

# Social and economic effect of surveying, portraying and safeguarding Land

Yasushi Shimoyama

GeoSpatial Information Authority(GSI),  
Ministry of Land, Infrastructure,  
Transport and Tourism, Japan

- Basic Act on the Advancement of Utilizing Geospatial Information (2006)
  - Article 3 Basic Principles (4)
    - Policies for the advancement of utilizing geospatial information must contribute to the promotion of effective use, development and conservation of the national land, and to the protection of the lives of the people, their persons and their property by enhancing the effective and efficient management of public facilities, and the promotion of measures against disasters, etc., through active engagement of the state and local governments in accomplishing their administrative work and projects.

- Basic Act on the Advancement of Utilizing Geospatial Information (2006)
  - Article 3 (5)
    - Policies for the advancement of utilizing geospatial information must contribute to the improvement of the administrative efficiency of governments as well as to their functional enhancement through the prevention of unnecessary duplication of mapping and the improvement of integration, flexibility and transparency of policies, etc., by sharing geospatial information that is essential for each section of government administration.

- Basic Act on the Advancement of Utilizing Geospatial Information (2006)
  - Article 14
    - Concerning the advancement of utilizing geospatial information, the state and local governments shall take measures including the broader use of geographic information systems in their administrative work and projects, the diversification and improvement of the quality of public services thereof, and other necessary measures in order to enhance the people's convenience as well as the efficiency and functionality of administrative management.

- Basic Act on the Advancement of Utilizing Geospatial Information (2006)
  - Article 18 (2)
    - As a general rule, the state state should provide the fundamental geospatial data that it possesses through the Internet without compensation.

- During past decade
  - Recognition of government changed. Many of government officials know “geospatial information”
  - Activities of local governments are progressing, but not sufficient.
  - The fundamental geospatial data was provided free of charge and are now updating.
  - Raw data received at GNSS control station from positioning satellite is also free.  
(Receivers of 1,300 GNSS control stations almost accept GLONASS data, now about 60% stations accepted Galileo data, after periodic replacement)

- We should go to further stages based on the concept of the basic act.
- Our organization should continue to prepare fundamental geospatial data (urban area: 1:2,500, rural area: 1:25,000), distributed free of charge.
- Raw data received at GNSS control station from positioning satellite is also free.
- We should insist on the benefit of these basic work. How to explain?

# Target of this presentation

## : How to understand “impact”?

1. Impact to the society in general
2. Impact to an individual user/application
3. Impact of each geospatial technology or work (to users)

# 1. Impact of geospatial Information to the society in general

- We need to be:
  - Laterally expressed
  - Geospacially expressed

Mapping and surveying contribute to various fields in our society.

**For safety and security**

- Response to earthquake, volcanoes, water disaster
- Monitoring crustal deformation
- Investigation of topography causing disaster etc.

**For more valuable lives**

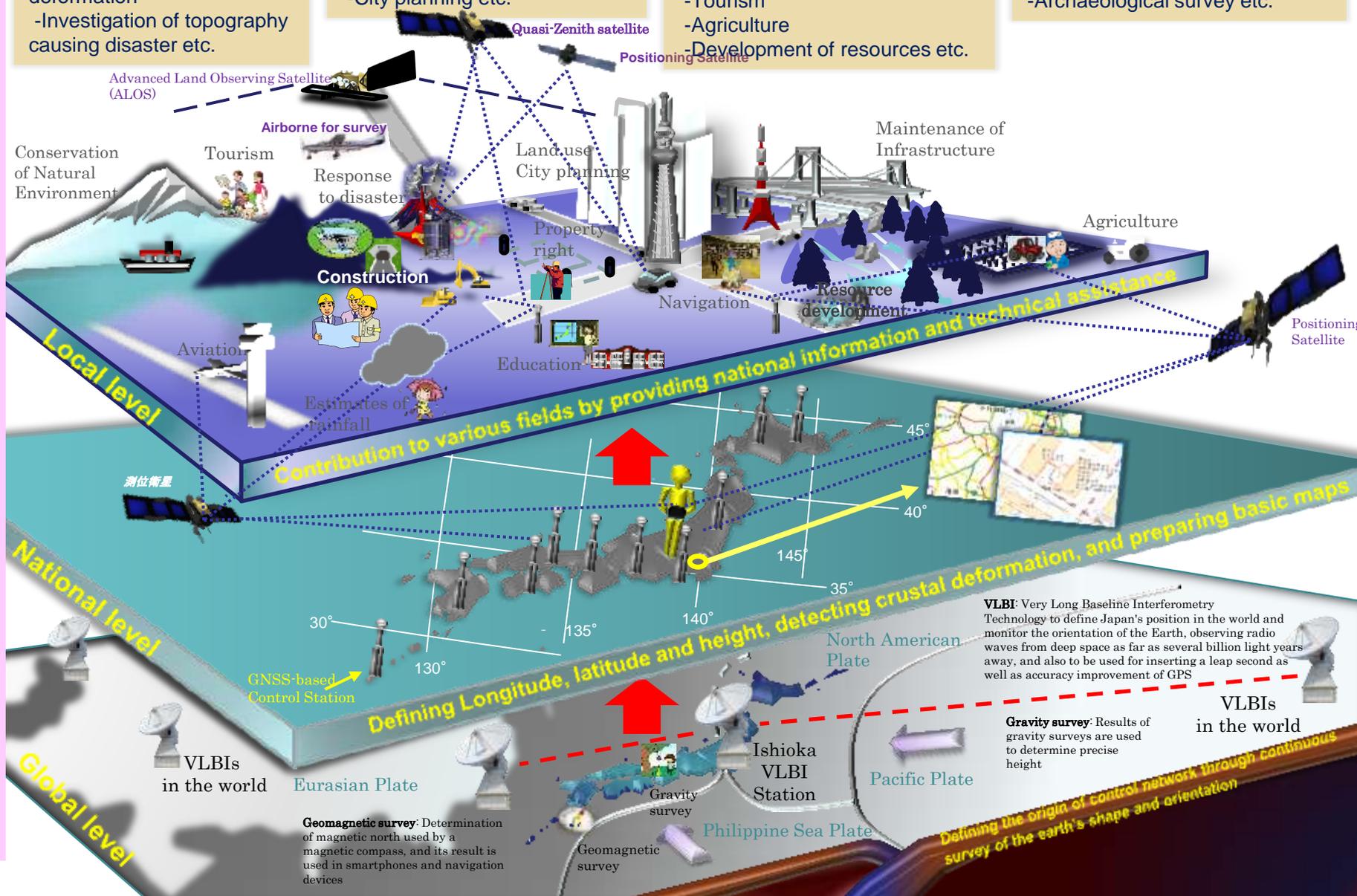
- Construction and maintenance of infrastructure
- Establishing land boundary
- City planning etc.

