Introduction of NIED

- as a New JPT Member -

National Research Institute for
Earth Science and Disaster Resilience

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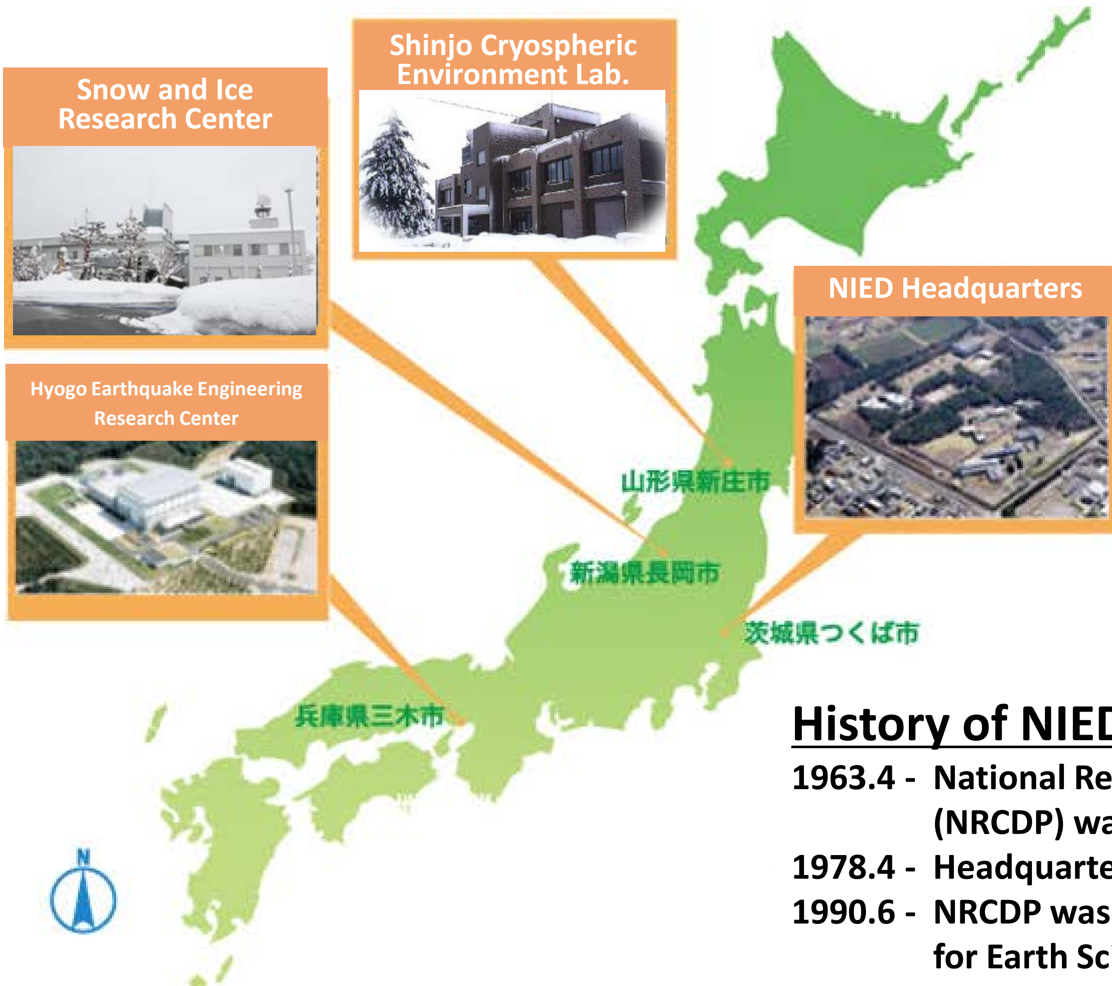
National Research Institute for Earth Science and Disaster Resilience



PRESIDENT : Dr. Haruo Hayashi

Number of Staff : 249 (As of 2016.4.1)

Budget : 9.2 billion yen

History of NIED

1963.4 - National Research Center for Disaster Prevention (NRCDP) was established at Tokyo.

