Regional Workshop on
Strengthening Multi-Hazard Early Warning System in Pacific Islands Countries
Nuku'alofa, Tonga
26-27 April 2018

Geospatial Infrastructure that Helps Keep us Resilient to Natural Disasters - Japan's example

Shoichi Oki

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

Geospatial Information Authority of Japan

- Government Organization and Responsible for Surveying and Mapping in Japan
- Designated Government Organization in Disaster Management System

Contents

1. What is UN-GGIM-AP?
2. Hazards in Japan and its geological setting
3. How works ST/GIS for disaster management?
   (a) Prepare thematic maps to raise awareness
   (b) Monitoring & Early warning system
   (c) Quickly find the impact and damages
4. Summary

Contents

UN-GGIM-AP: Introduction and Role

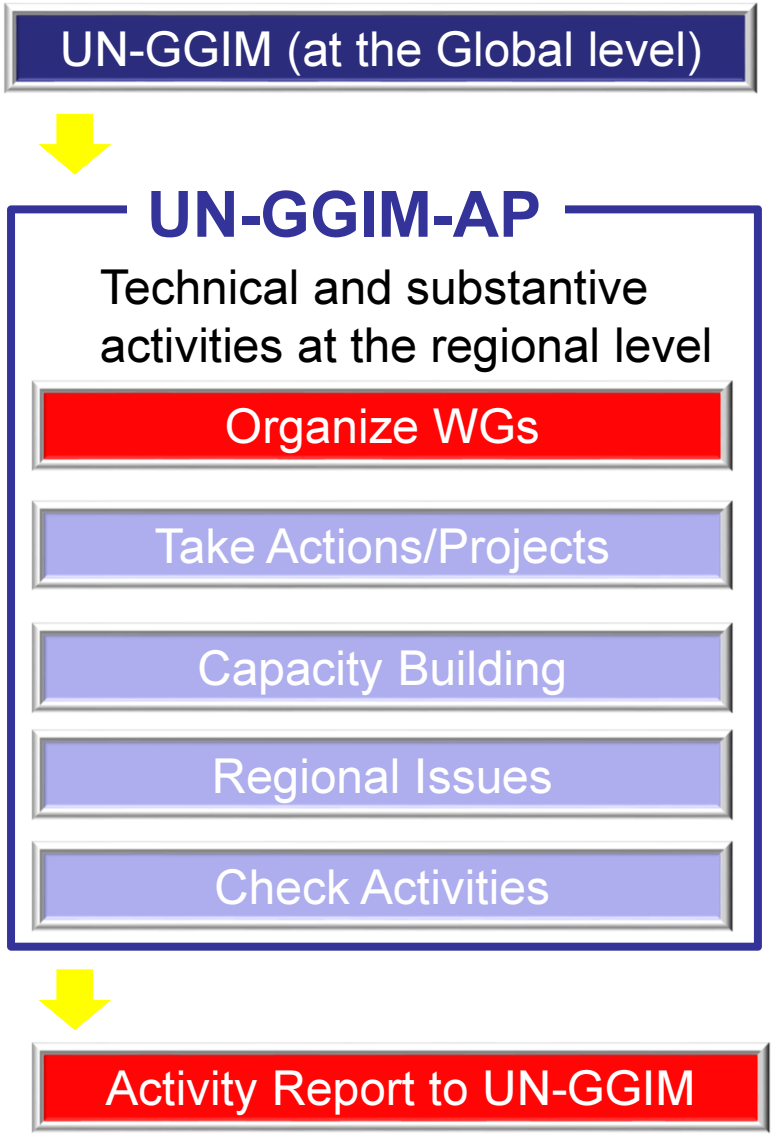
UN-GGIM-AP

- 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-AP: Working Group on DRM

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).

(*) NGIAs: National Geospatial Information Authorities

WG2 of UN-GGIM-AP is discussing specific activities in AP and developing the Guidelines for Disaster Risk Reduction using Geospatial Information to realize the strategic framework adopted by UN-GGIM.

Objectives of the Guidelines:

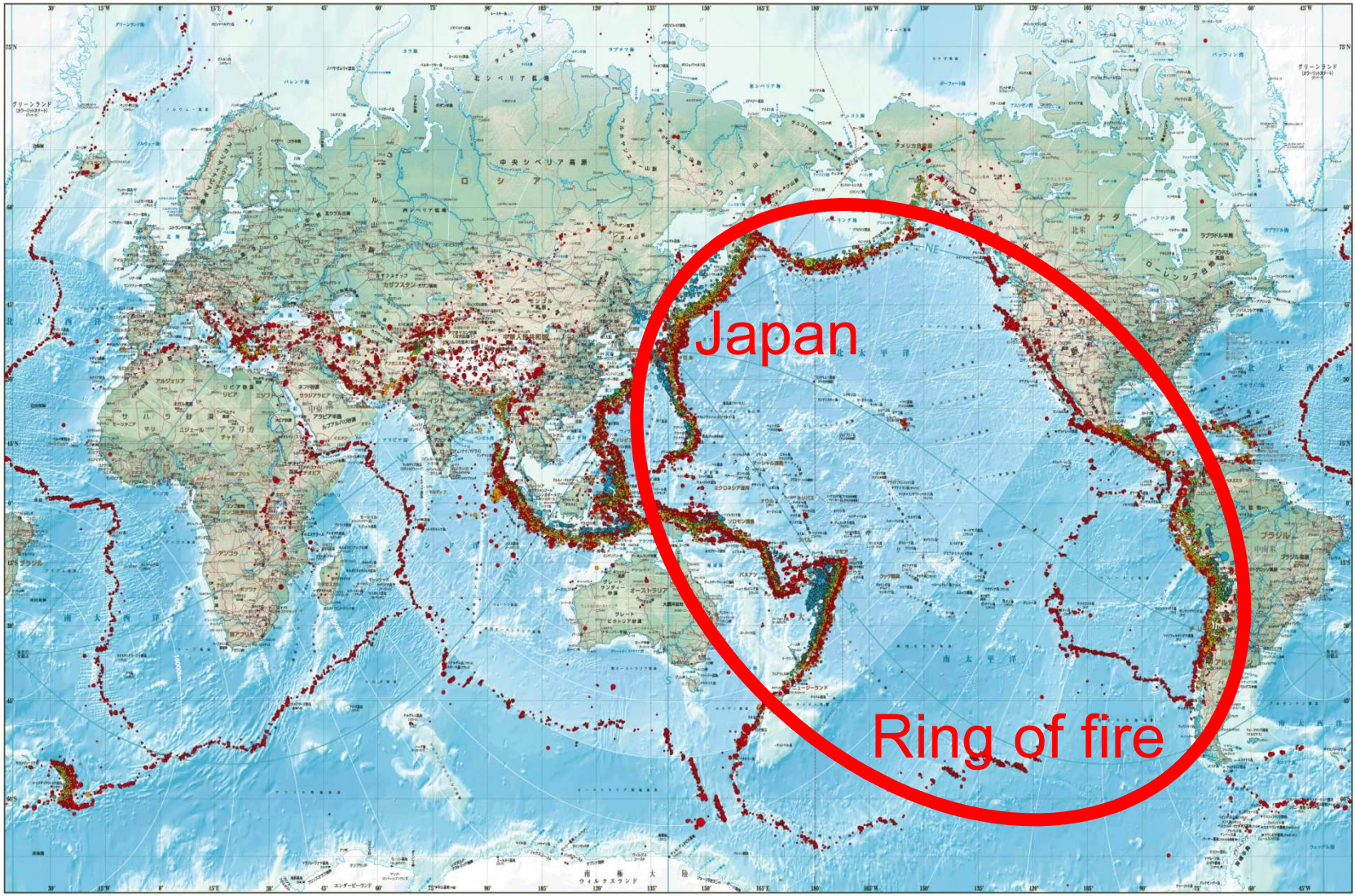
- To propose practical approaches, efforts, and ideas to help NGIAs in the Asia-Pacific region to strengthen their capabilities in disaster risk reduction.

- To enhance disaster risk reduction efforts of NGIAs through the Guidelines and by utilizing geospatial information thereby contributing to the implementation of SFDRR in the Asia-Pacific region.

Contents

Seismicity Map of the World

Earthquakes > M5.0 in 1977-2014



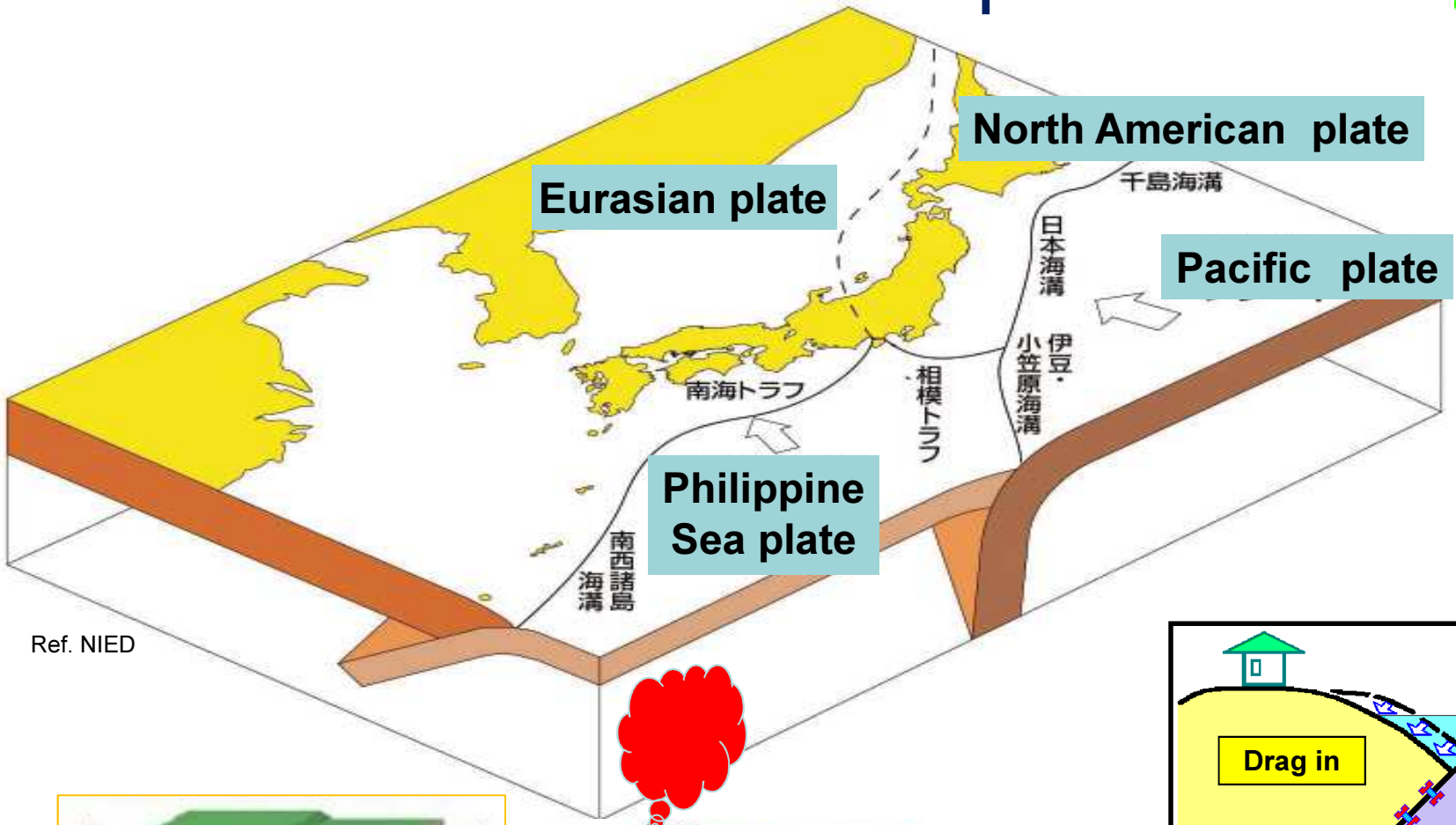
Earthquake Research Institute, University of Tokyo, http://www.eri.u-tokyo.ac.jp

Active Volcanoes in Japan

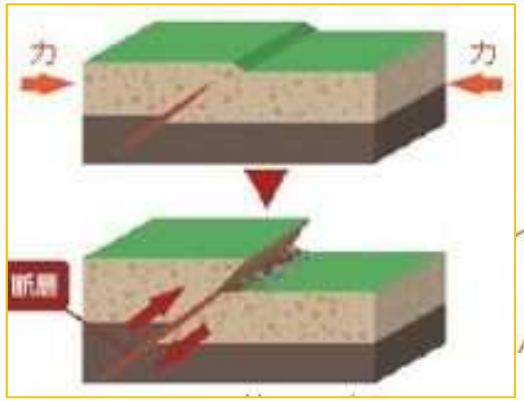
Active Volcanoes : 110
Constant Monitoring : 50