**For industrial development**

- Navigation (supporting cars or people to decide a route)
- Tourism
- Agriculture
- Development of resources etc.

**For education, historical survey and culture**

- Education of geography
- Understanding changes of land
- Archaeological survey etc.



## 2. Impact to an individual user or application

examples:

- Disaster prevention/mitigation
- Preserving cultural properties
- Safeguarding children and older people

## Disaster Prevention/Mitigation

Preparedness

Response

Recovery

### Contribution of mapping/surveying fields (examples)

- Hazard maps on basic maps with evacuation information

- Monitoring crustal deformation using GNSS

- Detailed survey of disaster affected area  
(field survey, aerial photo, radar image)

- Emergency transportation routes using GIS

- Preparing basic maps for recovery

- Re-calculating coordinates of control points/benchmarks

### Collecting disaster information

Using latest technologies such as airborne/UAV survey, temporal Remote GNSS Monitoring System etc.



Taking photos by airborne survey



Taking videos by UAV



Setting temporal Remote GNSS Monitoring System

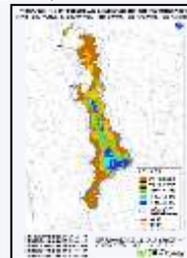
### Providing geospatial information related to disaster



Flood of Kinu River (Movie)

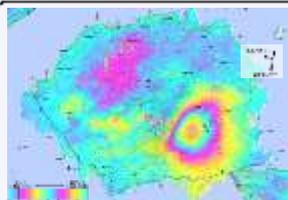


Aerial photos before and after the disaster



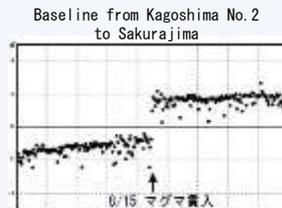
Estimated flood area

Heavy Rainfall Disaster in the Kanto and Tohoku district (Sept. 2015)



Interferometric SAR(InSAR) image by ALOS-2 Satellite (Aug.10 to 24, 2015) (Original data are owned by JAXA)

Analysis of crustal deformation using satellite data



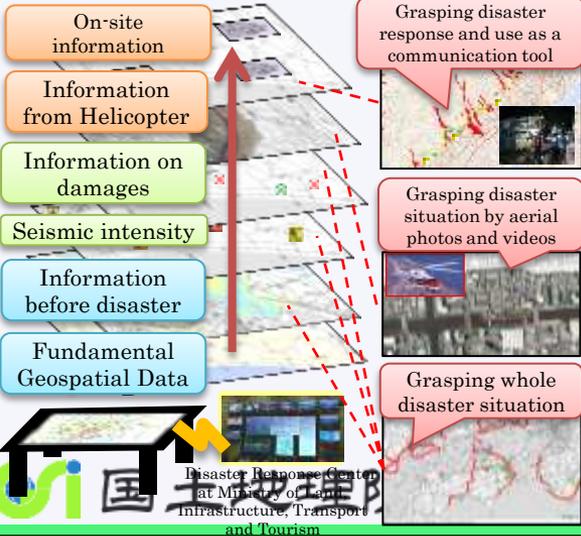
Continuous monitoring by GNSS-based control stations

(Sakurajima Island) Prepared on 16 May, 2016

We  
 Survey  
 Portray  
 Safeguard  
 our Land.

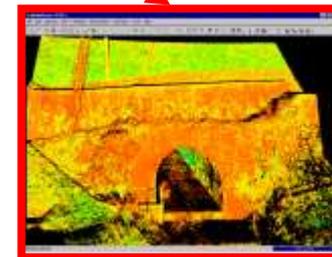
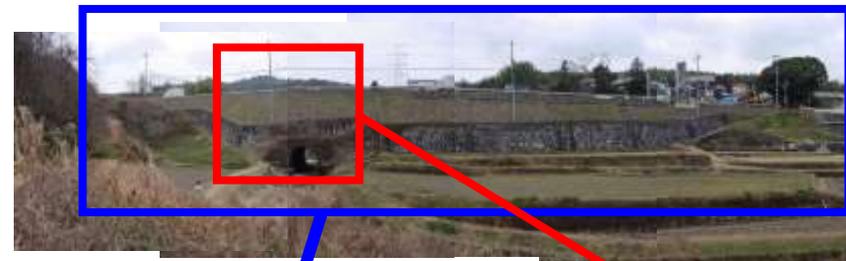
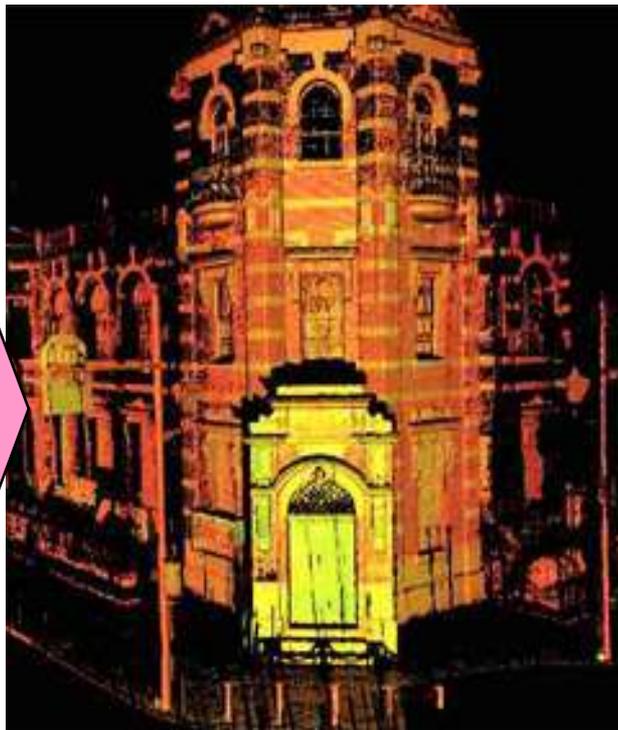
### Integrated Disaster Information Mapping System (DiMAPS)

Disaster information system for rapid grasping and sharing information by collecting a variety of disaster information and for overlaying on one digital map



Valuable cultural remainders should be investigated in detail especially in case of development. Preservation measures are adopted if required.

Precise survey using control points survey and/or drones contributes to preparing electronic design data and properly managing the cultural properties.