1978.4 - Headquarters moved from Tokyo to Tsukuba.

1990.6 - NRCDP was re-organized as National Research Institute for Earth Science and Disaster Prevention (NIED).

2016.4 - NIED was re-organized and re-named as National Research Institute for Earth Science and Disaster Resilience.

Observation of earthquake and tsunami

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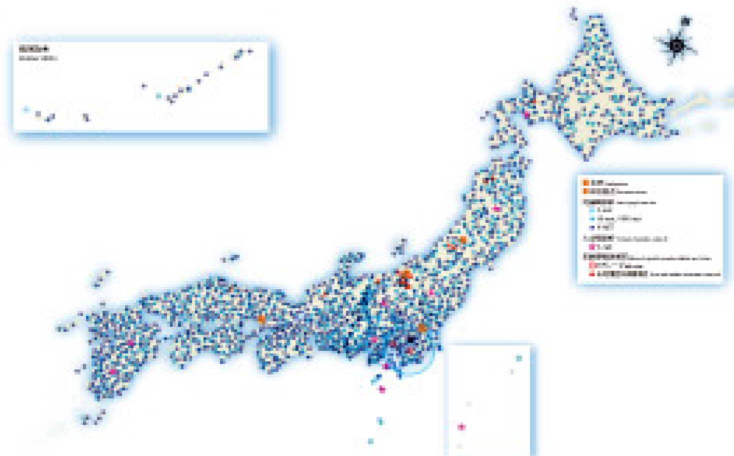
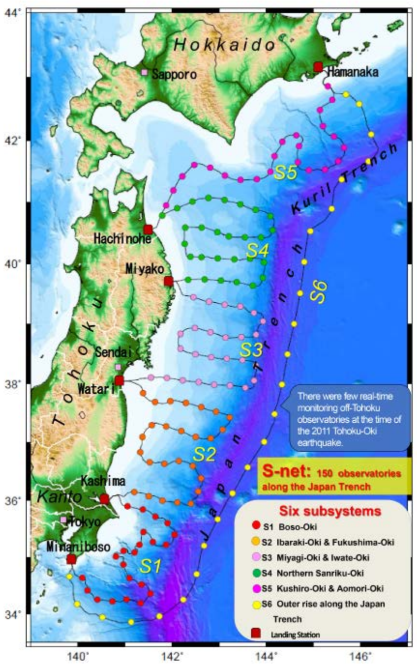
- **Earthquake observation networks**
  NIED's seismograph networks cover the entire Japan to monitor all types of earthquakes. The observed data are shared with JMA in real time to be used for the earthquake early warning.

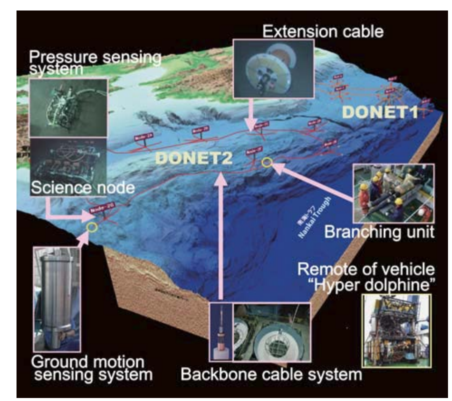




S-net **(Seafloor observation network for earthquakes and tsunamis along the Japan Trench)**

- **S-net**
  The network composed of 150 observation units, each of which contains a seismograph and a tsunami sensor, is installed at the deep ocean bottom along the Japan Trench off Tohoku, observes earthquake and tsunami that occur in the area.

- **DONET (Dense Ocean Floor Network System)**
  DONET monitors earthquake and tsunami that could occur at the Nankai Trough earthquake rupture zones.