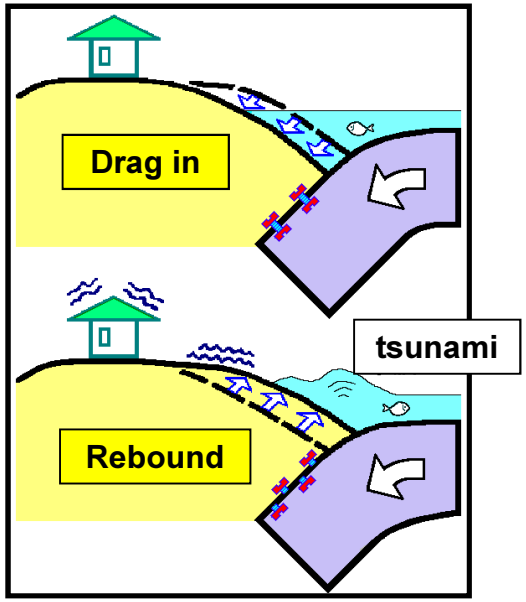
Ref. Japan Meteorological agency

Tectonic Plates around Japan



Ref. NIED

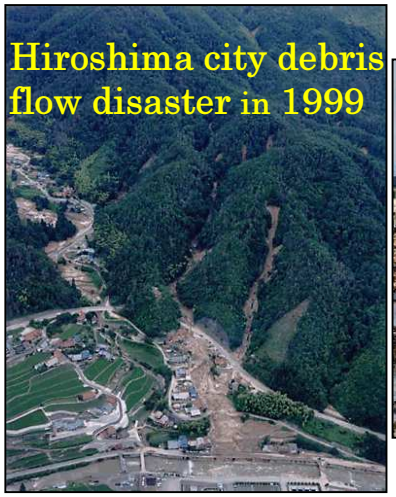




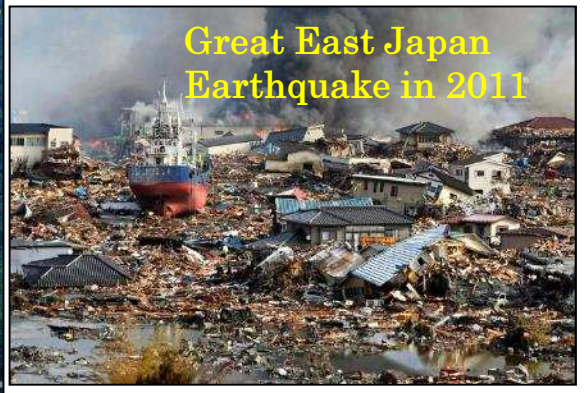
Hazards in Japan

- Earthquake
- Tsunami
- Volcanic Eruption
- Tropical Storm
- Flood
- Landslide

Great Hanshin-Awaji Earthquake in 1995



Hiroshima city debris flow disaster in 1999



Great East Japan Earthquake in 2011

Mt. Ontake eruption in 2014

Kochi prefecture heavy rain disaster in 1998

World Risk Index (UNU, 2016)

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
1.	Vanuatu	36.28 %	63.66 %	56.99 %	34.90 %	81.16 %	54.90 %
2.	Tonga	29.33 %	55.27 %	53.08 %	28.66 %	81.80 %	48.76 %
3.	Philippines	26.70 %	52.46 %	50.90 %	31.83 %	80.92 %	39.96 %
4.	Guatemala	19.88 %	36.30 %	54.76 %	35.82 %	81.00 %	47.46 %
5.	Bangladesh	19.17 %	31.70 %	60.48 %	38.23 %	86.36 %	56.84 %
6.	Solomon Islands	19.14 %	29.98 %	63.83 %	44.01 %	85.56 %	61.90 %
7.	Brunei Darussalam	17.00 %	41.10 %	41.36 %	17.40 %	63.17 %	43.53 %
8.	Costa Rica	17.00 %	42.61 %	39.89 %	21.32 %	63.78 %	34.57 %
9.	Cambodia	16.58 %	27.65 %	59.96 %	37.55 %	86.84 %	55.49 %
10.	Papua New Guinea	16.43 %	24.94 %	65.90 %	54.81 %	83.94 %	58.95 %
11.	El Salvador	16.05 %	32.60 %	49.25 %	27.84 %	74.78 %	45.14 %
12.	Timor-Leste	15.69 %	25.73 %	60.98 %	49.93 %	81.39 %	51.61 %
13.	Mauritius	15.53 %	37.35 %	41.58 %	18.02 %	61.59 %	45.14 %
14.	Nicaragua	14.62 %	27.23 %	53.69 %	33.67 %	80.70 %	46.71 %
15.	Guinea-Bissau	13.56 %	19.65 %	68.99 %	52.64 %	89.93 %	64.38 %
16.	Fiji	13.15 %	27.71 %	47.47 %	24.18 %	74.69 %	43.55 %
17.	JAPAN	12.99 %	45.91 %	28.29 %	17.82 %	38.04 %	29.00 %
18.	Viet Nam	12.55 %	25.55 %	49.45 %	24.95 %	76.67 %	46.67 %
19.	Gambia	12.07 %	19.29 %	62.58 %	44.77 %	83.87 %	59.11 %
20.	Jamaica	11.83 %	25.82 %	45.81 %	25.43 %	71.30 %	40.70 %
21.	Haiti	11.68 %	16.26 %	71.85 %	61.81 %	91.24 %	62.49 %
22.	Chile	11.65 %	30.95 %	37.66 %	19.67 %	58.61 %	34.70 %
23.	Benin	11.39 %	17.06 %	66.76 %	52.23 %	82.00 %	66.06 %
24.	Guyana	11.39 %	22.90 %	49.72 %	27.16 %	78.96 %	43.05 %
25.	Niger	11.24 %	15.87 %	70.80 %	57.72 %	86.56 %	68.11 %
26.	Madagascar	11.15 %	16.03 %	69.52 %	65.23 %	83.79 %	59.55 %
27.	Dominican Republic	10.96 %	23.14 %	47.36 %	27.55 %	73.16 %	41.38 %

出典：World Risk Report 2016 (UNU)

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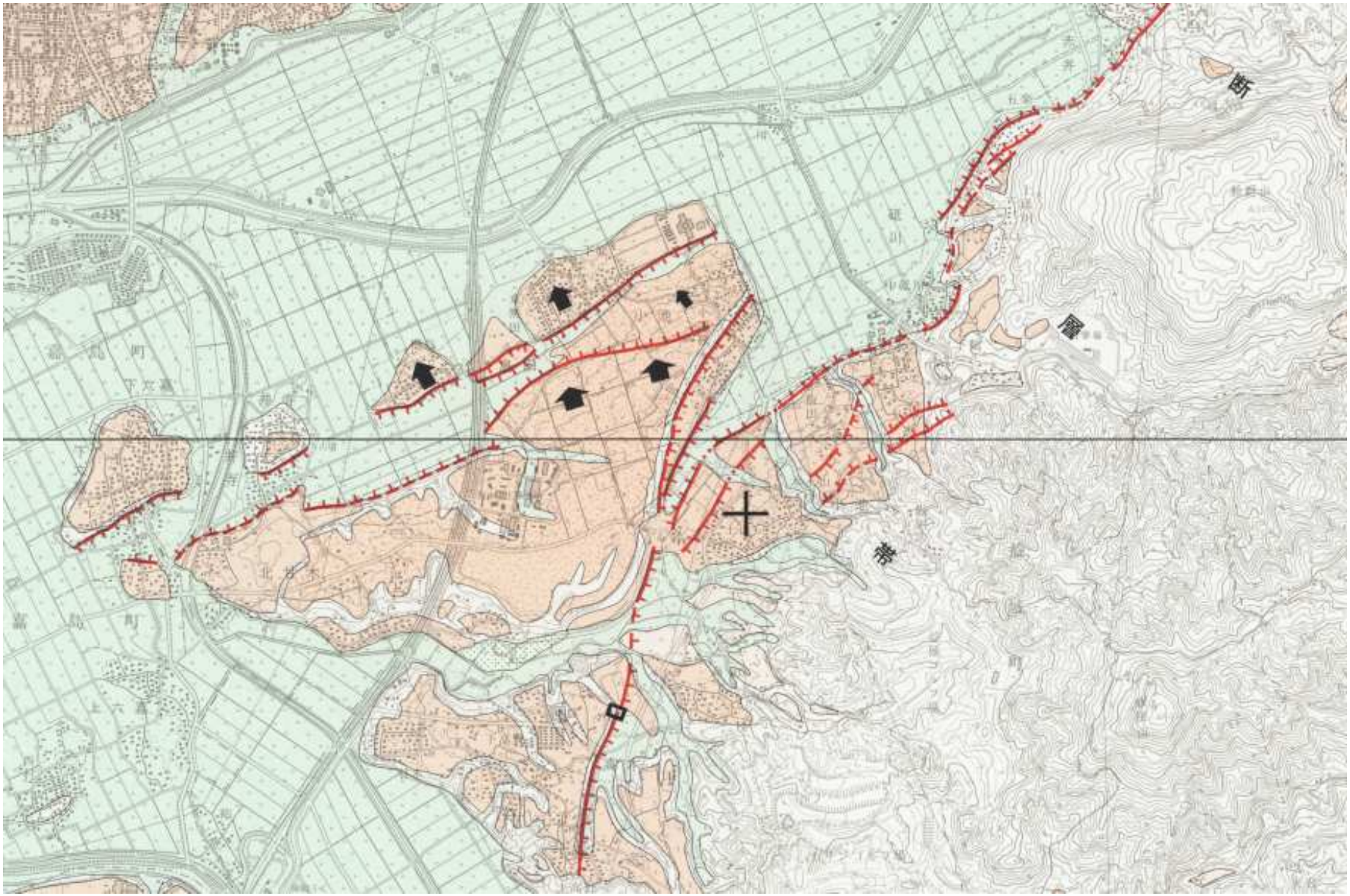
Active Fault Map Disaster Risk Reduction