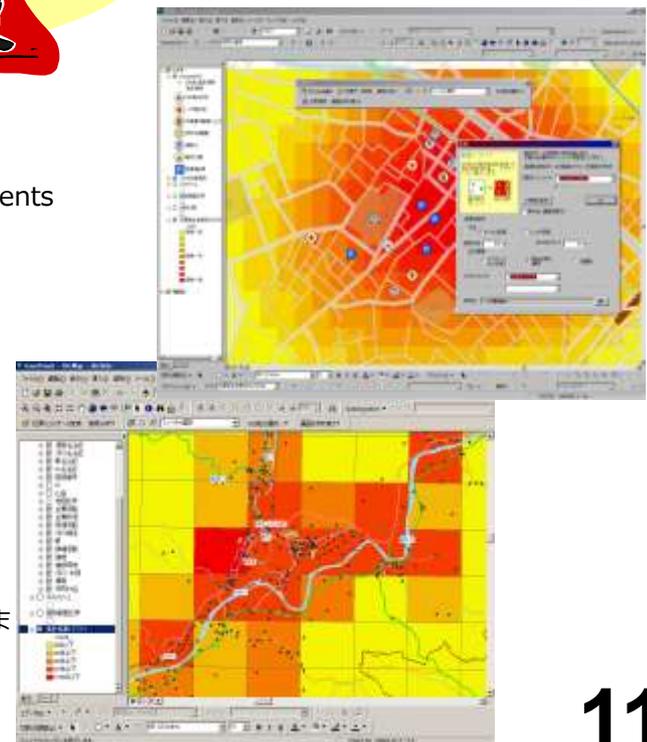
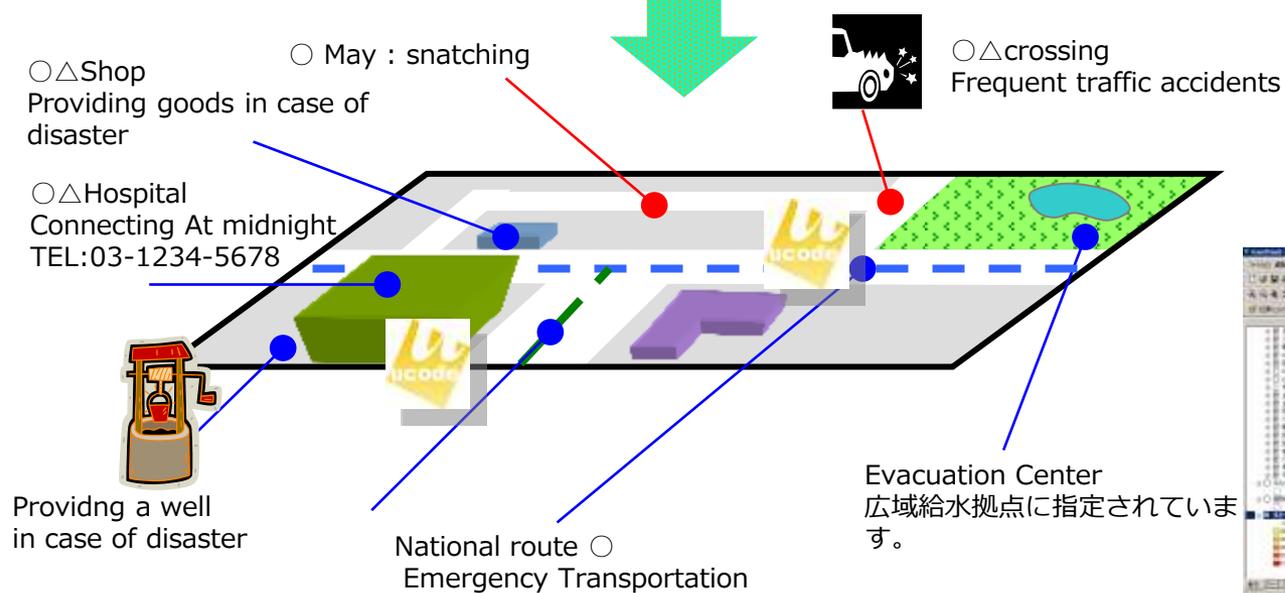
# Safeguarding children and older people

How to safeguard children and older people is a strong concern of society.

Visualizing the places of some accidents or other information through basic map and positioning system enables them to live more prepared/peaceful life.



Where did crimes/accidents happen?



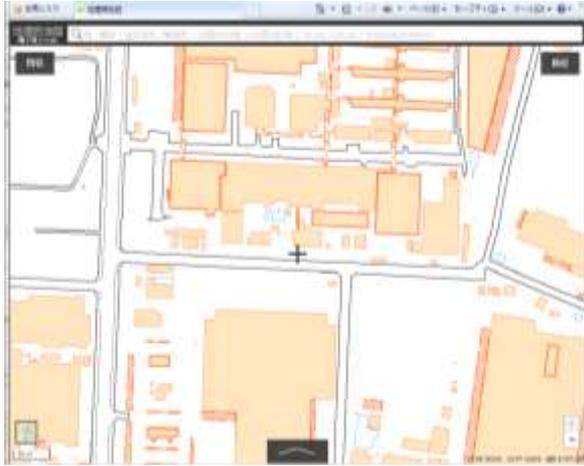
### 3. Impact of each geospatial technology or work (to users)

- UAV

- GNSS-based Control Stations

- National Maps

# We are using UAV for



- Mapping(by public survey)
- Disaster survey
  - Taking aerial photograph
- Construction  
(i-Construction)
  - designing, calculating the amount of soil, construction records etc.
- Others:
  - historical properties survey, Landscape survey, etc.

155 private survey companies own UAV  
among 539 ones (29%)

# We are using UAV

- For mapping by public survey
  - “Public survey” means the survey executed by governments or local governments based on the Survey Act
- GSI developed two major guidelines in Japan last March;
  - Technological guideline
  - Guideline for safety survey

# Using UAV in case of natural disaster

## ●Surveying wide area



(Volcano of Kuchinoerabu)



(Volcano of Nishinoshima)

## ●Investigating damaged area



Kinu River flood (2015)



Kumamoto earthquake(2016)