DONET

Large-scale experiment facilities

- **E-Defense**

  The world's largest 3-D shaking table of E-defense (20m × 15m) is used to verify the seismic performance of a life-size structures.

E-Defense

- **Large-scale Earthquake Simulator**

Large-scale Earthquake Simulator

It enables large-scale earthquake-proof experiments with the second largest shaking table of the world (14.5m × 15m).

- **Large-scale Rainfall Simulator**

  The facility can simulate near natural rainfalls (15mm-300mm) to study the water disasters caused by the heavy rainfalls

Large-scale Rainfall Simulator

Other major research areas

- **Cryospheric Environment Simulator (CES)**
  CES can create natural cryospheric environment by simulating near natural snowfall.

Artificial snowfall simulated at CES

X-Band Multi-Parameter Radar

- **X-Band Multi-Parameter Radar System (MP Radar)**
  MP Radar enables accurate rainfall estimate from raindrop shape and their drop-size distribution.

- **Volcanic activity monitoring**
  NIED observes volcanic activities accurately with Volcanic observation network (V-net). The data recorded by V-net are used for estimating the behavior of magma and the eruption.

V-net locations

Society implementation

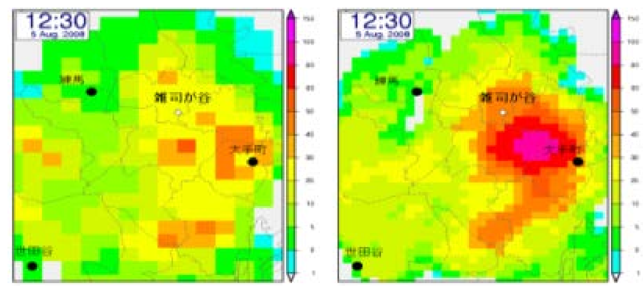
NIED implement its research outcomes in society.

Earthquake Early Warning

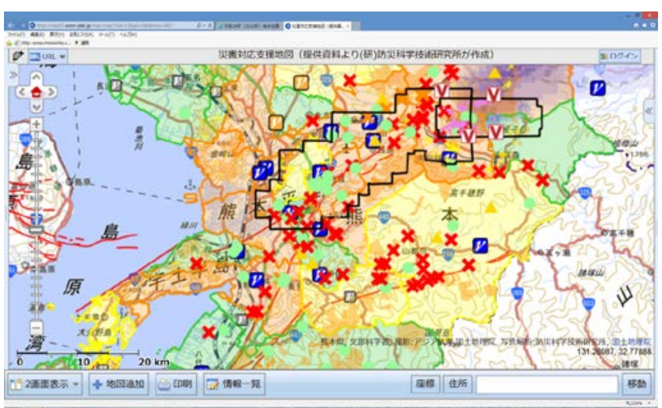
JMA and NIED jointly developed Japan's earthquake early warning system. 80% of ground motion data used for EEW are observed by NIED's seismographs.

Network for detecting heavy rain

NIED developed high-resolution X-band MP radar to detect localized and sudden heavy rain and tornado.



