FIG WORKING WEEK 2017
Helsinki Finland
29 May - 2 June 2017

3-D crustal deformation detected by SAR interferograms of ALOS-2 satellite

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Outline

- Introduction
  - SAR satellite of Japan, ALOS-2
  - InSAR Analysis of Geospatial Information Authority of Japan

- 3-D coseismic displacement field detected by InSAR
  - How to construct 3-D displacement from InSAR
  - Central Tottori Earthquake (Mw 6.2)

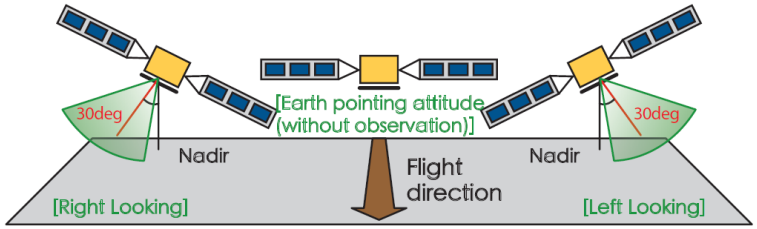
ALOS-2

- L-band SAR satellite developed by JAXA*
- High resolution and frequent recurrence interval (14 days)
- Right-and-left looking observation capability

JAXA: Japan Aerospace Exploration Agency

Satellite	Mass	Approx. 2t
Mission Data Downlink		Direct Transmission or via Data Relay Satellite
SAR Frequency range		L band (1.2GHz)
Observation Mode	Spotlight	Resolution: 1-3m Swath: 25km
	Strip map	Resolution: 3m, 6m or 10m Swath: 50 or 70km
	Scan SAR	Resolution: 100m Swath: 350km

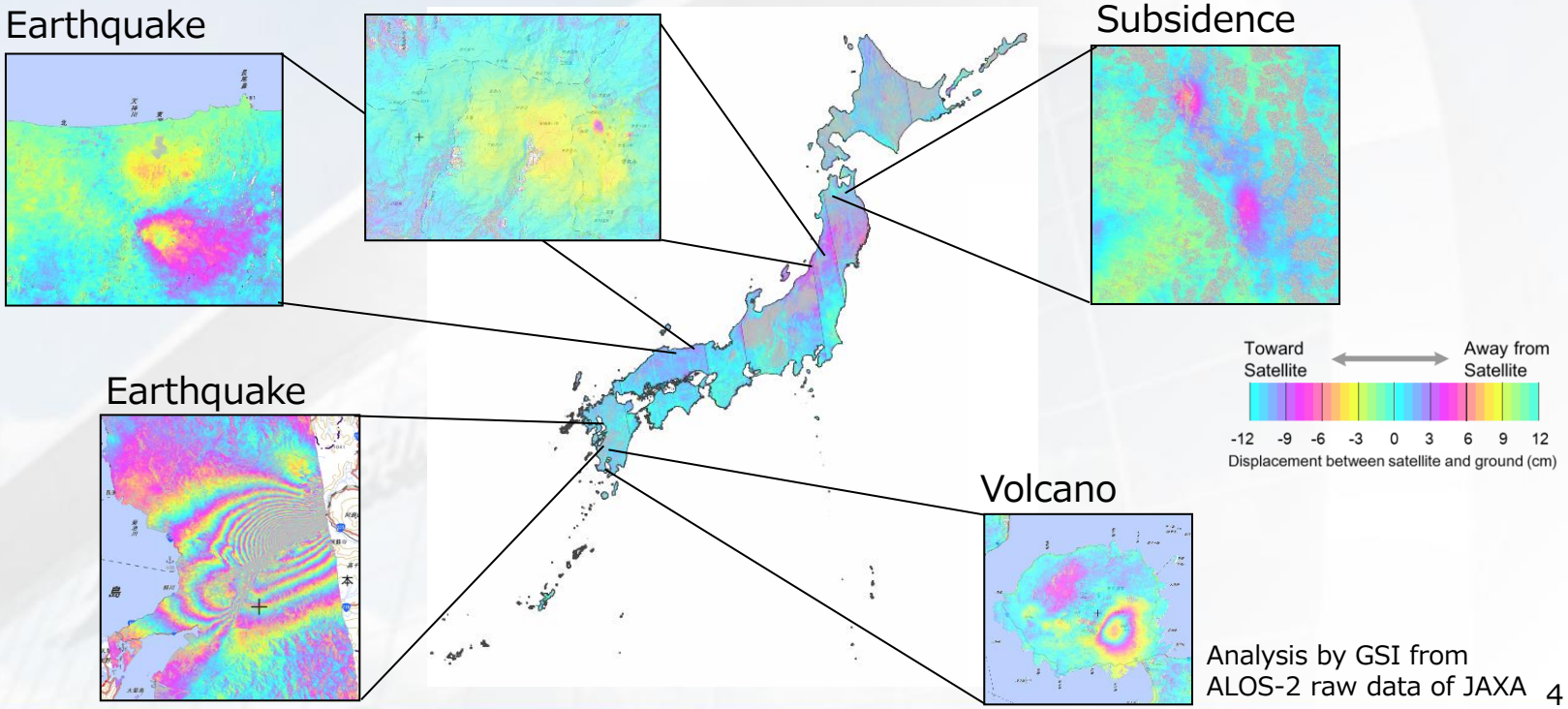
http://global.jaxa.jp/projects/sat/alos2/pdf/daichi2_e.pdf