## Using Fixed-wing



## Using multicopter



# Revealed active faults (youtube)

YouTube JP



2:56 / 6:01

【国土地理院】南阿蘇村河陽周辺の断層（平成28年4月18日撮影）



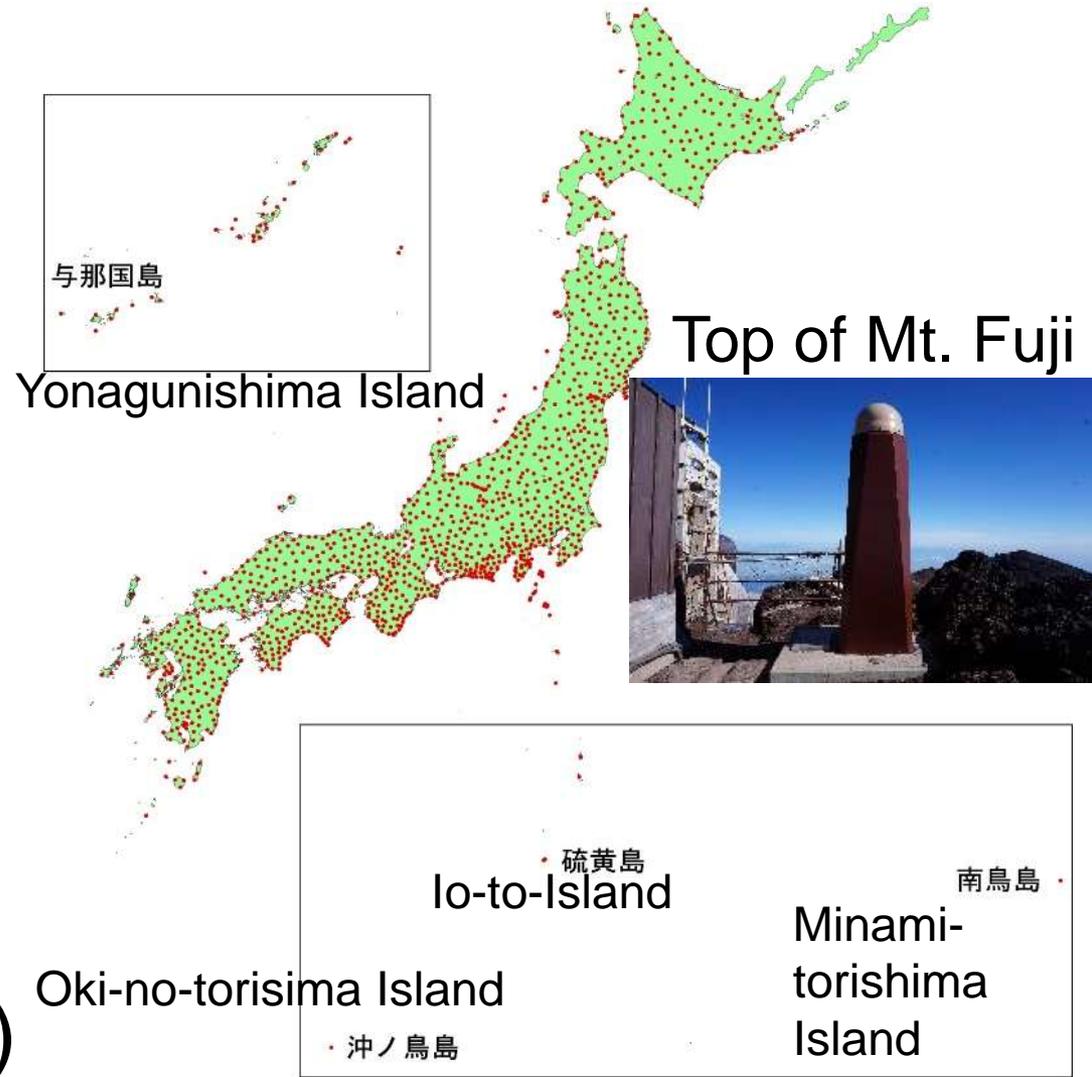
国土地理院動画チャンネル

チャンネル登録 1,367

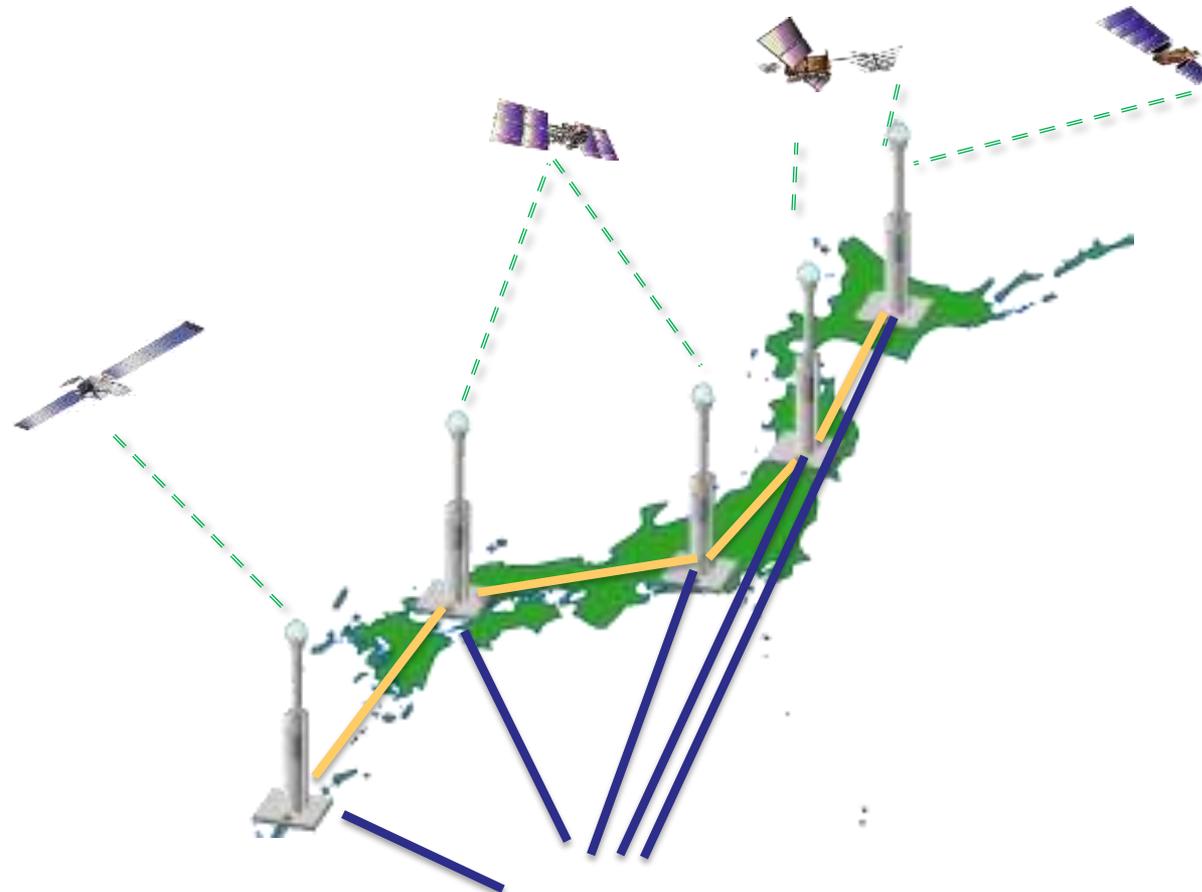
6,337

+ 追加   共有   ... その他

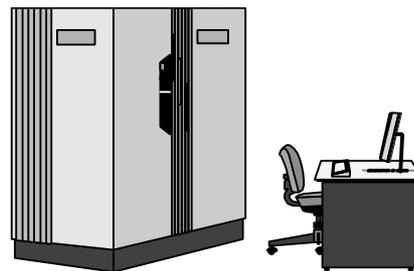
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GNSS-based Control Stations  
(About 1,300 stations)



