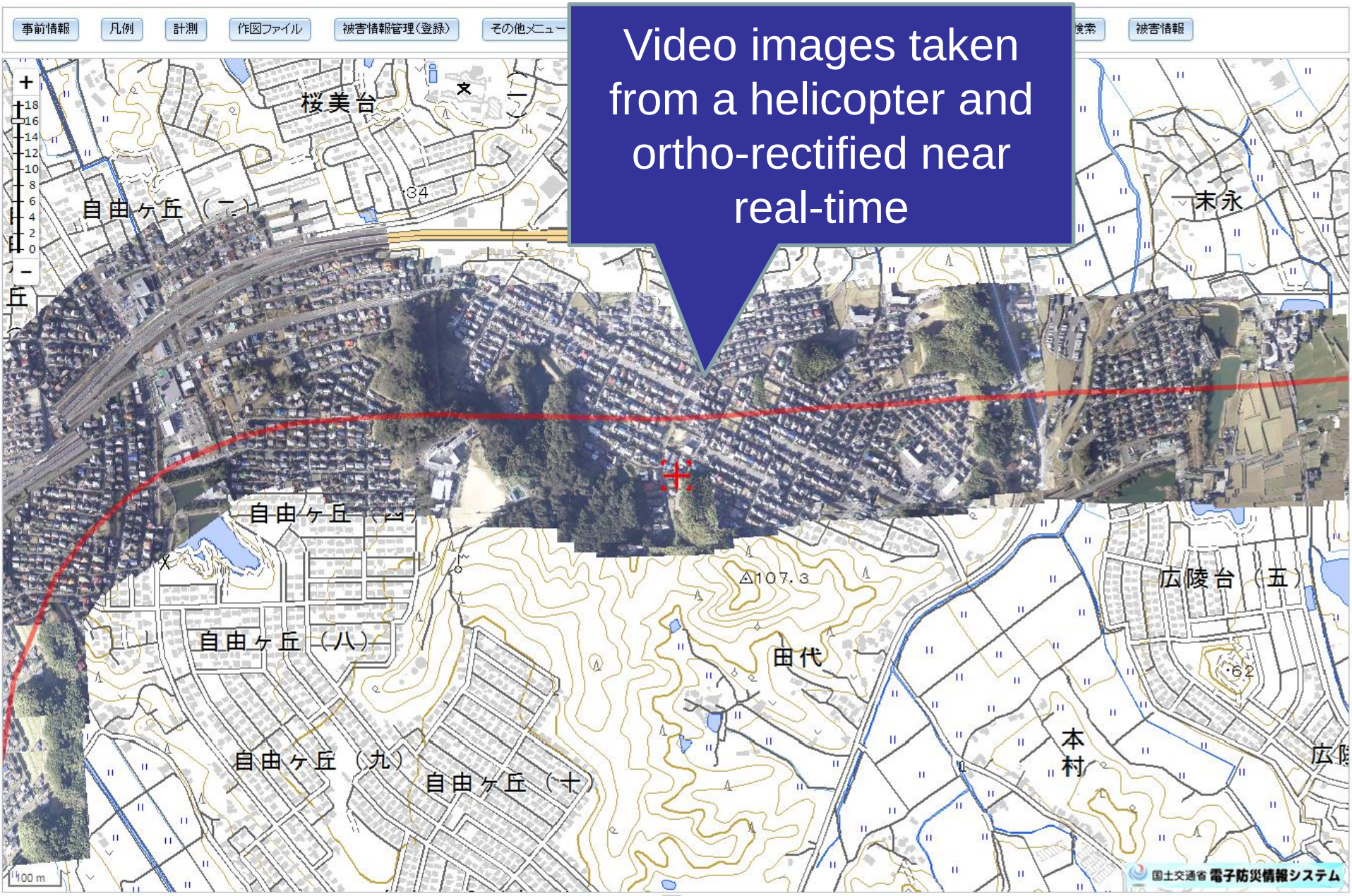
Base map data and the platform for web map are offered by GSI.

Locations of MLIT Branches, Evacuation Area, Local Government, etc.

Geospatial Information Platform for Decision Makers



Geospatial Information Platform for Decision Makers



Video images taken from a helicopter and ortho-rectified near real-time

Activities during the pre-disaster period

- These examples showed above are open to the public each by each, as a judgement of the Japanese Government.

- The indicators for disaster risks may have spatial distribution.
  e.g. Probability of the big earthquake, land slides, etc.

- Geospatial tools may help visualizing these risks so that people can understands these risks properly to reduce the loss by disaster.

- Some data are offered to the running organizations from the GSI. The GSI continues to cooperate with those organizations.

Contents

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development

Summary

- We are now witnessing a Revolutionary Innovation in geospatial information technologies.

- National Geospatial Information Authorities in Asia and the Pacific annually have UN-GGIM-AP meeting to discuss technical and substantive activities in the geospatial information field at the regional level.

- Japan has national vision of "*G-spatial Society*" and relevant ministries and stakeholders collaboratively make efforts, and GSI contributes to provide geospatial infrastructure.

- Such geospatial infrastructure will contribute to achieve SDGs.

Thank you!