Right-and-left looking observation capability

InSAR analysis of GSI (routine)

- GSI monitor ground deformation of Japan with InSAR
- Routine analysis: 4 to 6 interferograms a year for each region

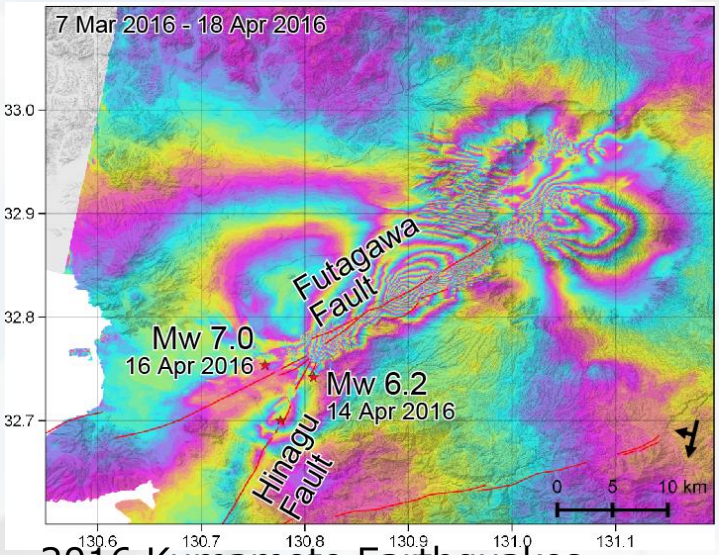


Analysis by GSI from ALOS-2 raw data of JAXA

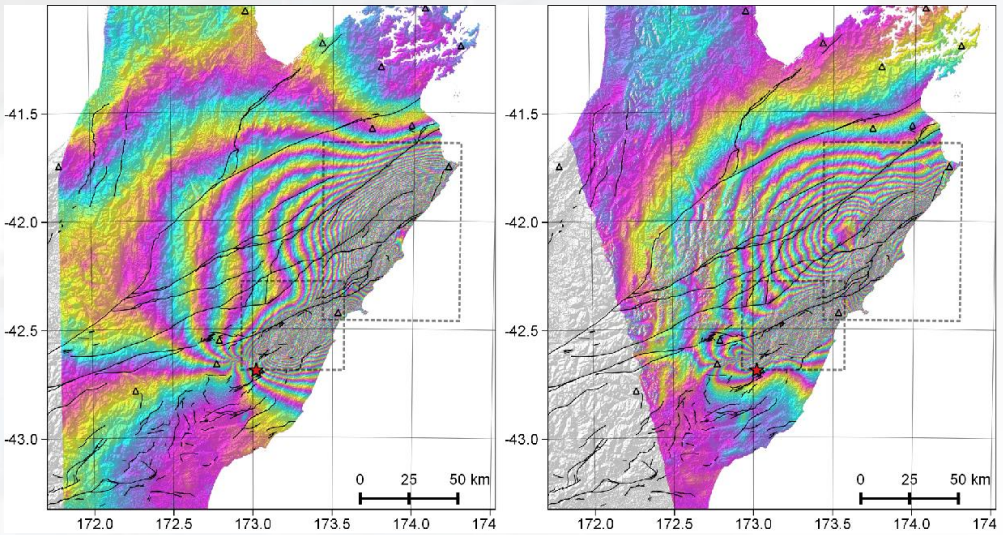
InSAR analysis of GSI (emergency)

- Emergency analysis: prompt observation after and during disaster events such as earthquakes, volcanic eruption etc.
- GSI also analyzes events outside of Japan