GEONET\* Central  
Analysis Center



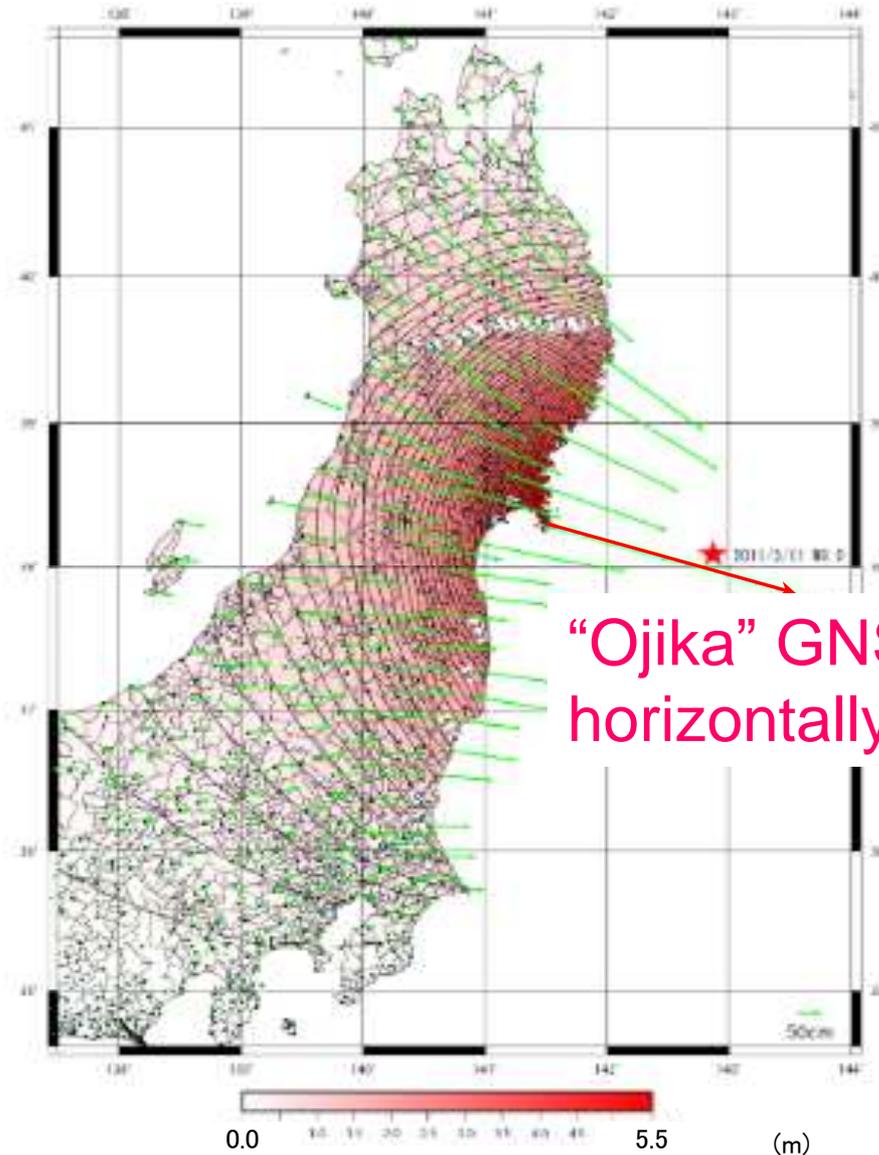
\*GNSS Earth Observation NETwork system 23

- Survey (control point survey, photogrammetry)
  - Cost reduction
- Disaster prevention/mitigation
  - Crustal deformation
  - Revising coordinates of control points
    - Contribution to immediate recovery
  - Forecasting the amount of rainfall
    - Contribution to weather forecasting by Meteorological Agency

- Control points survey at public sectors by GNSS control points in 2014 (JFY)
  - Trial calculation of control point survey
  - Probably about 40% total cost reduction is achieved, compared to the former survey way using electronic tacheometer
- Airborne survey for mapping at public sectors by GNSS control points in 2014 (JFY)
  - Airplanes are equipped with GPS receiver and IMU for getting the position, and GNSS control stations make the actual position of airplane more precise
  - About 5% total cost reduction estimated, compared to the mapping by manual orientation