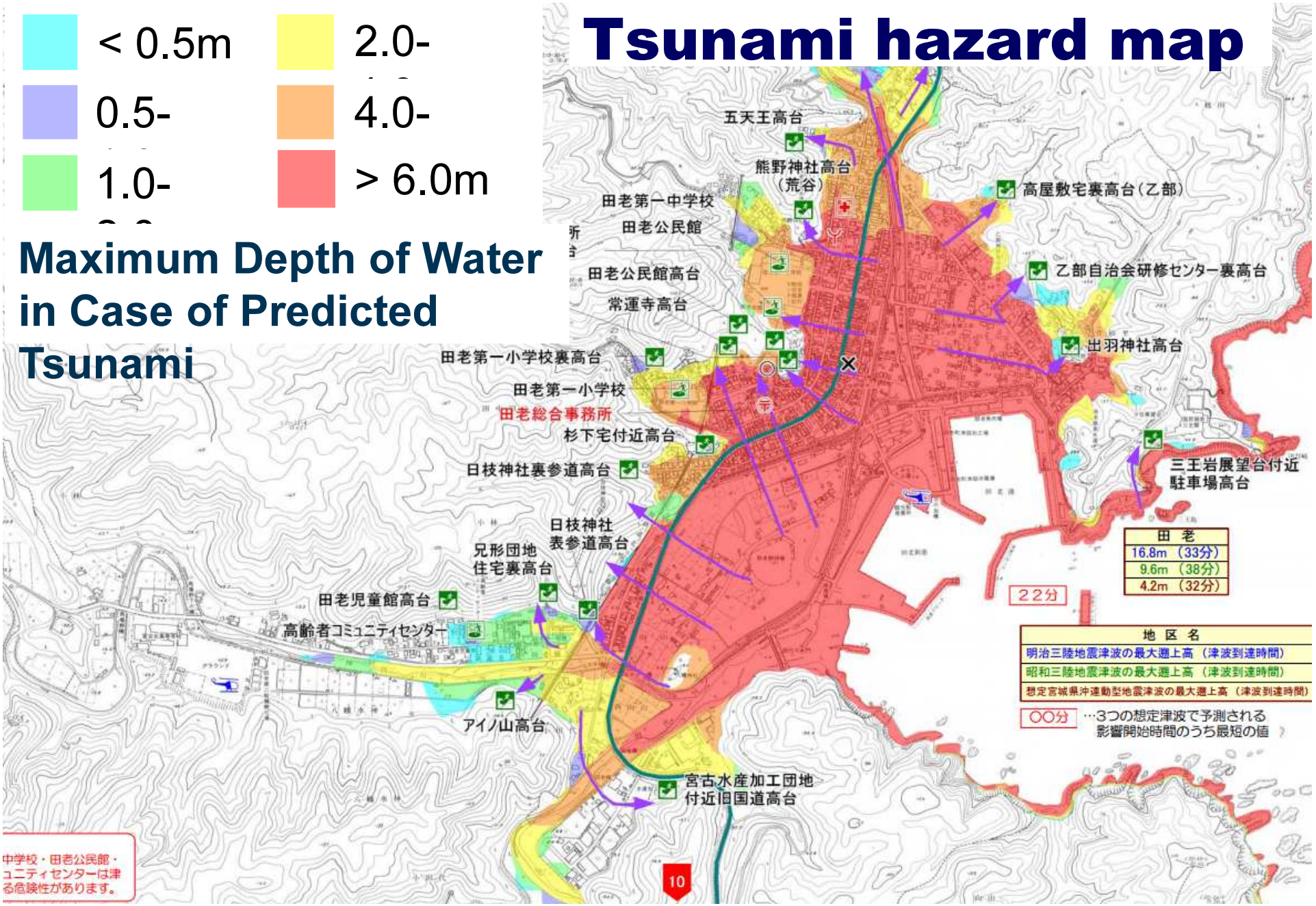


Geospatial Information for Individuals

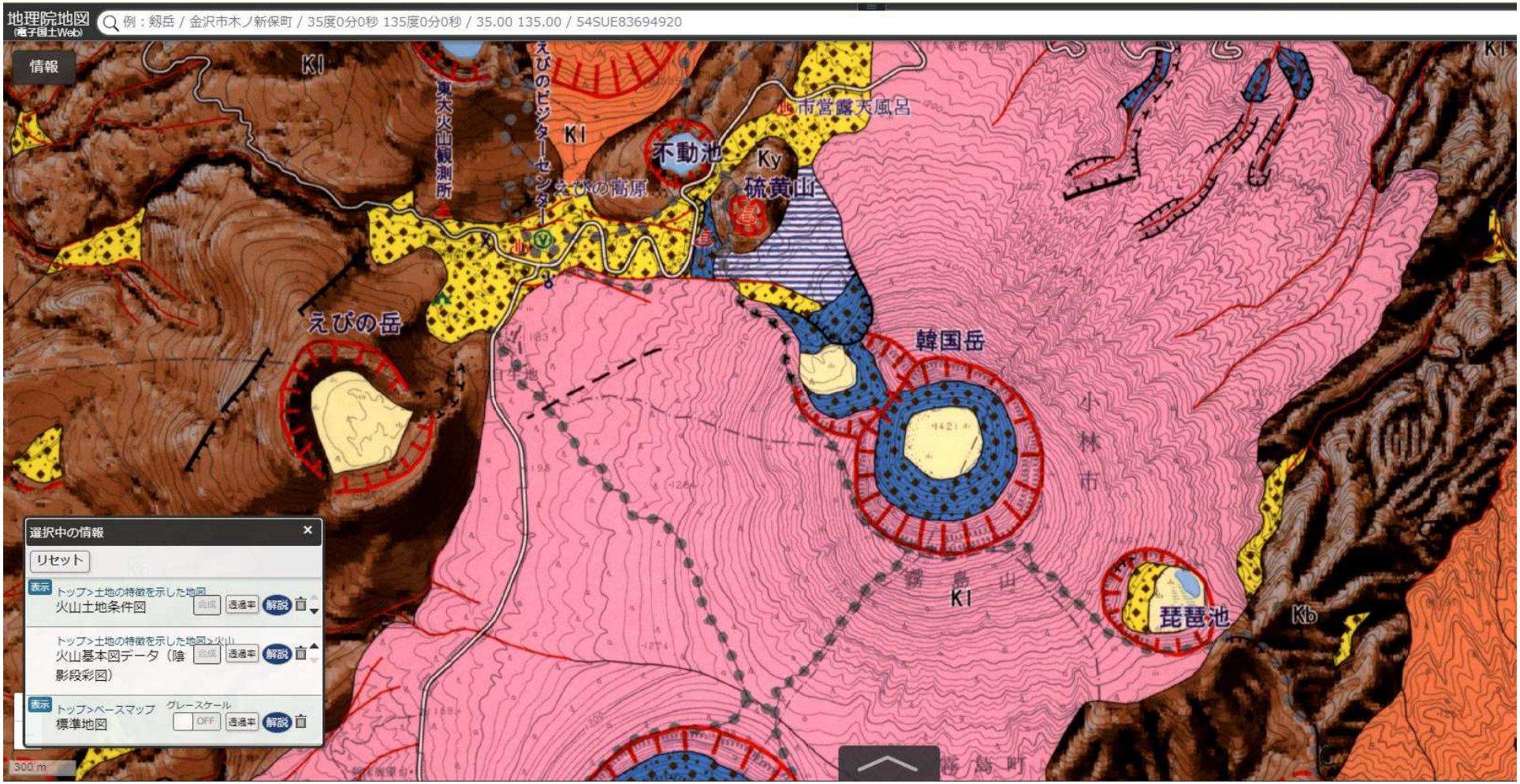
Tsunami hazard map

< 0.5m
0.5-
1.0-
2.0-
4.0-
> 6.0m

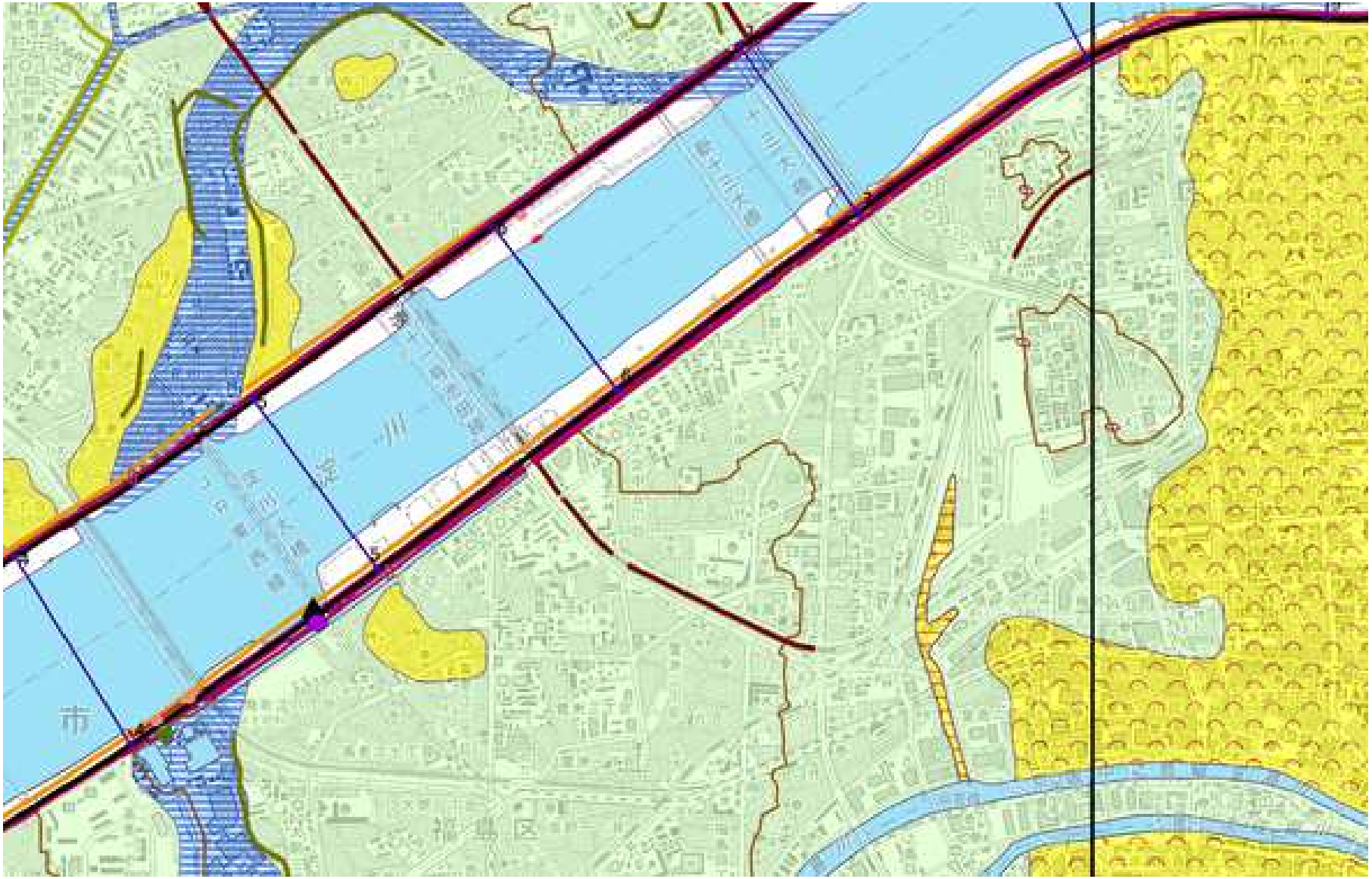
Maximum Depth of Water in Case of Predicted Tsunami



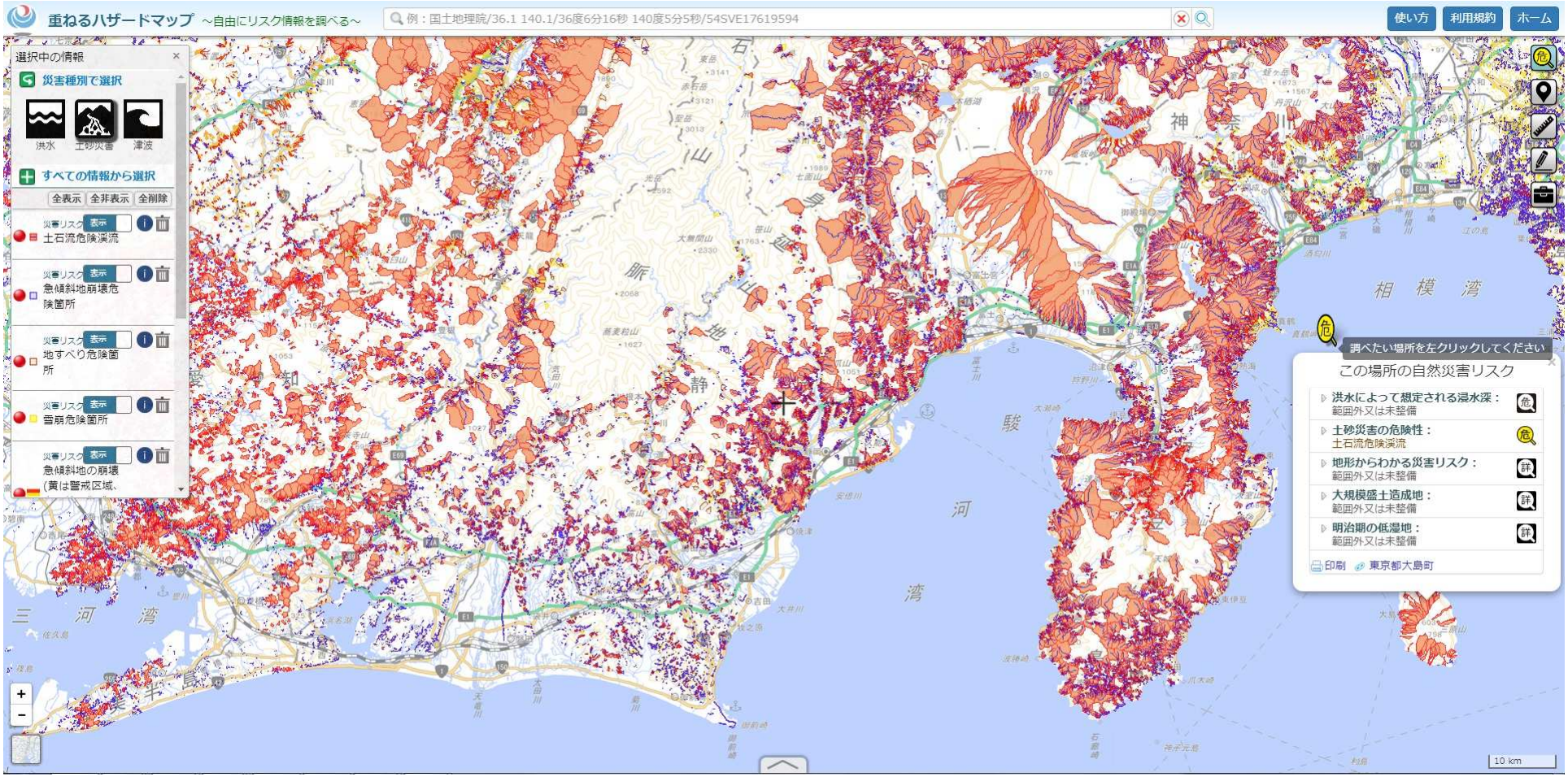
Volcano　Land Condition　Map



Land Condition Map for Flood Risk



Hazard Map for Landslide

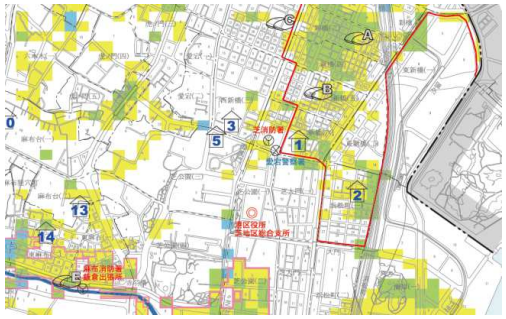


Hazard Maps prepared by Local Municipalities

Flood Hazard Map

Ota-Ku, Tokyo

Inland Waters Hazard Map



Minato-Ku, Tokyo

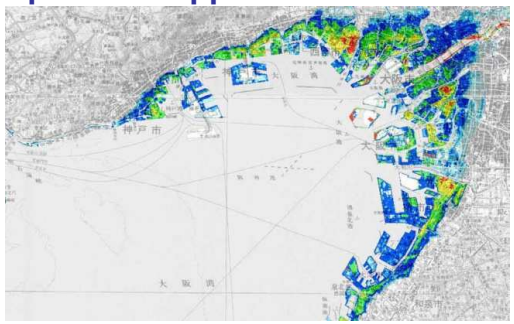
Landslide Disaster Hazard Map

Utsunomiya City, Tochigi Prefecture

Height Tide Hazard Map

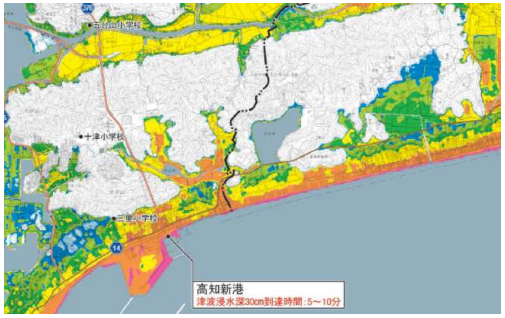
Shimonoseki City, Yamaguchi Prefecture

Map of the supposed inundation area



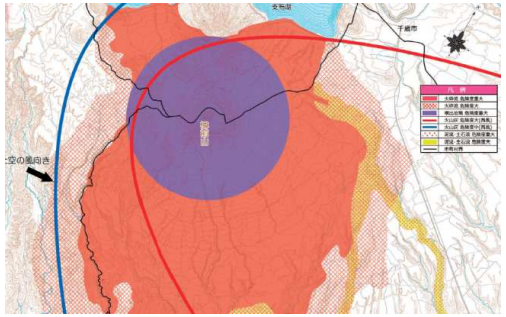
Osaka Bay

Tsunami Hazard Map



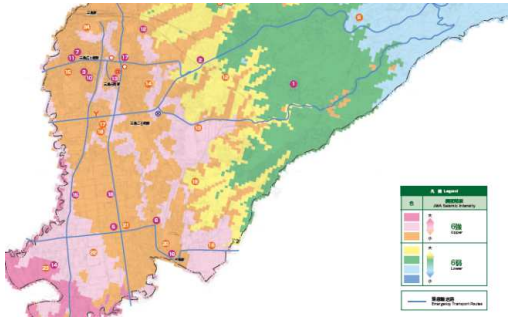
Kochi City, Kochi Prefecture

Volcano Hazard Map



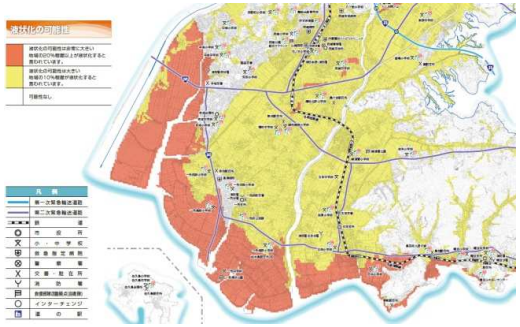
Mount Tarumae (Hokkaido)