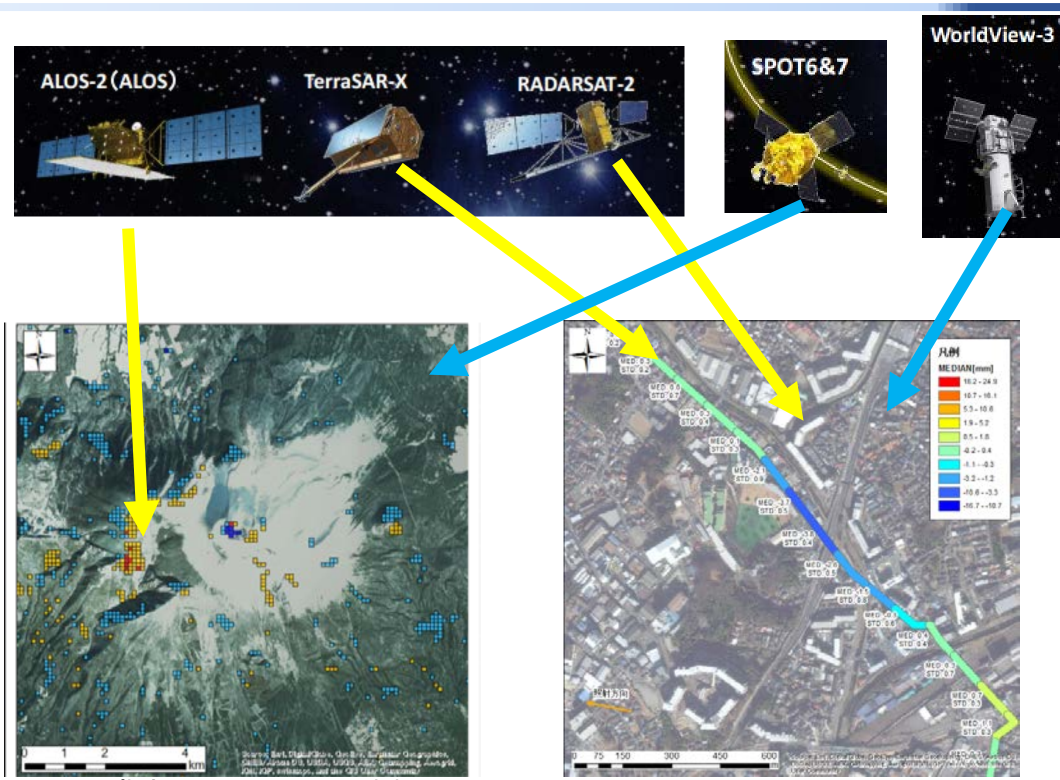
1 km mesh (30 min interval) 500 m mesh (5 min interval)



Web-based information system

NIED developed a platform that can integrate various disaster information and share it with stakeholders for disaster response activities.