# How is the GEONET used?

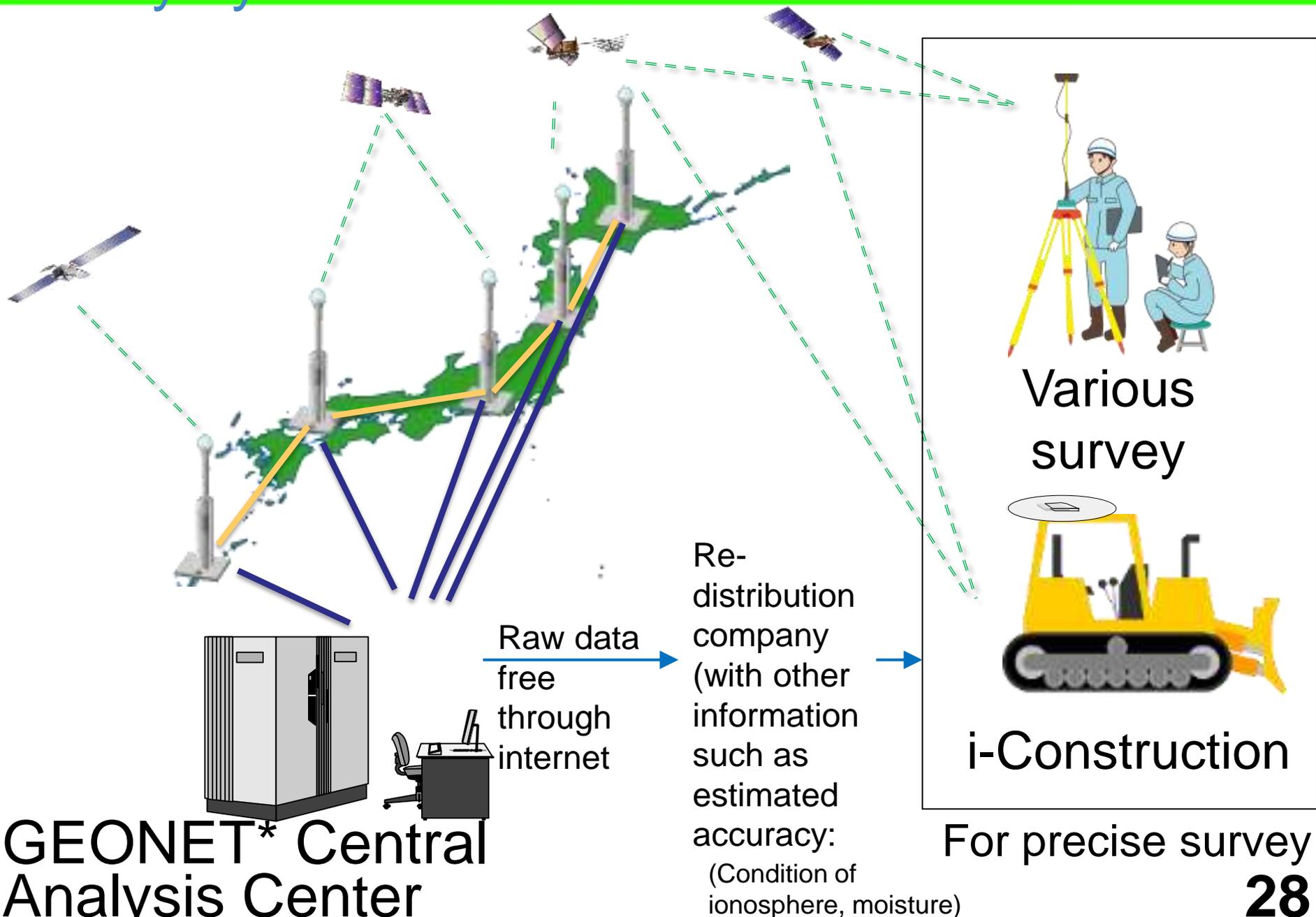
## Crustal Deformation just after Great East Japan Earthquake



“Ojika” GNSS Control Point horizontally 5.3m moved.

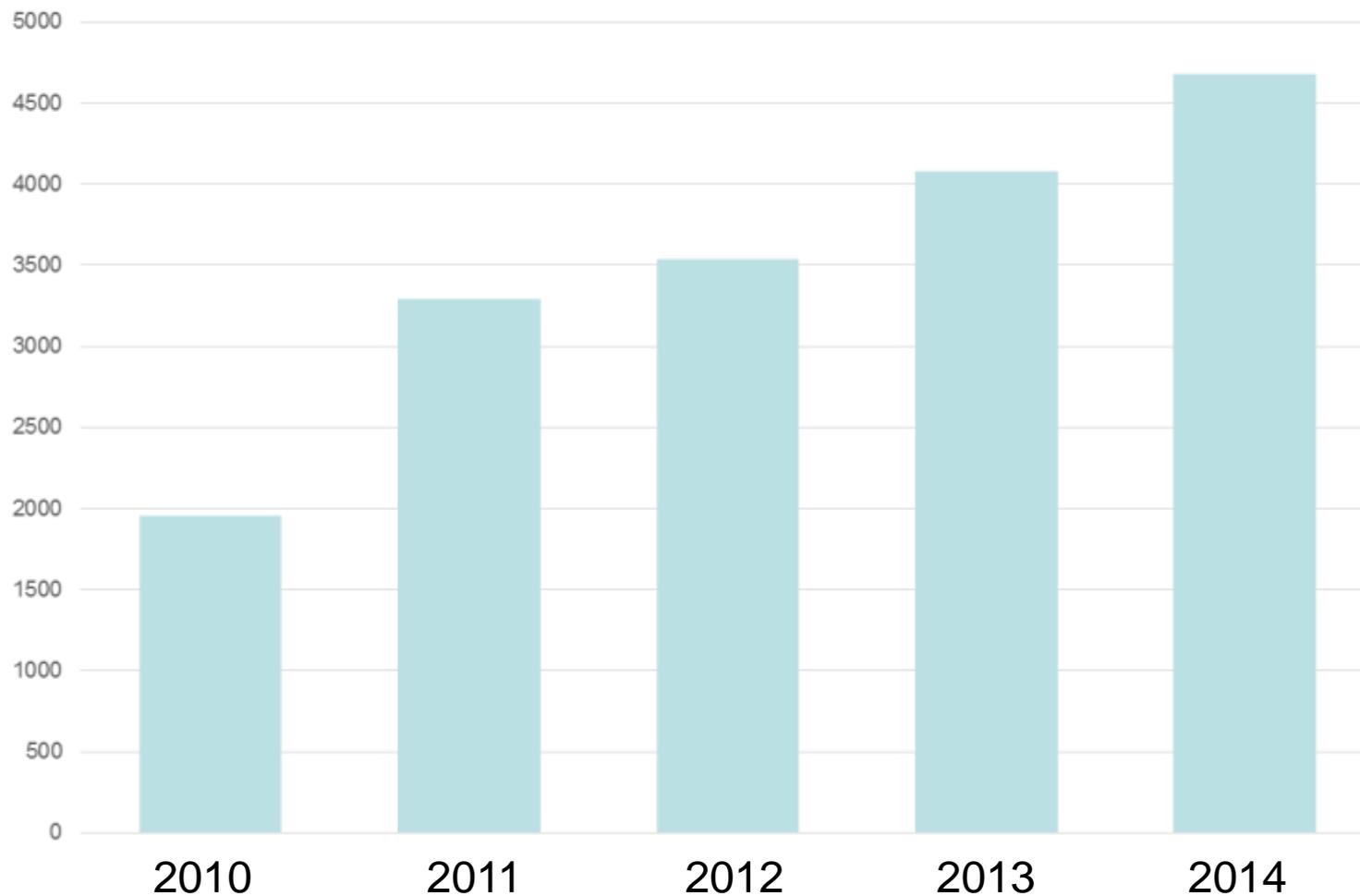
- Airborne laser survey to get DEM (more than 7,000km<sup>2</sup>/year in Japan)
- Mobile Mapping System (more than 15,000km/year in Japan)
- Providing real-time positioning service
  - i-Construction
  - Intelligent agriculture - unmanned machines
- QZSS (Japanese positioning satellite)