Earthquake Damage Estimation Map



Mishima City, Shizuoka Prefecture

Ground Subsidence(Liquefaction) Map



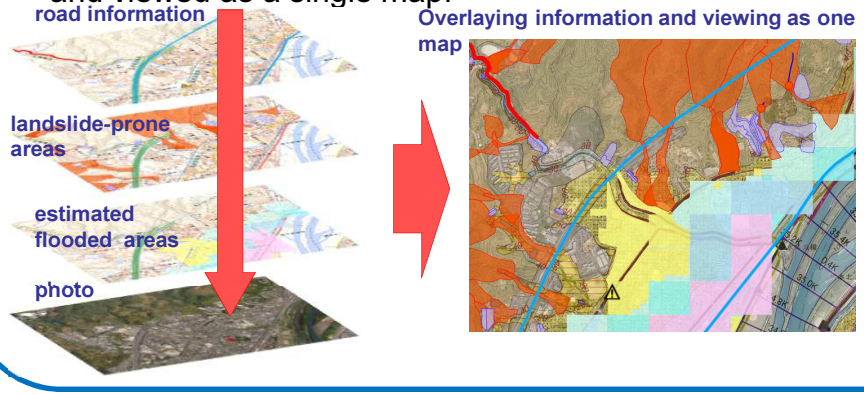
Nishio City, Aichi Prefecture

MLIT Hazard Map Portal Site

Information useful for evacuation and disaster preparedness

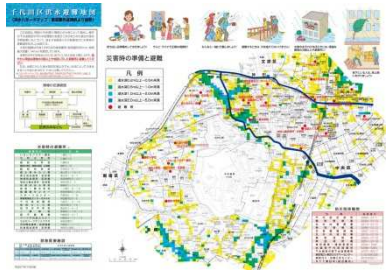
Overlaid hazard maps

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



Local hazard maps

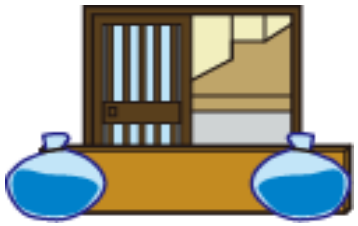
Hazard maps of municipalities across Japan are available.



Flood hazard map
(Chiyoda Ward, Tokyo)

Tsunami hazard map
(Fujisawa City)

Evacuation route



Measures for flooding

Enhancing seismic safety

Measures for liquefaction

Hazard Map Portal Site : http://disaportal.gsi.go.jp/

ハザードマップ 検索

Contents

Strategy of Early warning

Speed of

Radio wave/Electric signal

>> Primary Seismic wave

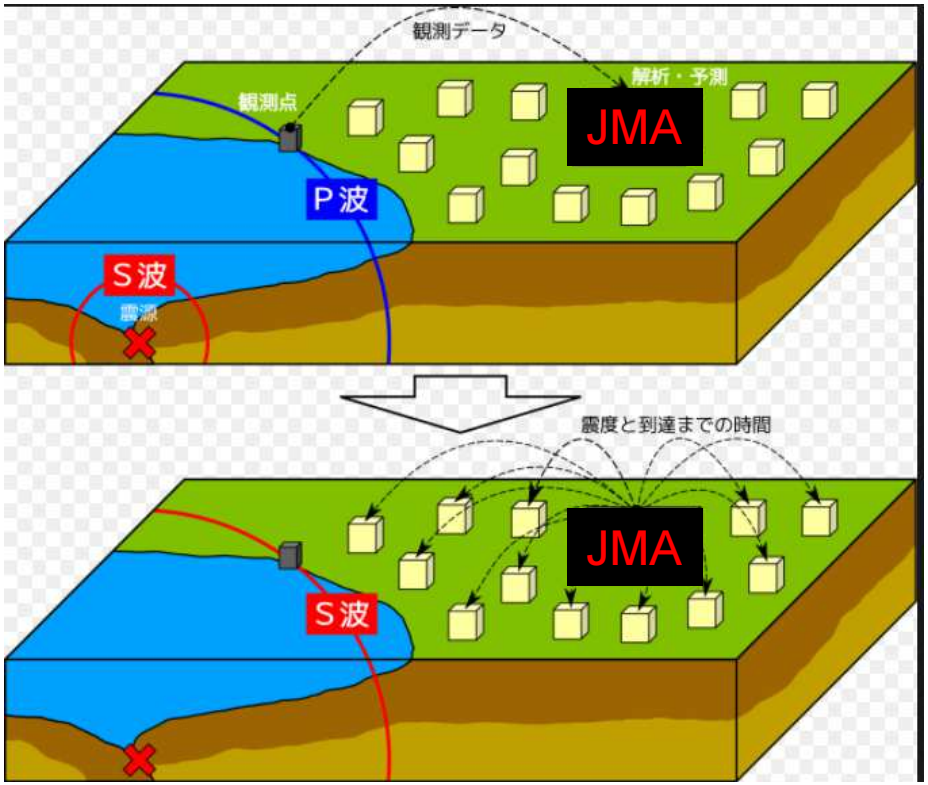
> Secondary Seismic wave

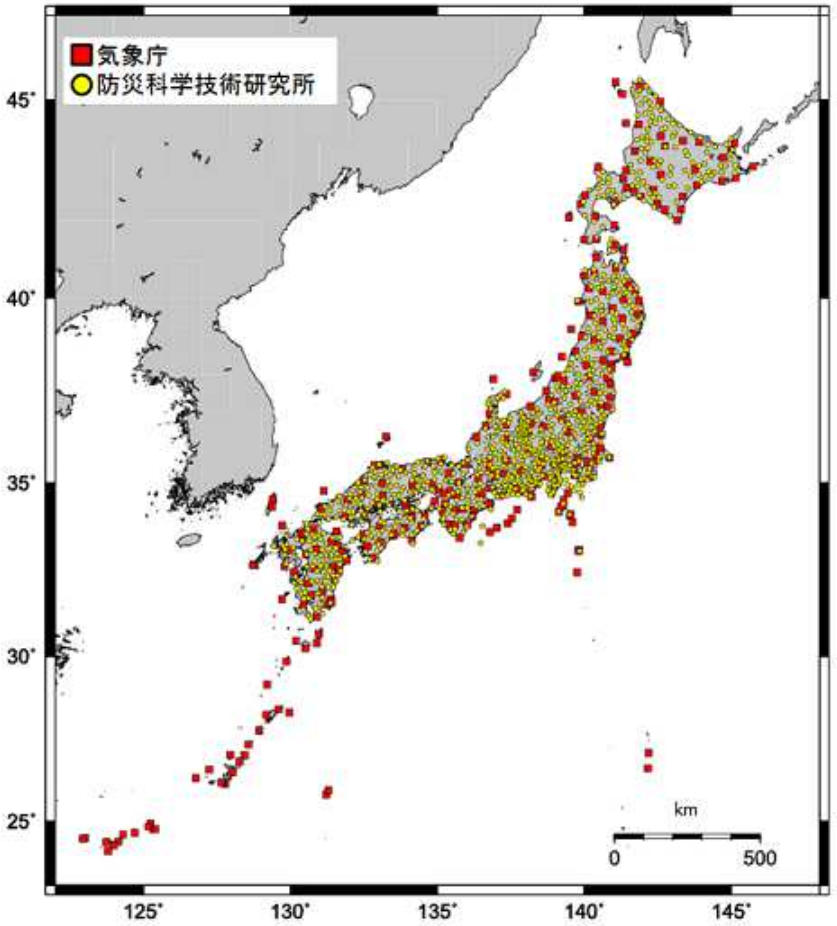
= Crustal deformation

> Tsunami wave

Use this time delay!

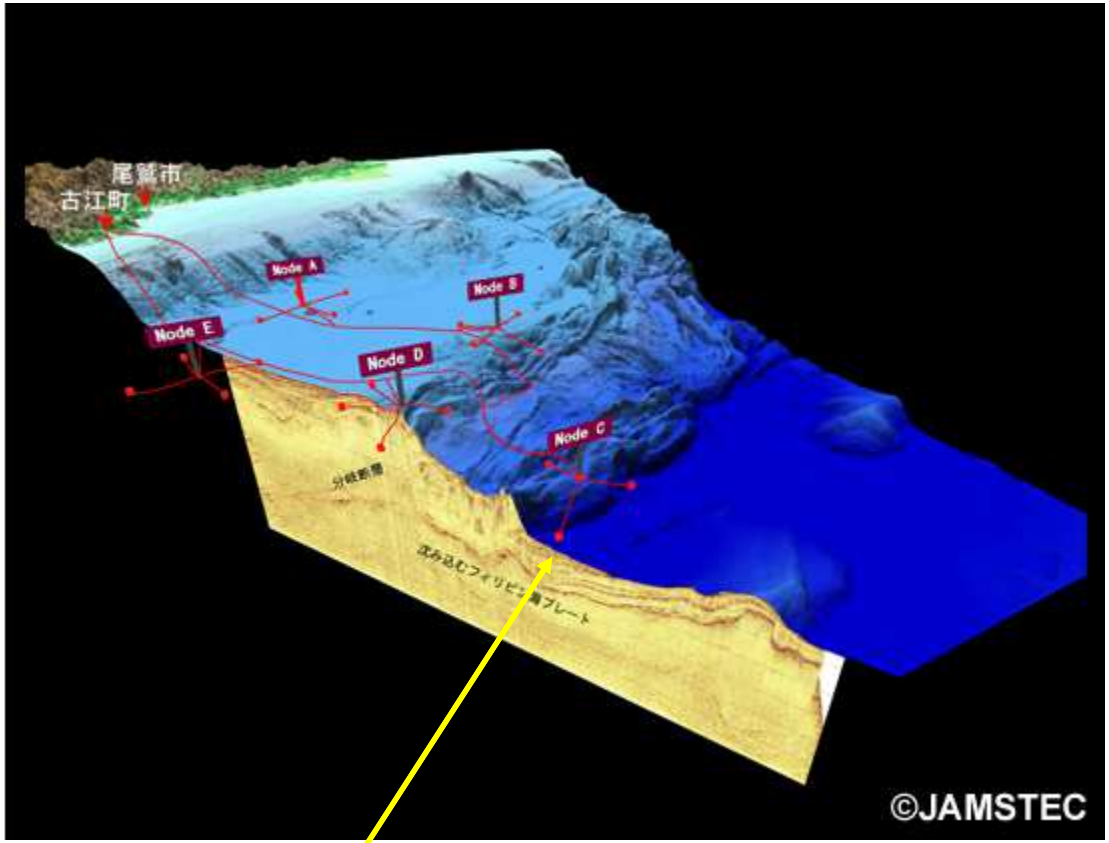
Early warning using seismic sensor on the ground