Using SAR data in disaster management



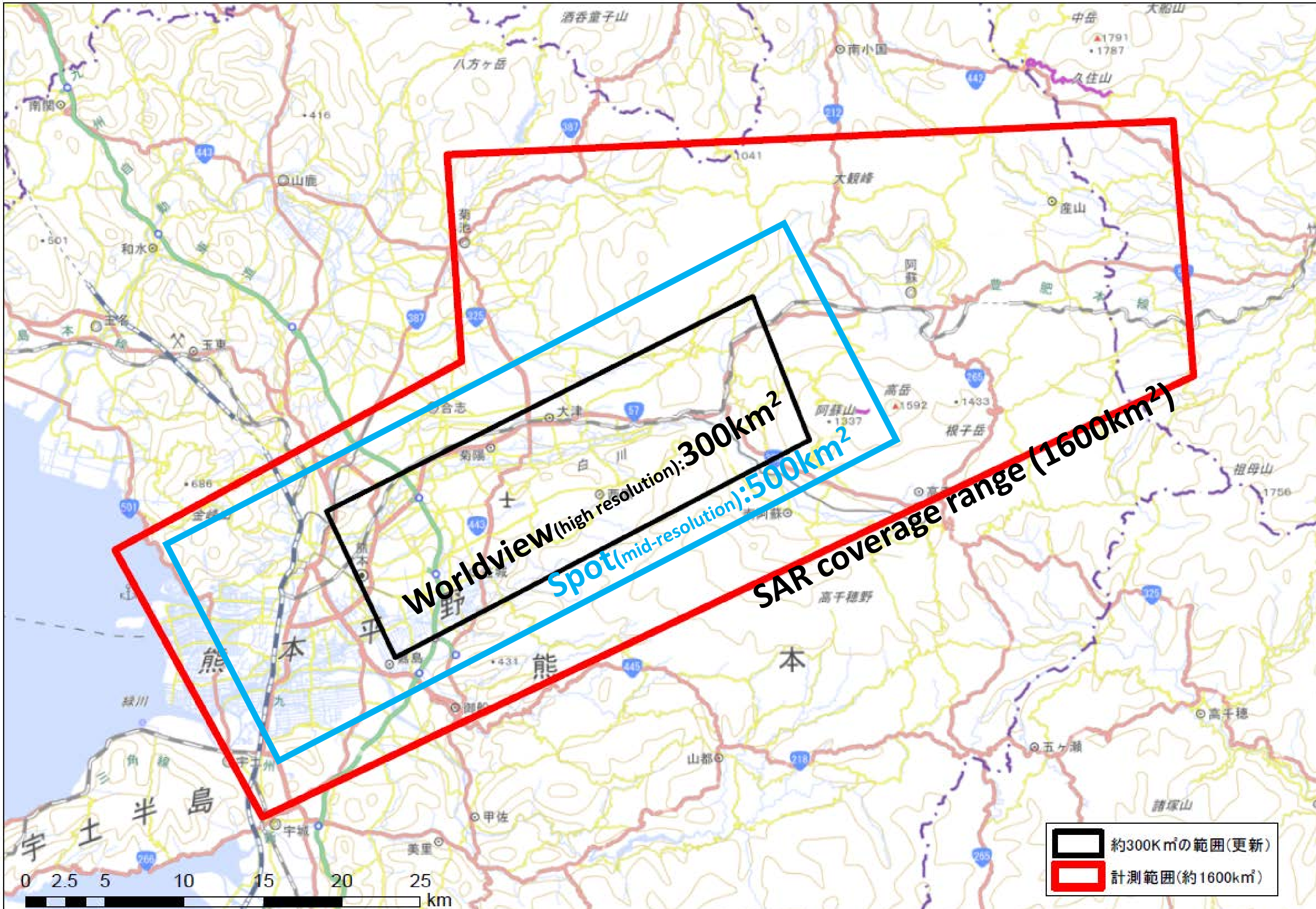
Diag. 1 (left: image using mesh by ALOS2 to express ground transformation)

Diag.2 (Right: Changes to road surface expressed by Terra SAR-X and Radarsat-2)

In 2016, a few month after the Kumamoto Earthquake, using SAR data NIED attempted to investigate ground deformation at already earthquake damaged areas.

Satellites	Observation Cycle	Influence Breadth	Wavelength	Specialty
ALOS-2 (SAR, Japan)	14 days	25km~	L band (approx. 24cm)	Ground fluctuations /landslides in woodland areas
Terra SAR-X (SAR, Germany)	11 days	18km~	X band (approx. 3cm)	Ground surface with no vegetation, buildings
RADARSAT-2 (SAR, Canada)	24 days	18km~	C band (approx. 5cm)	Ground surface with underbrush, buildings
SPORT6, 7 (optical, France)	26 days	60km	1.5m	Background to analysis results (wide-area)
World View 2, 3 (optical, US)	1-11 days	13.1km~	around 40cm	Background to analysis results (details, expanded)