# Survey by data of GNSS-based Control Stations

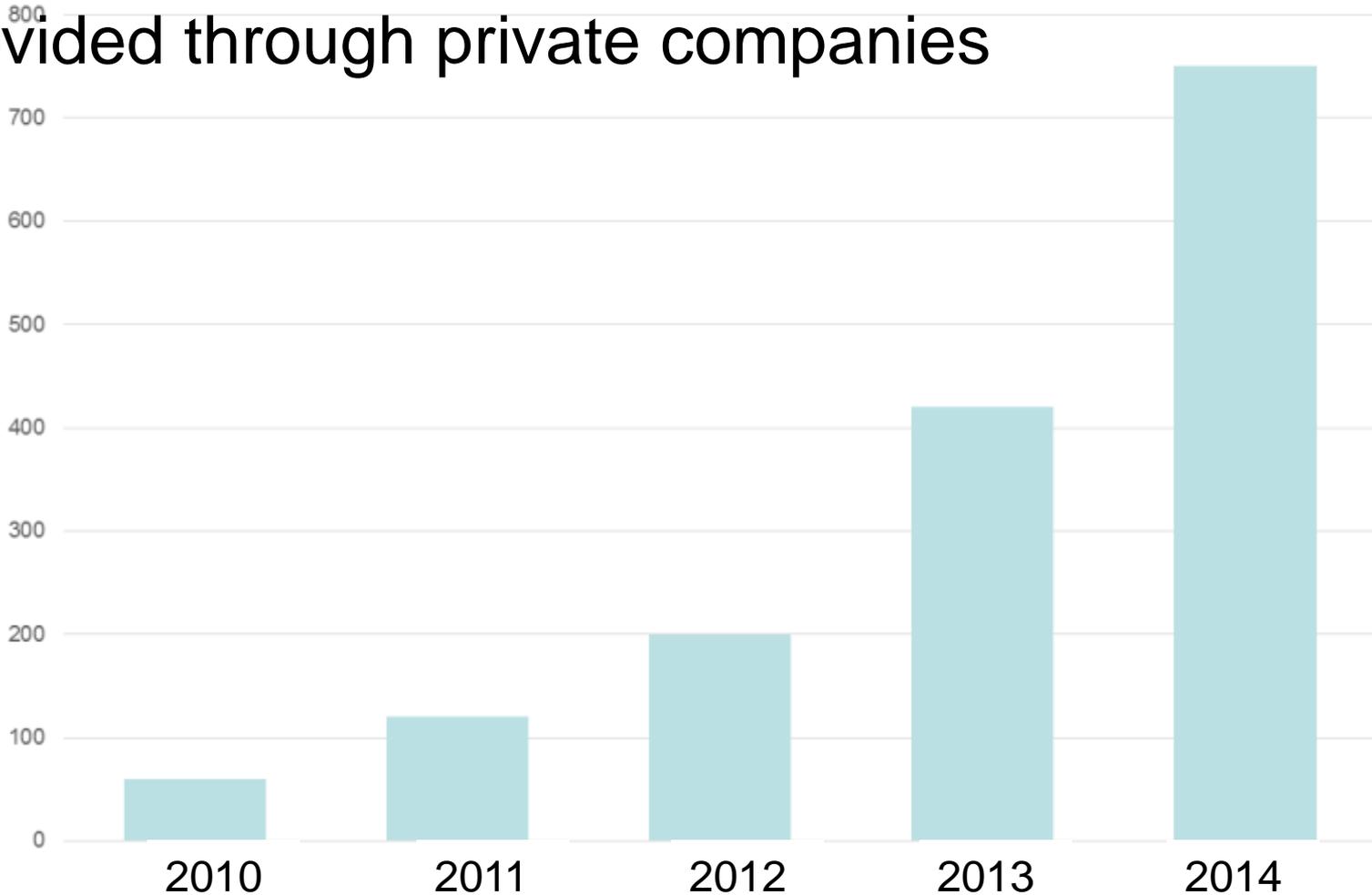


**GEONET\* Central Analysis Center**

## Users of real-time data (GEONET) provided through private companies



Users of real time data for Intelligent construction/agriculture using GEONET provided through private companies



## Printed map



## Image map data



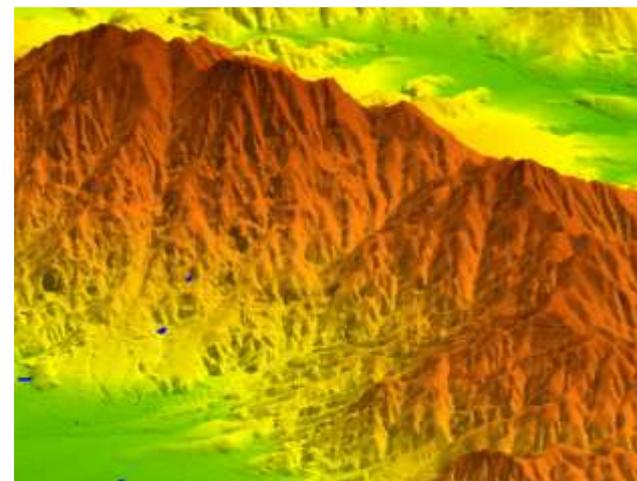
## Vector data

(seen through viewer software)