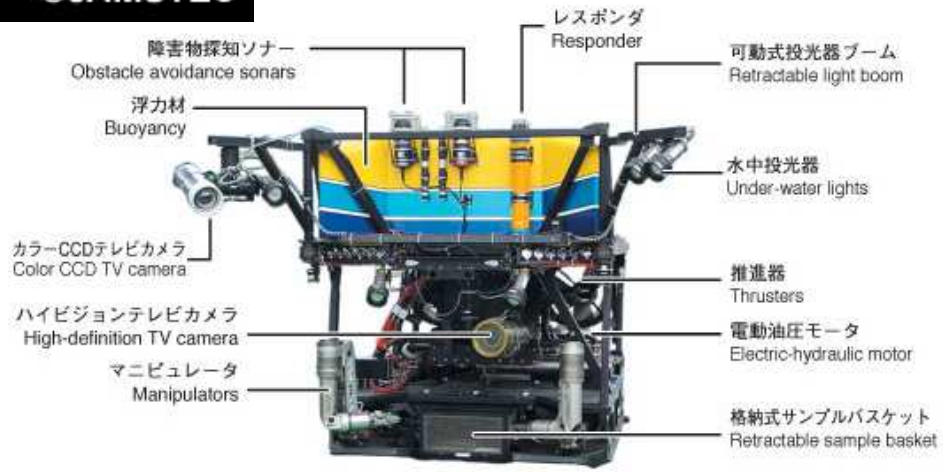




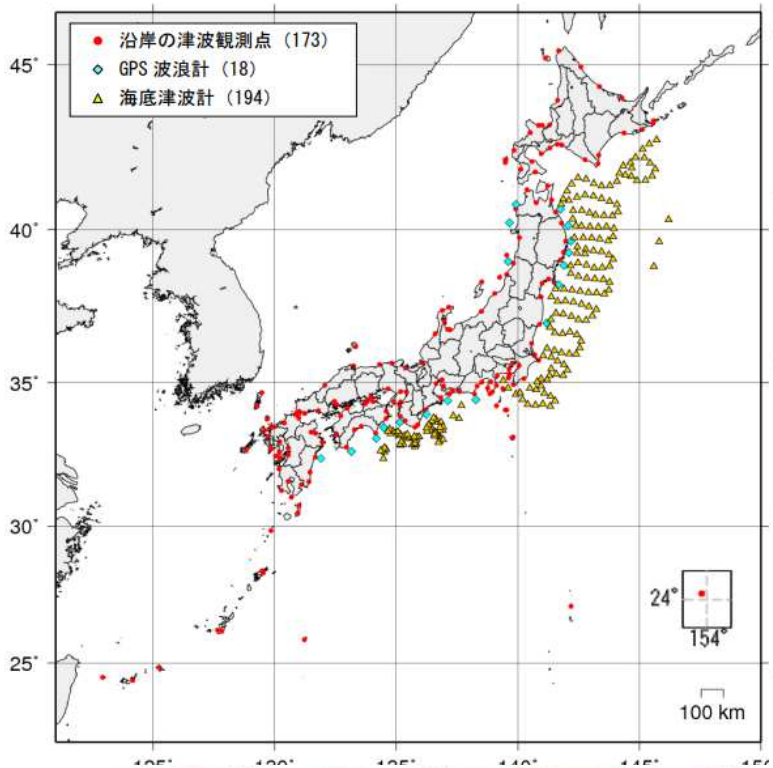
緊急地震速報に活用している地震観測点（平成28年4月1日現在）

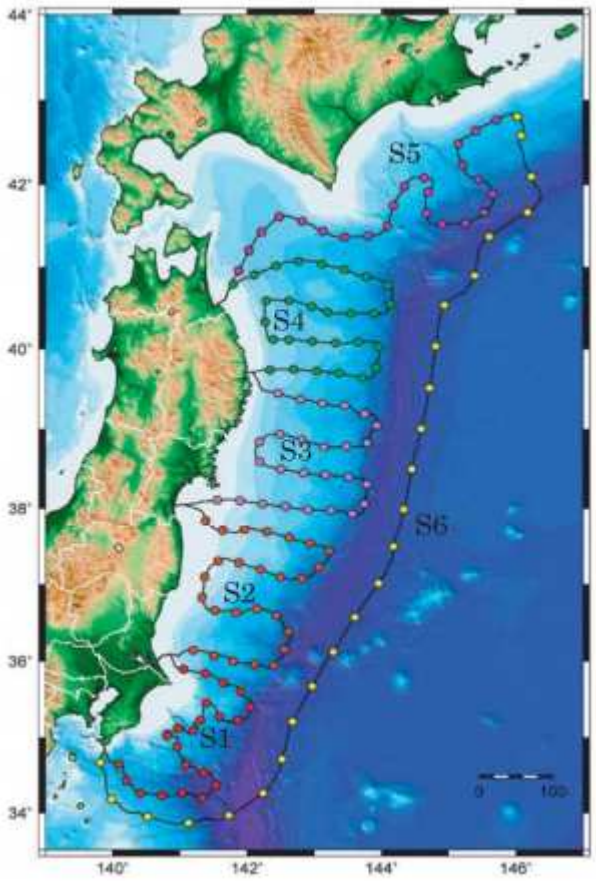
Seismic and Tsunami sensor on the sea floor



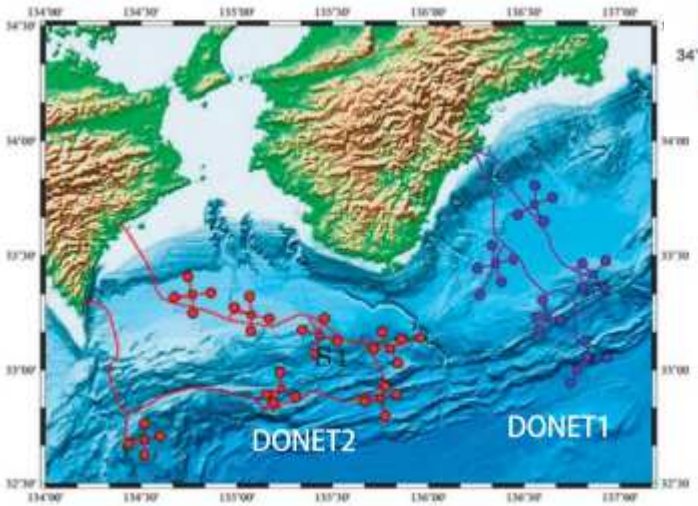


Sea floor network systems for earthquakes and tsunamis





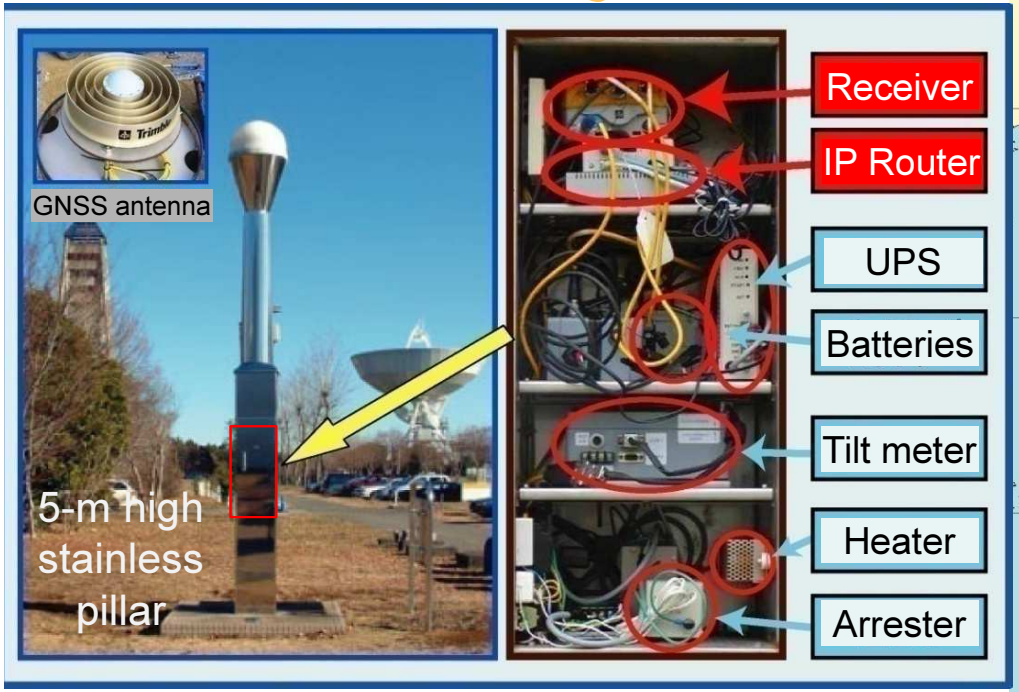
SNET 150points
Cable length=5700 km

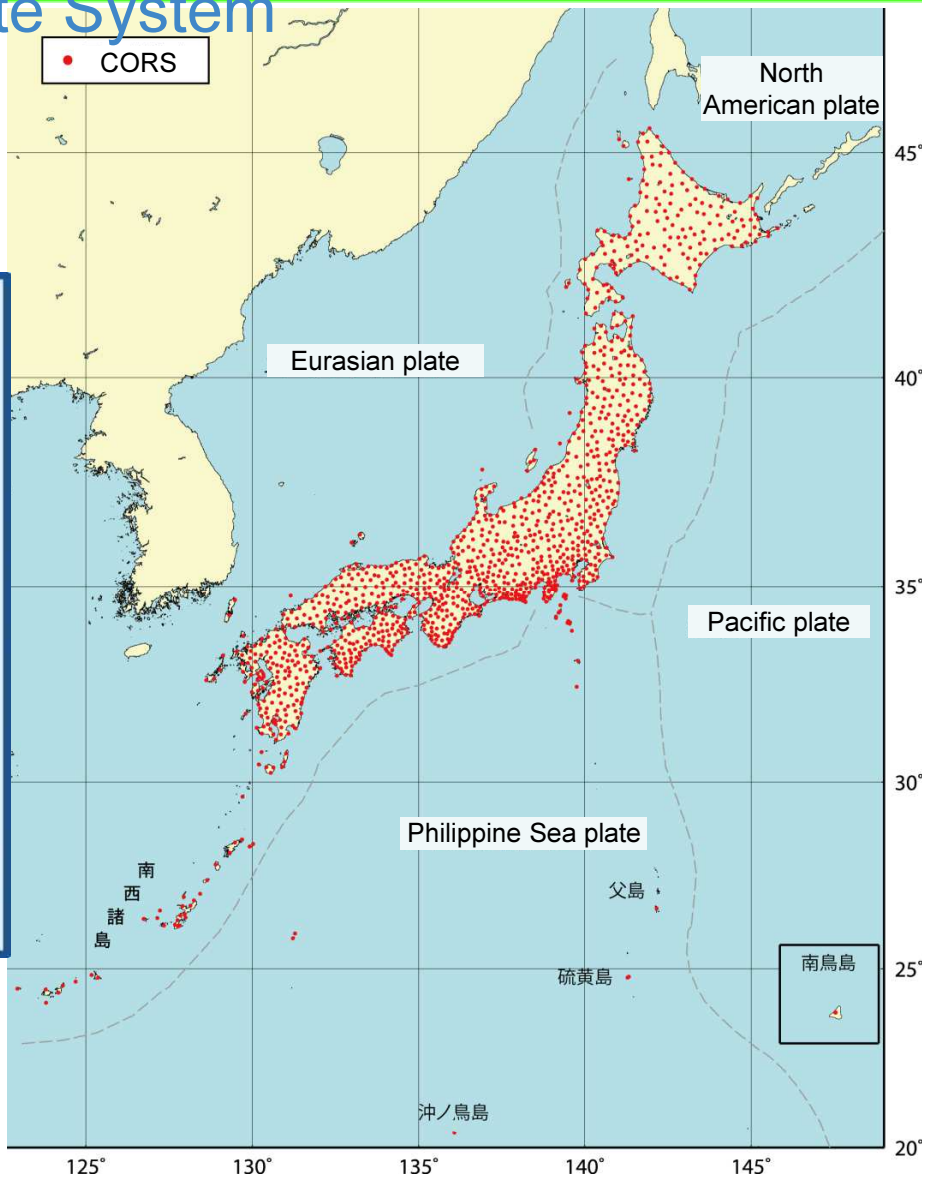


DONET1 22 points
DONET2 29 points

GNSS Continuously Operating Reference Stations (CORS)

GNSS: Global Navigation Satellite System

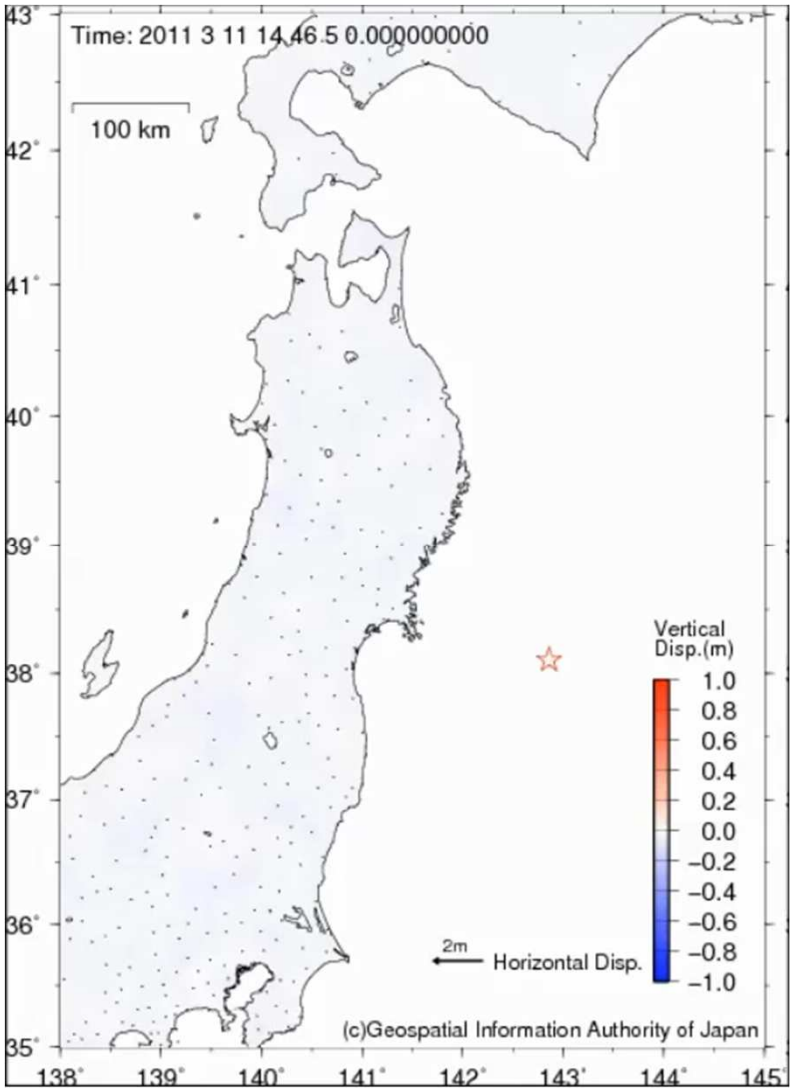




- The CORS network has 1318 stations over the whole country (at ~20 km interval).
- The continuous GNSS observation enables accurate measurement of crustal deformation.