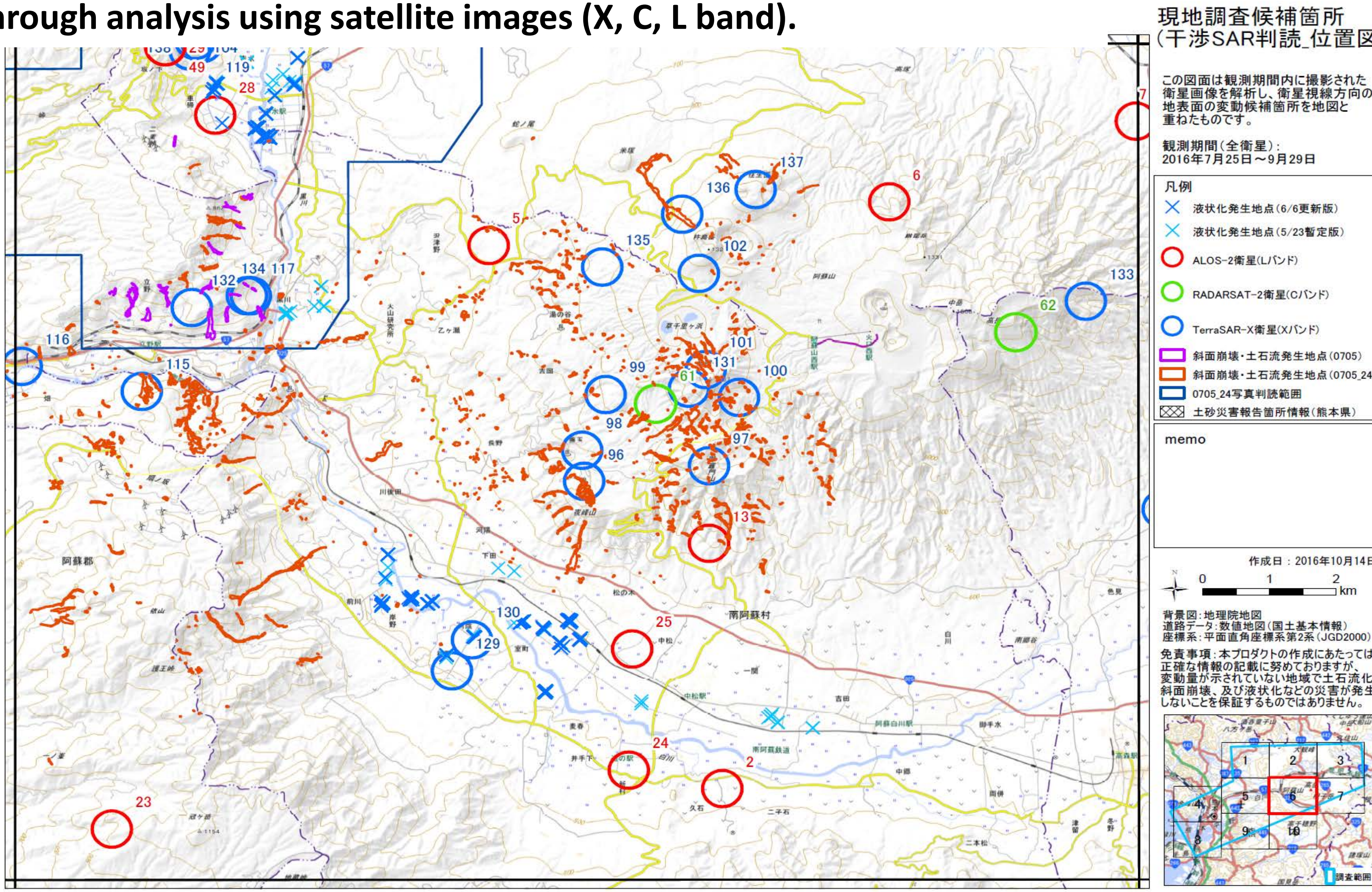
Range of SAR analysis using satellite data



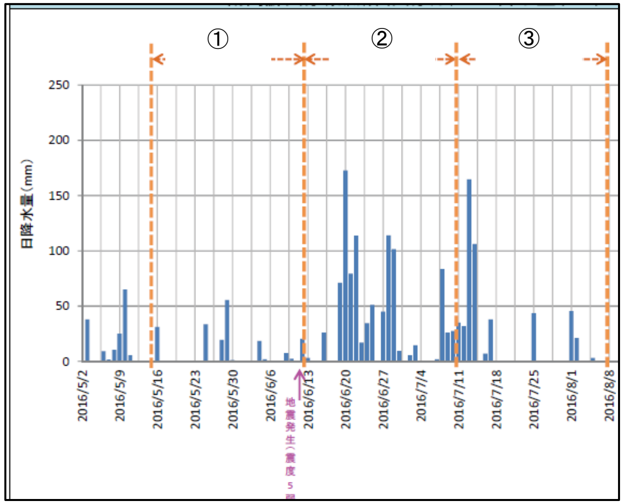
Corresponds to minimum purchase area of 300, $500km^2$ respectively.