## Digital Elevation Model

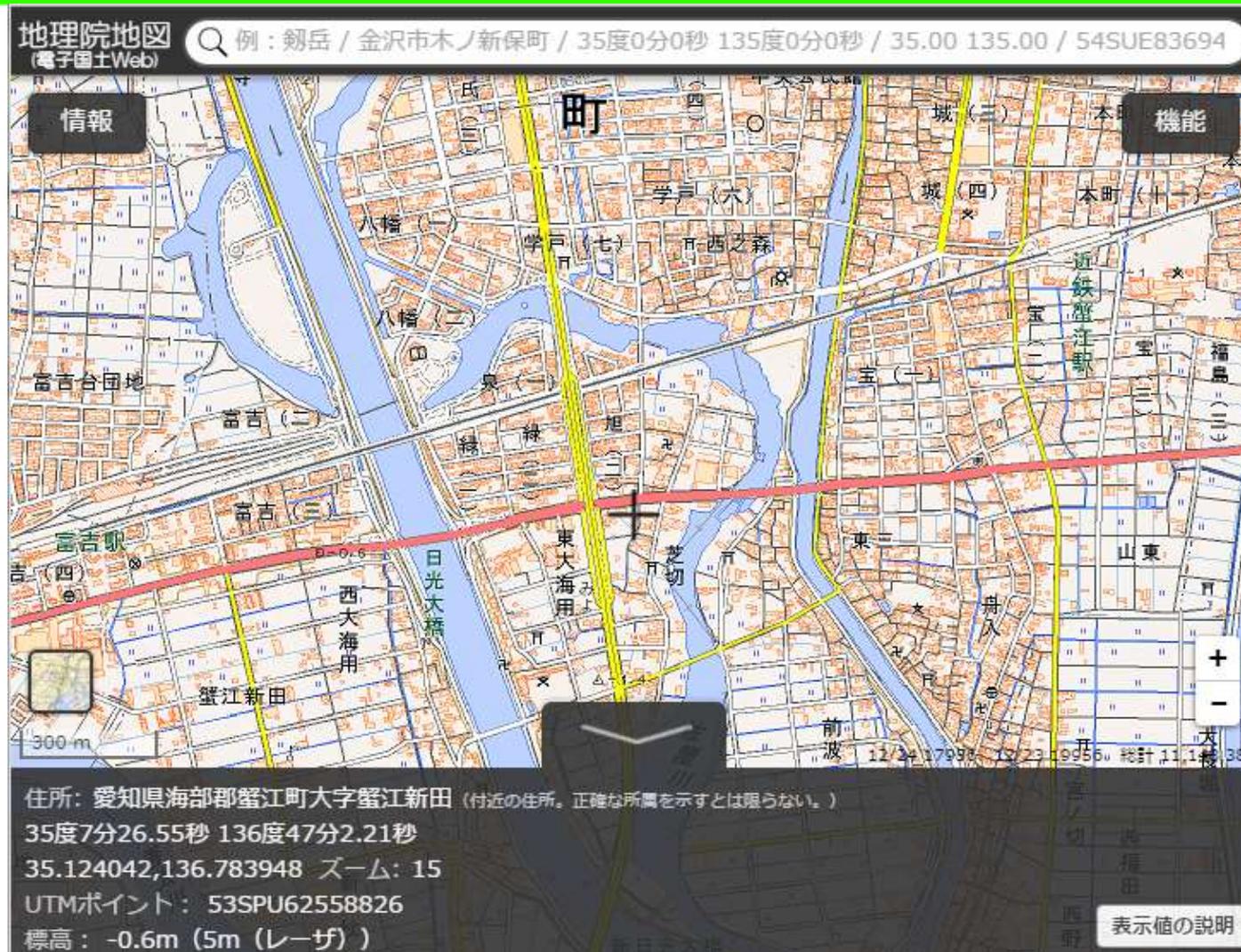
(by Laser scanner/digitalized contour)



# Impact of National Mapping

- National Maps of GSI are used for various purpose.
- They are also the basic map for disaster management in our country.
- The area where national map 1:25,000 (or more) was seen by the webmap of GSI “GSIMaps” in 2013 FY is about 4 billion km<sup>2</sup>.
- The area where the use of national map 1:25,000 for making other contents was requested by users and approved by GSI based on Survey Act is estimated as 50 million km<sup>2</sup> in 2014FY
  - Printed maps
  - Image map data
  - Vector data
  - Digital Elevation Model(mesh size is 10m(partly 5m))

# GSI Maps (National Maps displayed)



We can display any combinations of maps, aerial photos and thematic maps. Specific photos at disaster area can also be overlaid. (currently only in Japanese)

- 3 policies for promoting GSI Maps
  - Using open data based on guidelines of government
  - Using open source
  - Seeking for open innovation, through collaboration
- 3 technologies for GSI Maps
  - Elevation tiles
  - Vector tiles
  - Digital Fabrication (corresponding to demand; independency between tiles and APIs)

# Conclusion

- The effect of geospatial information should be discussed by
  - In general, use/application, technology or work
- We are always holding pamphlets for several minutes' explanation to high-level authorities, as a geospatial promotor of government side, in order to explain the contribution of geospatial information to the society,.
- We keep in mind that disaster management is a most important application in Japan, easy to understand.
- GSI's most important activities for best society and economy:
  - Keeping open data policies
  - Good updating, replacement or technical maintenance of geospatial infrastructure, in particular, GNSS systems, UAVs and Map data (tiles)

# Thank you for your attention

Email:

[shimoyama-y96ru@milt.go.jp](mailto:shimoyama-y96ru@milt.go.jp)

# Survey Defining control positions and providing a good environment for surveying

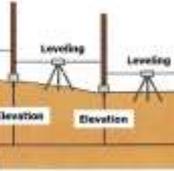


**Quasar**  
VLBI Stations



Longitude and Latitude are precisely provided based on the international observation. Position of Japanese archipelago and crustal deformation is monitored with mm-level accuracy.

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Leveling  
Elevation  
Elevation

Origin of the Japanese Vertical Control Network  
24.3900m  
Tide Station  
Moon sea level  
Tokyo Bay

Reference height is Tokyo Bay mean sea level.

Longitude, Latitude

Height

**Coordinates of origins -provided in Order for Enforcement of Survey Act**



Origin of the Japanese Horizontal Control Network (Minato City, Tokyo)



Origin of the Japanese Vertical Control Network (Chivoda City, Tokyo)

**Control points as a basis of survey**



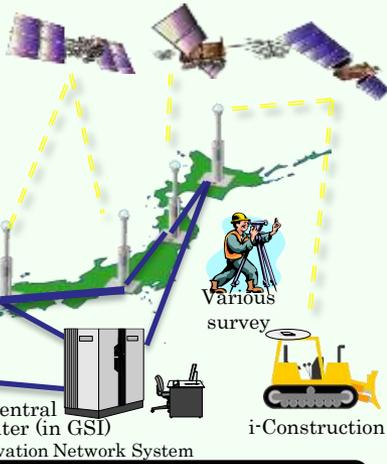
Triangulation Points  
(about 109,000 points)



GNSS-based Control Stations  
(about 1,300 stations)



Benchmarks  
(about 17,000 points)



GEONET\* Central Analysis Center (in GSI)  
\*GNSS Earth Observation Network System

Various survey  
i-Construction

Control points are a basis for all survey. GNSS-based Control Stations provide data for i-Construction and monitoring of crustal deformation.

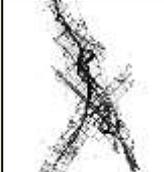
# Portray Developing maps covering the entire national land and providing in various forms

**Providing the maps as the basis of all kinds of maps**




Showing the entire national land of Japan, and providing geospatial information such as Digital Japan Basic Map, as the basis of other kinds of maps

**Quick and efficient updating of maps**



Information from administrators





Providing digital map of the Ken-O Expressway Goka-Interchange on its opening day, March 29, 2015.

Expressway is quickly updated in cooperation with government or local public organizations and administrators by the information from facility administrators.

**Provided through in a various types of media (according to needs)**








Provided through the Internet "GSI Maps" as well as in a variety of publication forms such as DVD, online, printed maps etc.