Minami Tori island

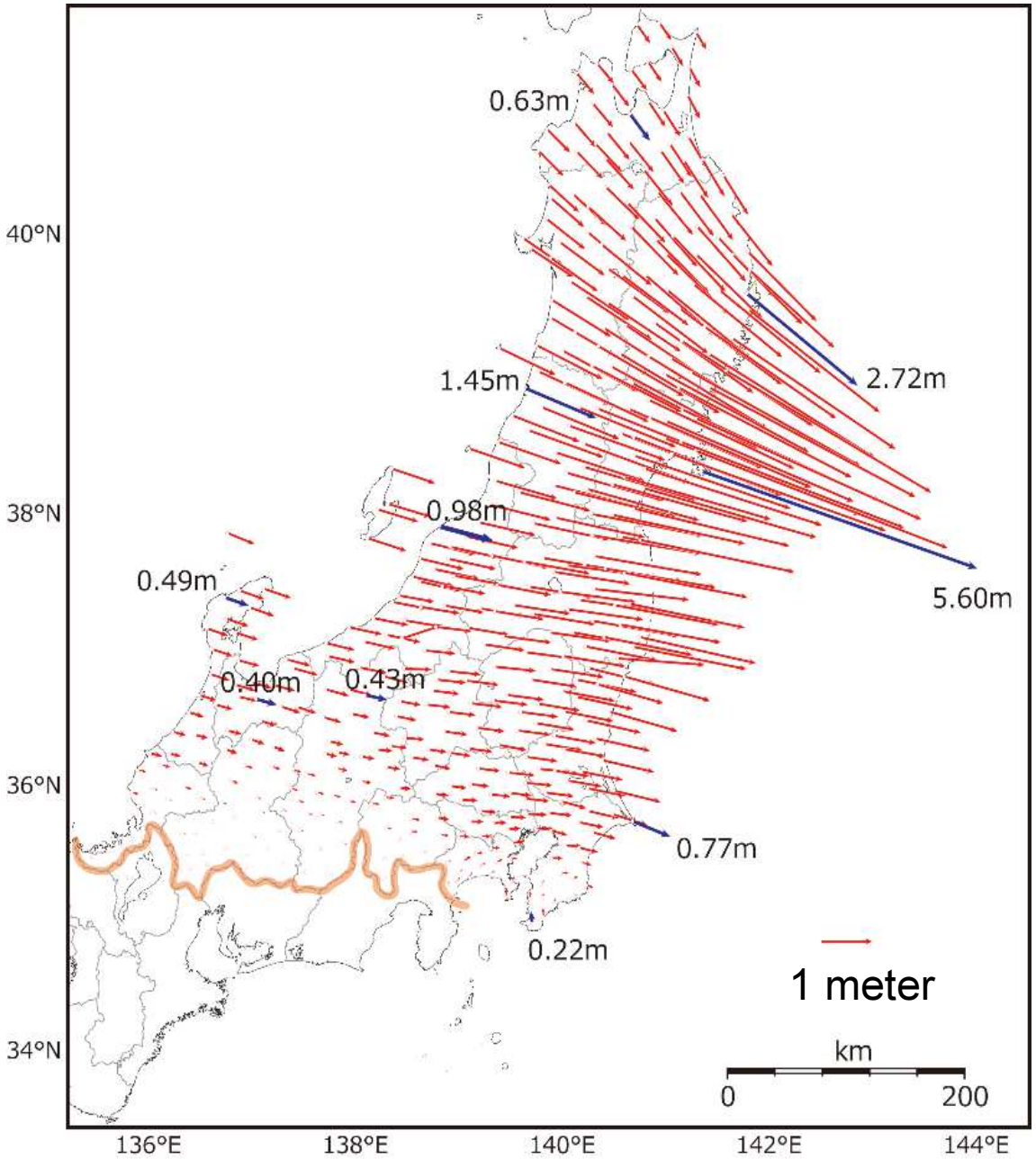
Crustal Deformation Caused by the Great East Japan Earthquake in 2011



Video showing the crustal deformation caused by the Great East Japan Earthquake.

- GNSS CORS detects co-seismic crustal deformation caused by earthquakes.
- Large SE-ward displacement (max. 5.3m) was observed during the Great East Japan Earthquake.

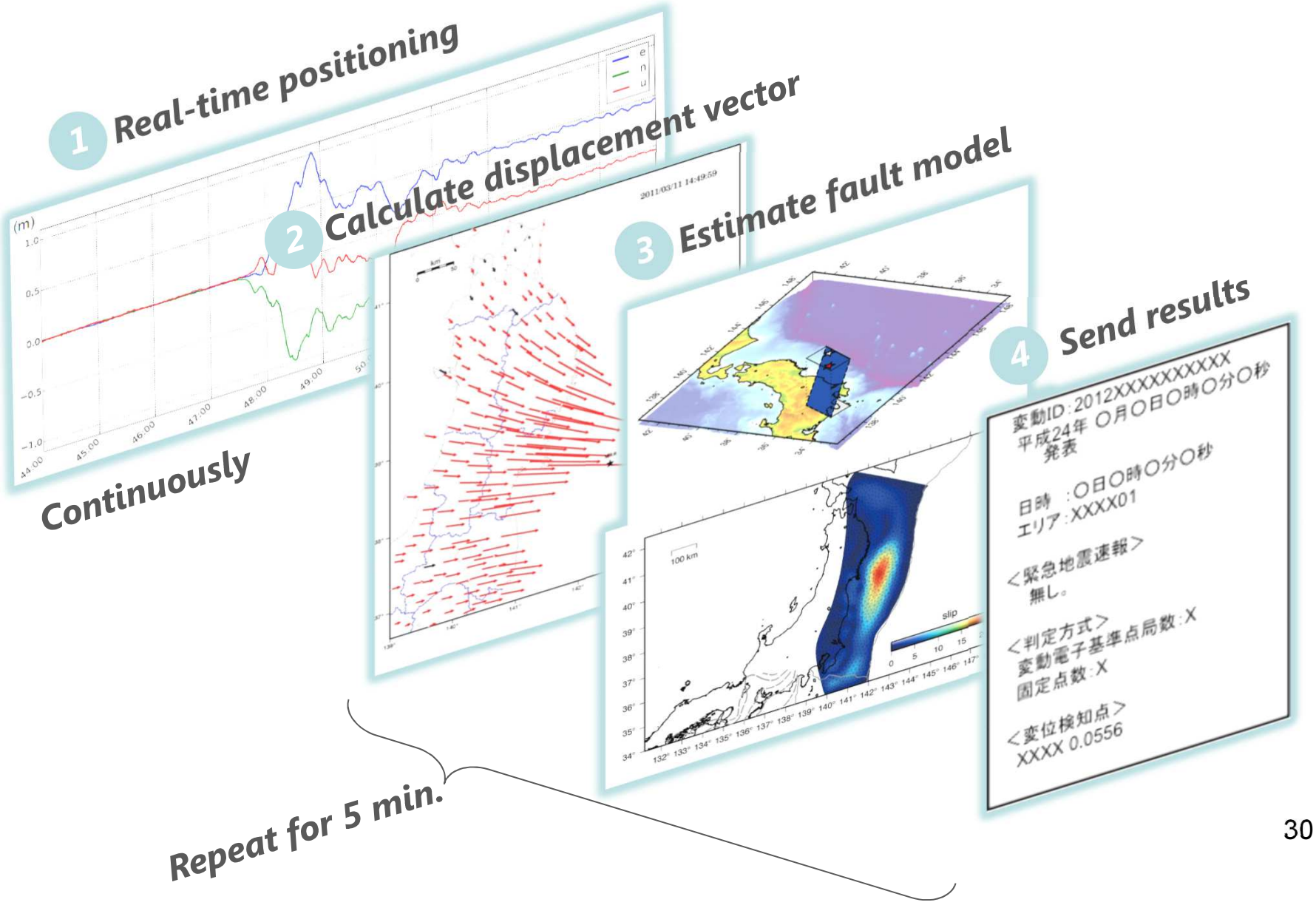
Crustal deformation detected by GNSS CORS



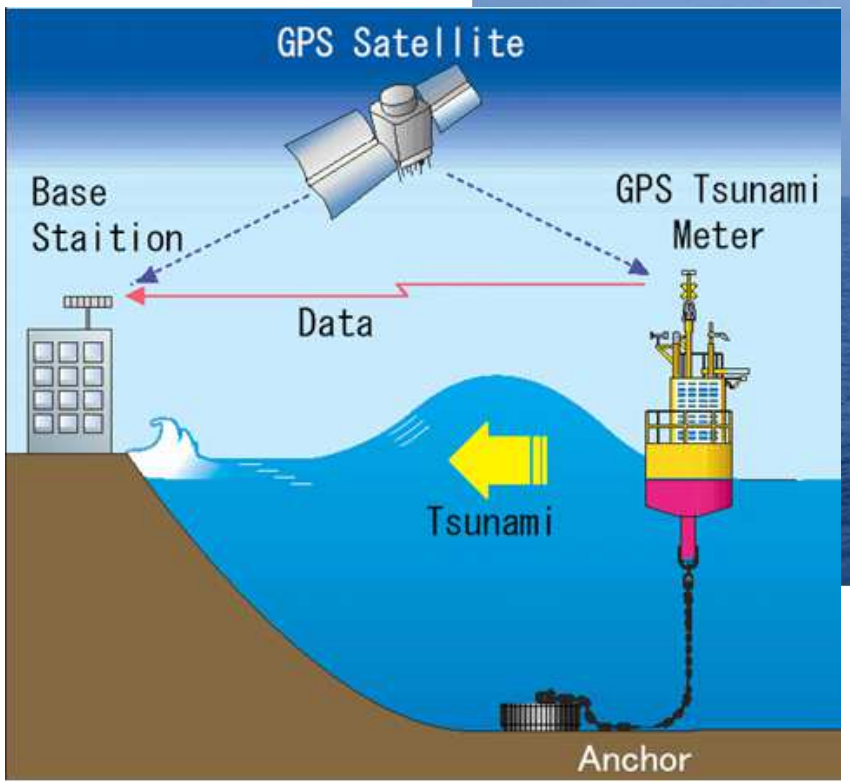
the deformation caused by the Great East Japan Earthquake

REGARD system workflow

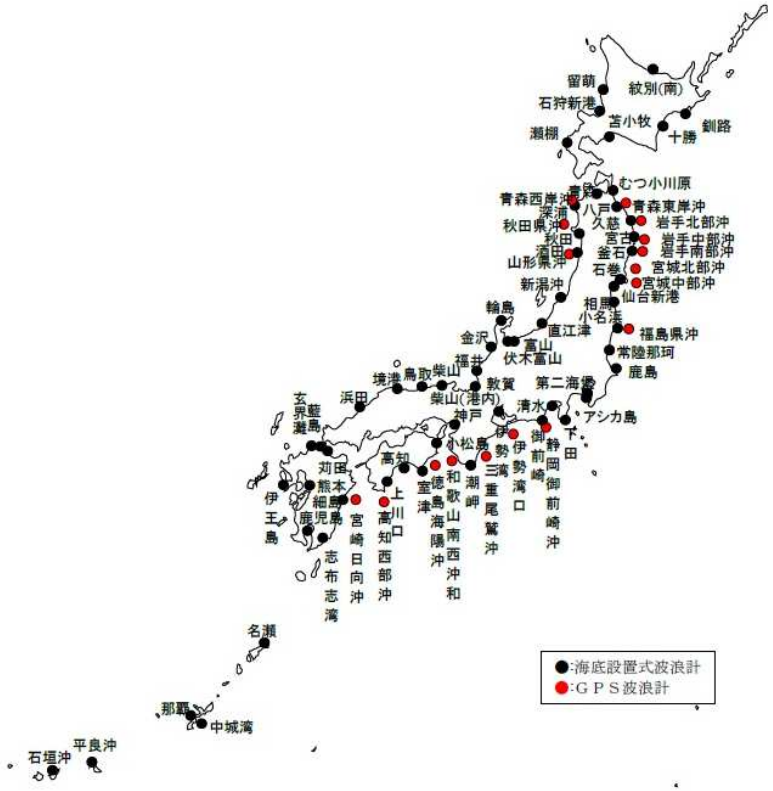
Real-time CORS Network for Tsunami Warning