Possible locations of ground surface deformation

Possible locations where ground surface deformation has occurred through analysis using satellite images (X, C, L band).

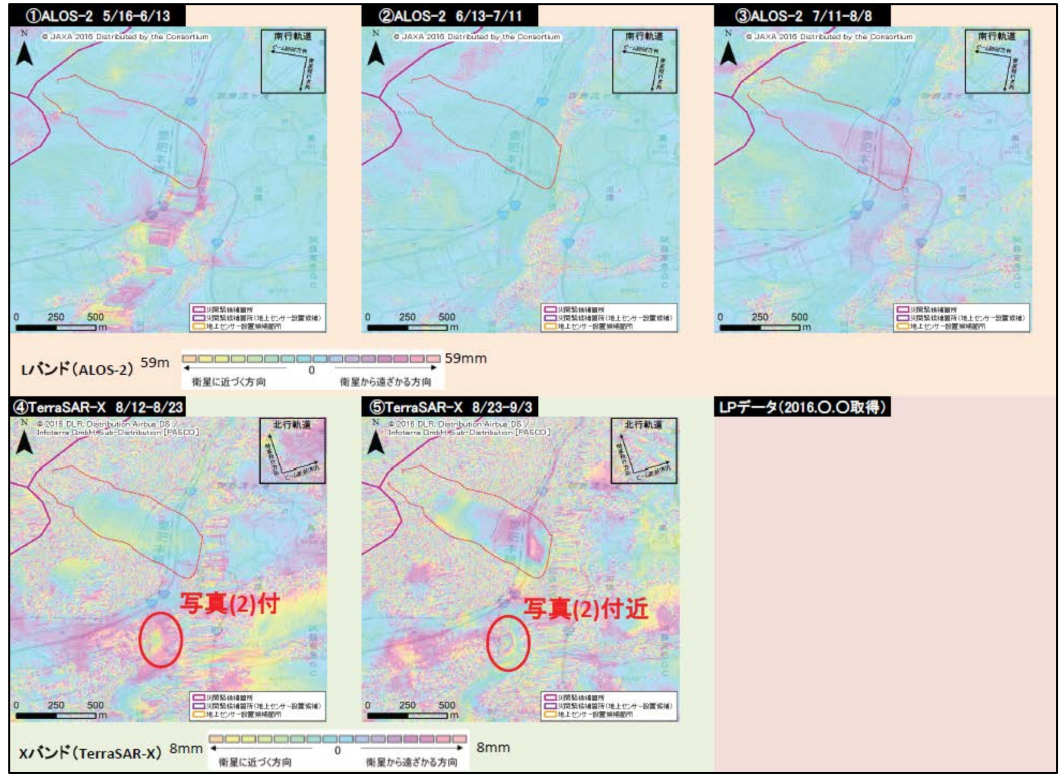


Observing ground deformation using satellite data



Daily amount of rainfall

Optical satellite image



Interference SAR analysis results

Change on the ground surface was confirmed in the observation.

Even after a lapse of a certain period of time, it's important to know if there is additional change.

Voice from NIED at the scene of disaster response

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Following a disaster, we want to grasp the state of damage chronologically.

<u>What we want to know?</u>

1. Areas suffering large damage right after disaster
2. Places where secondary disasters could occur
3. Places where restoration is delayed after time has elapsed.

<u>Changes/fluctuations that need to be discerned</u>

Slope change, ground transformation, liquefaction, subsidence etc.

Changes to buildings, to roads, levees, railways etc.

<u>Key technical challenges</u>

- Standardization of satellite data analysis (range, precision, analysis method etc.)

- Establishment of AI technology that can automatically process a large volume of data (even at 70% accuracy)