GPS Comprehensive Oceanographic Monitoring System



NOWPHAS :
Nationwide Ocean Wave information network for Ports and HArbourS



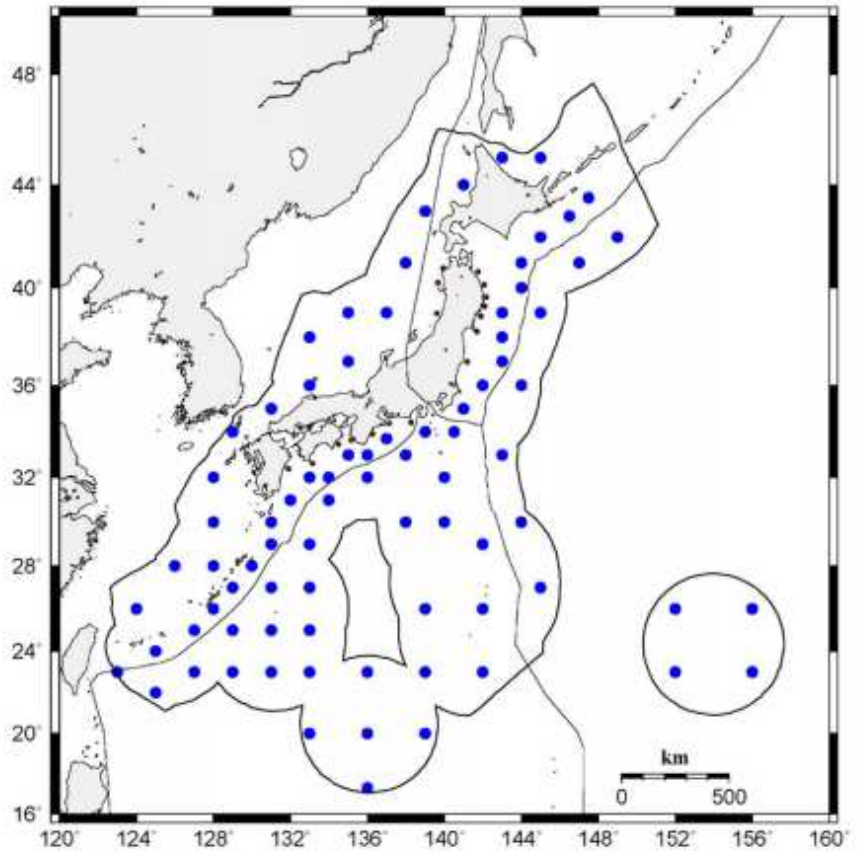


図3　将来ビジョン（赤○：国交省既設 18 基、青○：構想 81 基）

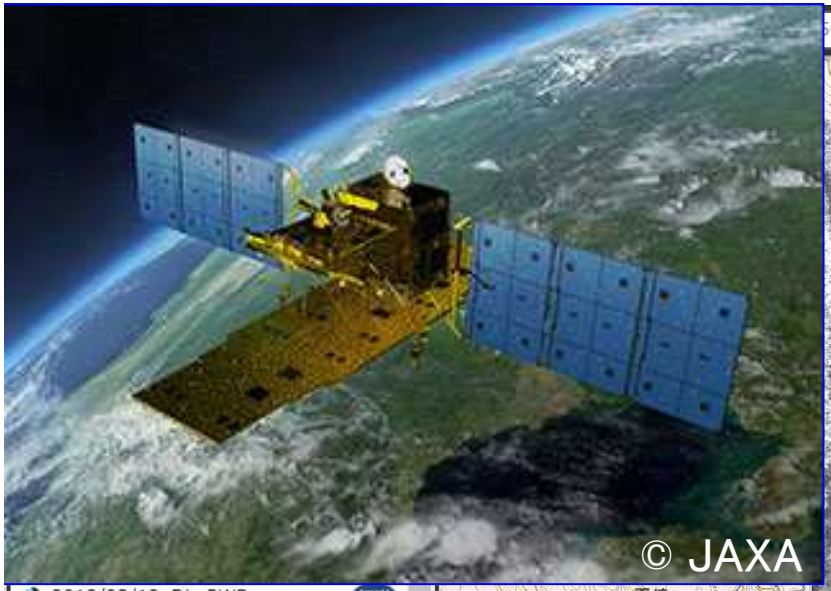
Current status

Future Plan using communication satellite

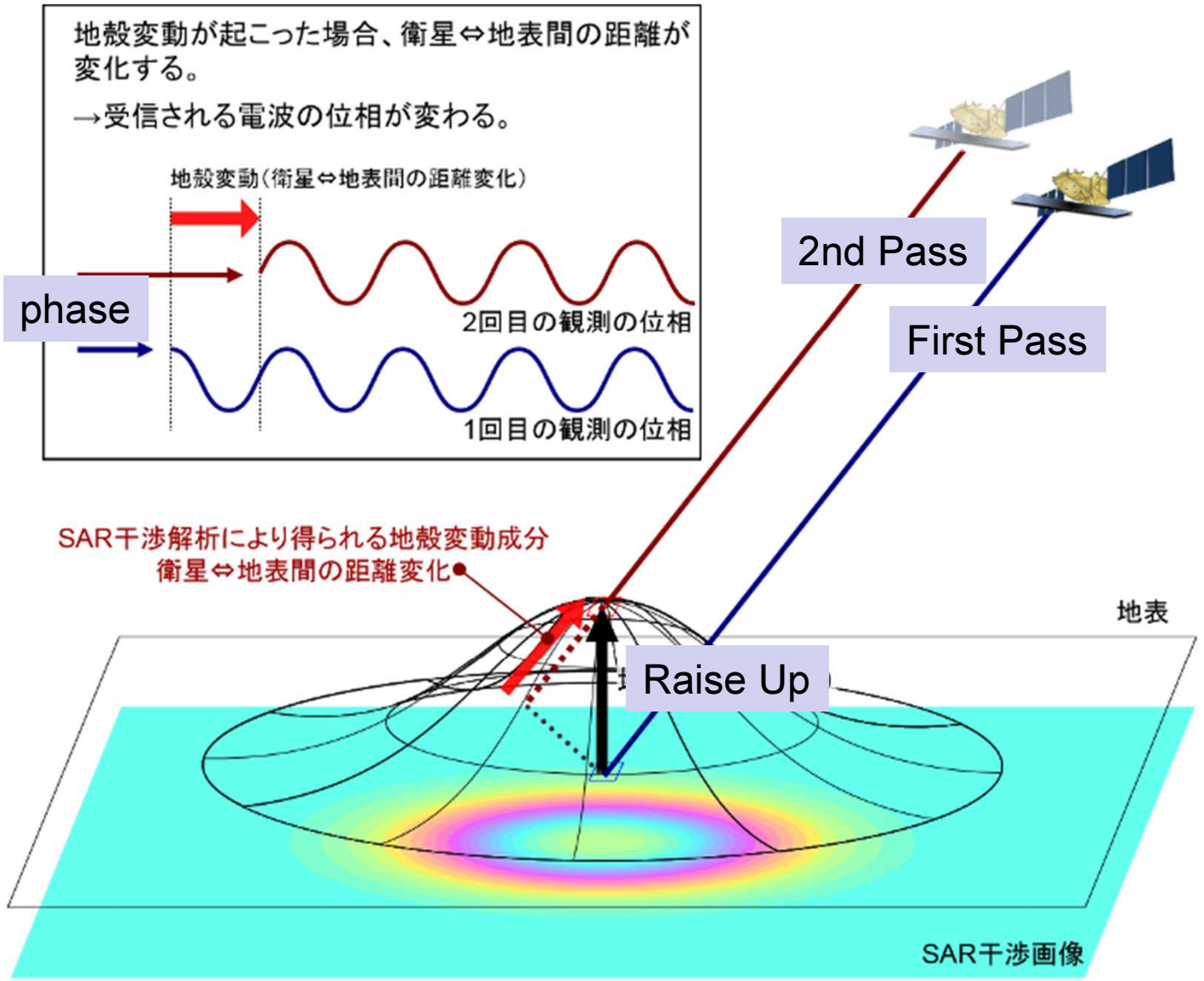
Earthquake Early Warning System

All data from various sensors
are send to JMA (Japan Metrological Agency)
for Warning using TV/mobile devices etc.

Monitor volcano using SAR satellite -Mount Kirishima-



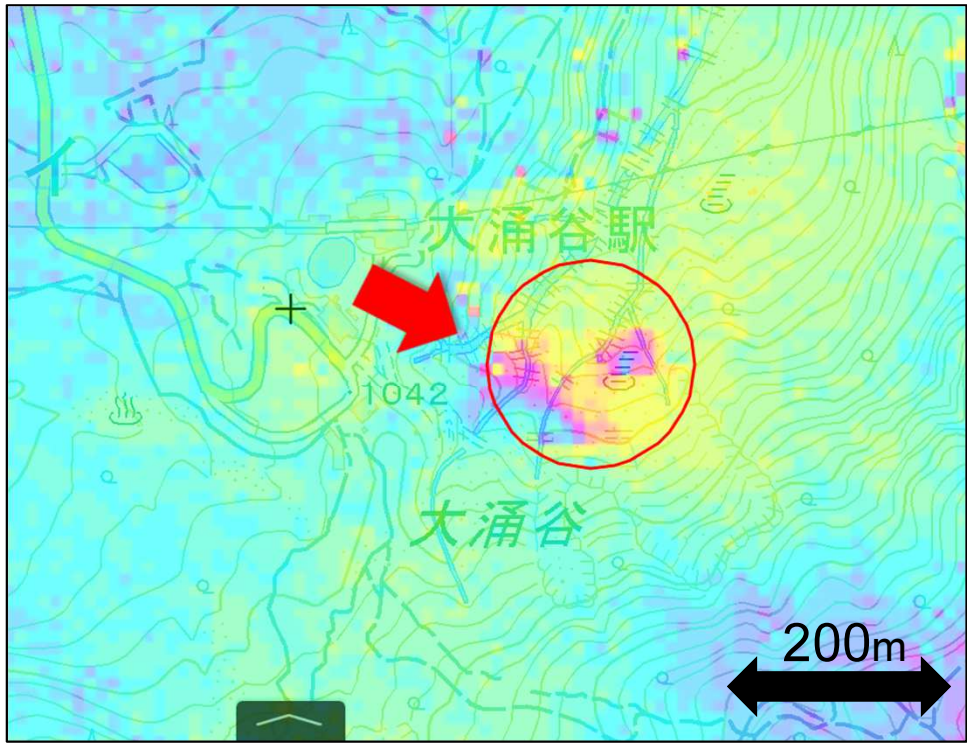
InSAR Method



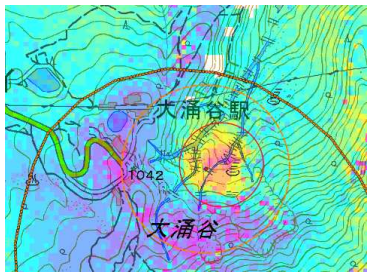
Monitoring Volcano by using InSAR - Mount Hakone -

Small-scale eruption about 2015/6/30-2015/7/1

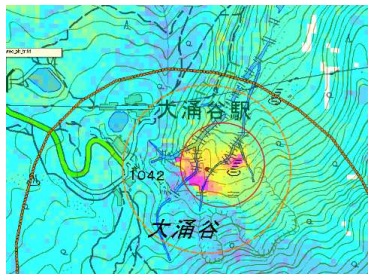
Picture
http://www.data.jma.go.jp/svd/vois/data/tokyo/STOCK/monthly_v-act_doc/tokyo/15m06/20150630_315_2.pdf



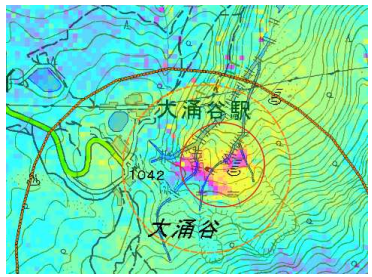
2015.4.17～2015.5.15



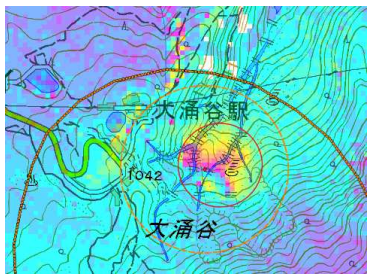
2014/10/9～2015/5/7



2015/3/1 ～2015/5/10



2015/4/17 ～2015/5/15



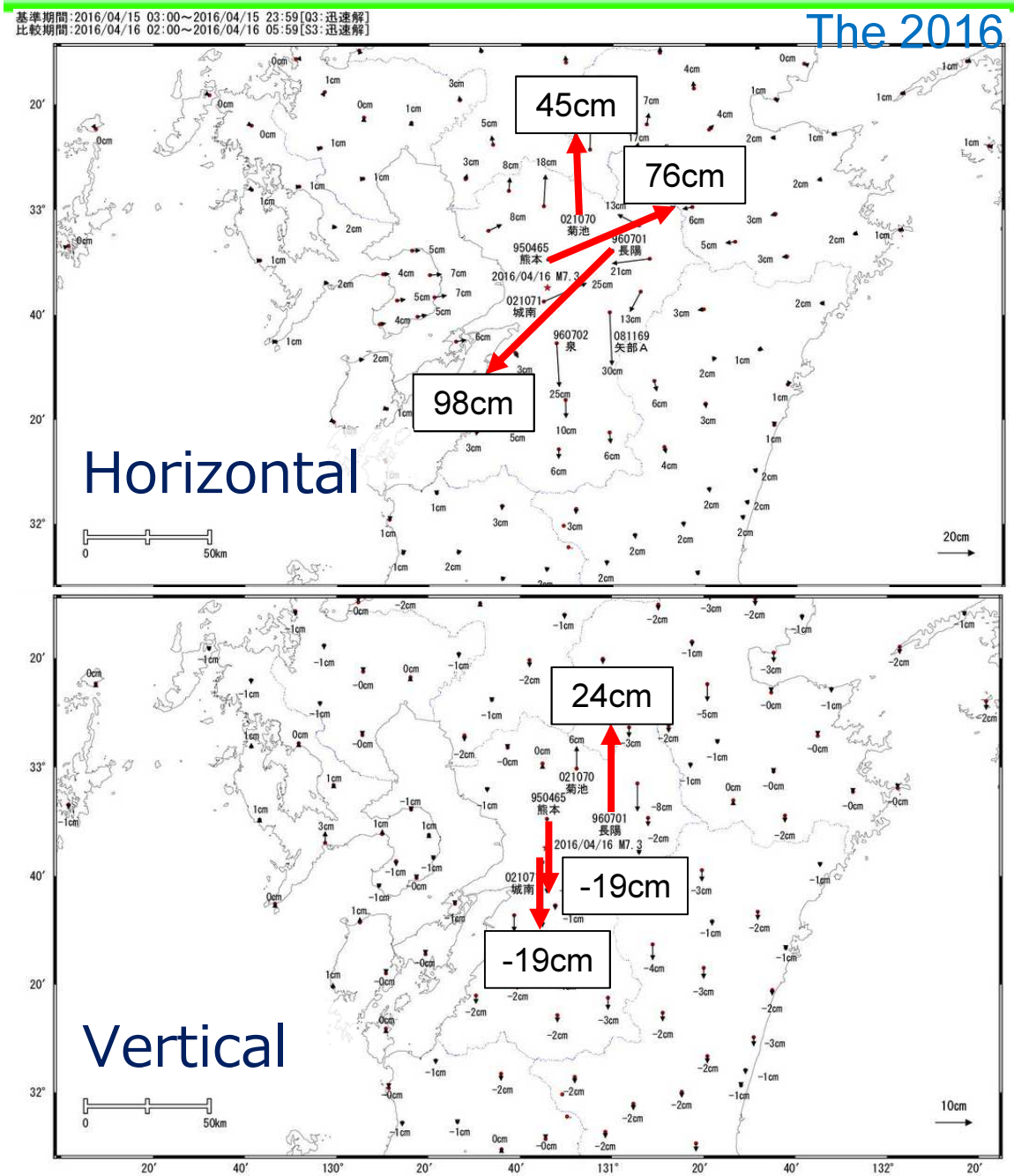
2015/5/7 ～2015/5/21

Volcanic eruption committee of JMA set Warning Level.

Contents

Crustal Deformation Detected by GNSS CORS

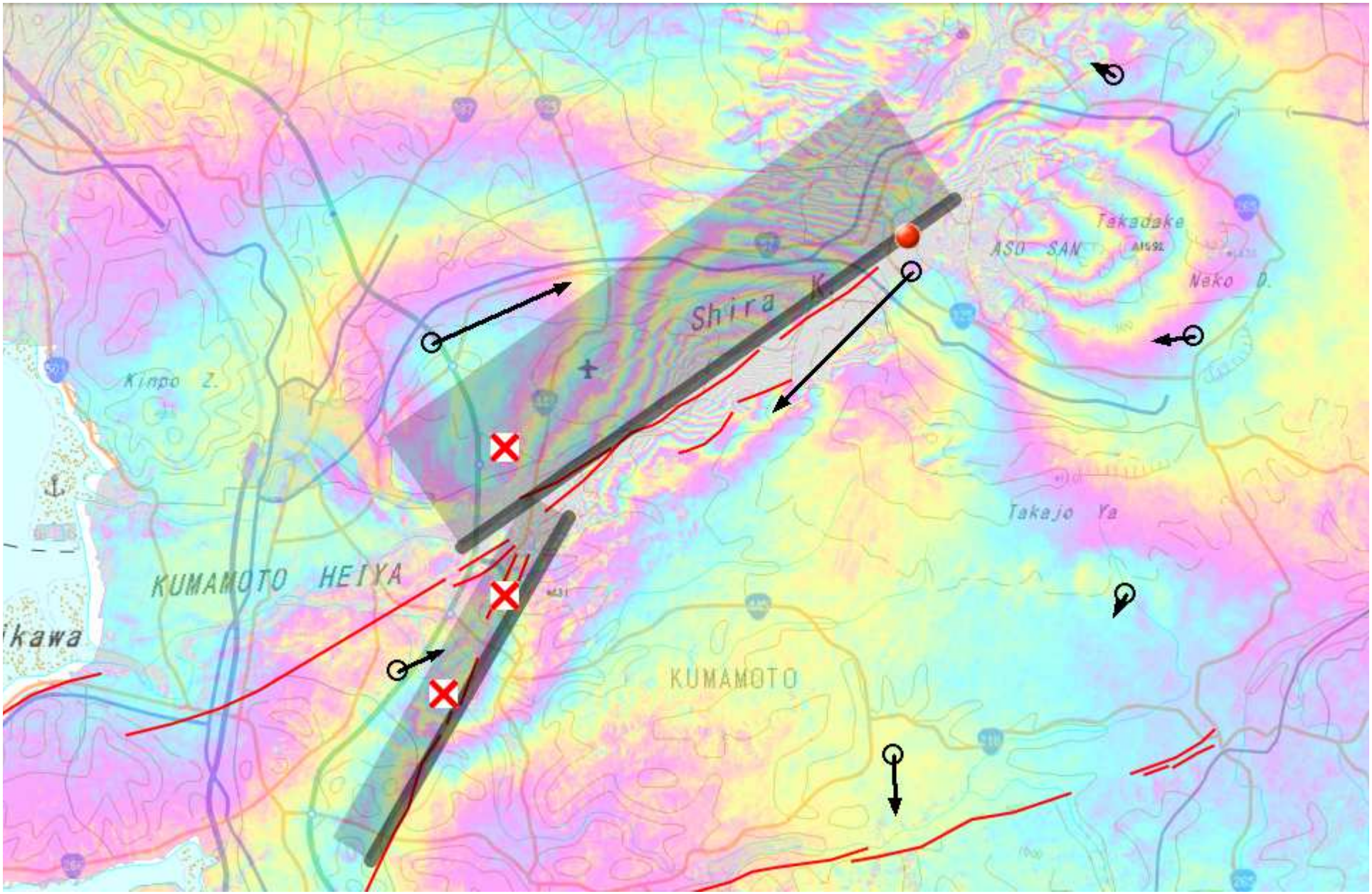
The 2016 Kumamoto Earthquake (M7.3)



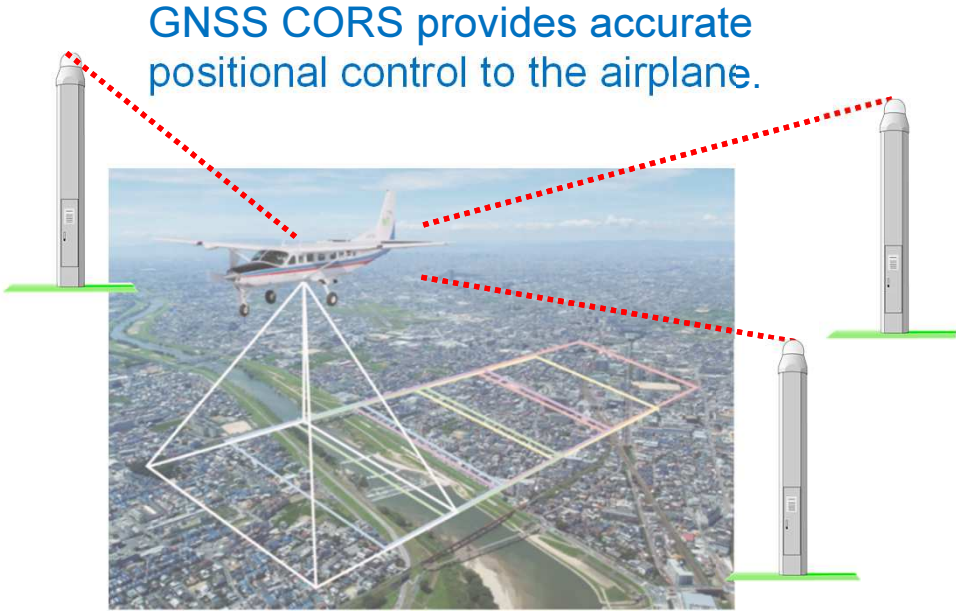
- Co-seismic deformation detected by GNSS CORS
  - ✓ SW-ward: max. 98 cm
  - ✓ Upward: max. 24 cm
- Detected deformation data was provided to the public in a few hours after the earthquake.

GNSS CORS helps find the impact and extent of potential damage caused by earthquakes.

CORS Data Analysis/Modeling and ALOS-2 InSAR Analysis

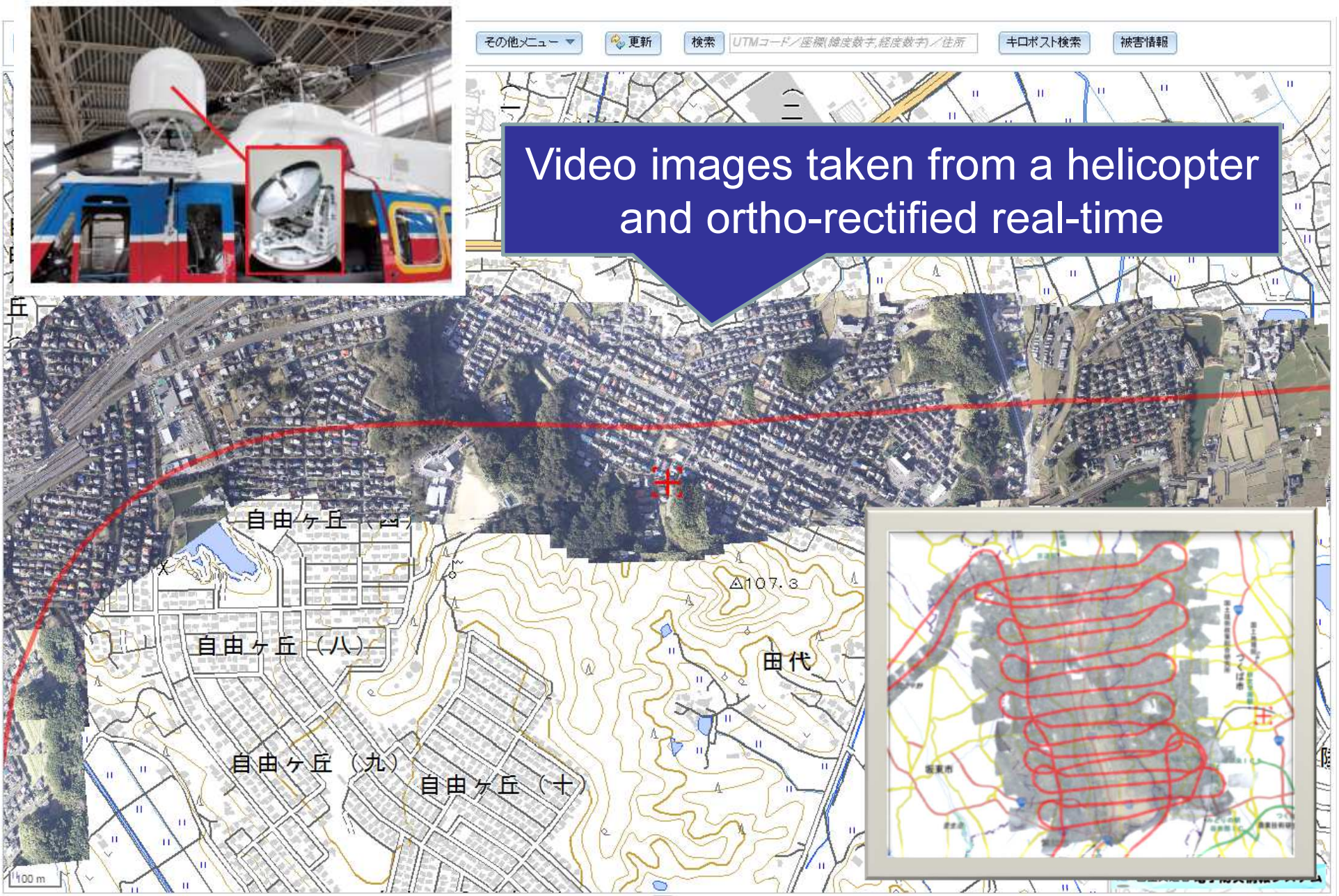


Aerial Photos



The photos revealed the impact and extent of damage in detail.

Geospatial Information Platform for Decision Makers



Integrated Disaster Information Mapping System

“ DiMAPS ”

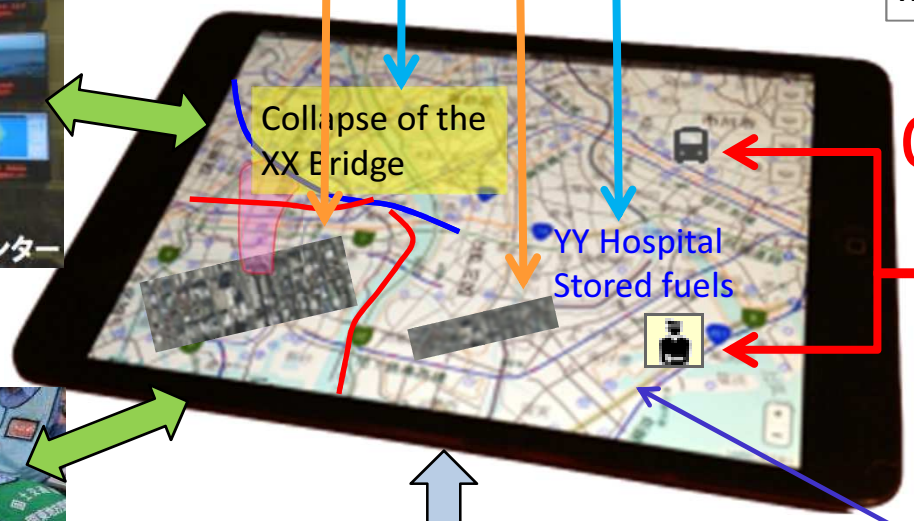
On-site Image

Live Video by Aircraft

Overlaying Live Information from Different Sources on One Map

- SAR image
- Road warning information
- Information about current conditions
- Positional information of disaster victims

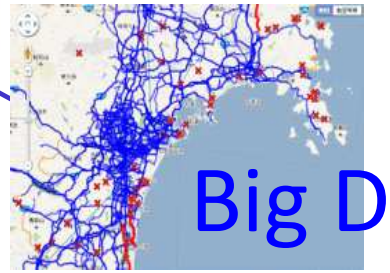
Situation Center



On-site Vehicles

Digital Map Table

Local Government



Big Data

Geospatial Information Platform for Decision Makers

Contents

Summary

- Japan has repeatedly experienced disastrous natural events, such as earthquakes, floods and landslides.

- In order to help keep the country resilient to these disasters,

  A) Prepare useful thematic maps to raise awareness of the people on the disaster risk reduction;

  B) Run Monitoring and Early warning system and

  C) Quickly find the impact and extent of damage caused by disasters to assist rescue.

- In all these efforts, Space Technologies and Geospatial Infrastructure plays a crucial role.

In Japan 1855,
people believe that Catfish occurs earthquake!

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