Interferograms of emergency analysis



2016 Kumamoto Earthquakes



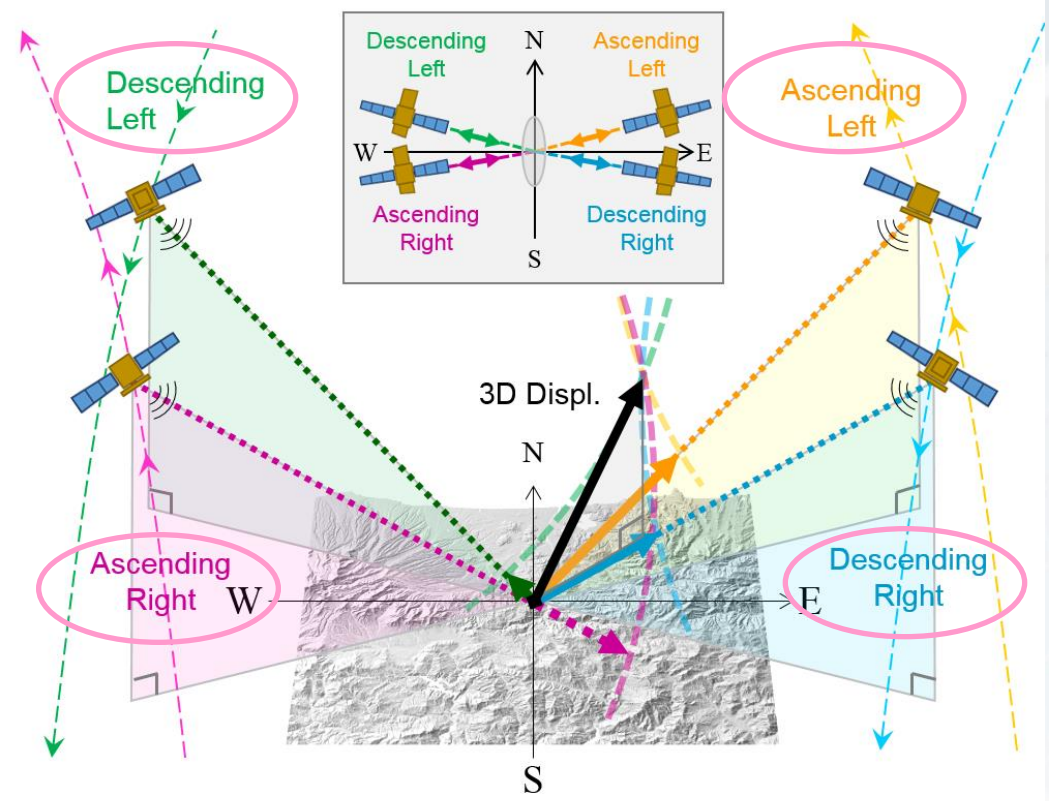
Kaikoura Earthquake (New Zealand)

Analysis by GSI from ALOS-2 raw data of JAXA

3-D coseismic displacement field detected by InSAR

- How to retrieve 3-D displacement from InSAR
- Central Tottori Earthquake (Mw 6.2)

How to retrieve 3-D displacement from InSAR?



Geometry of 3D InSAR

Retrieve 3-D deformation of each pixel

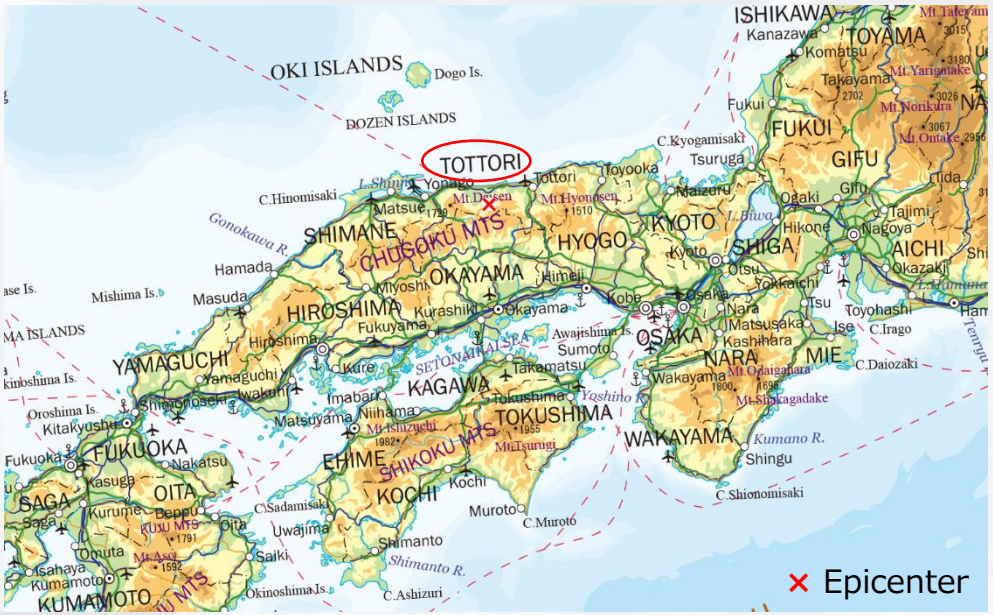
from three or more independent SAR images

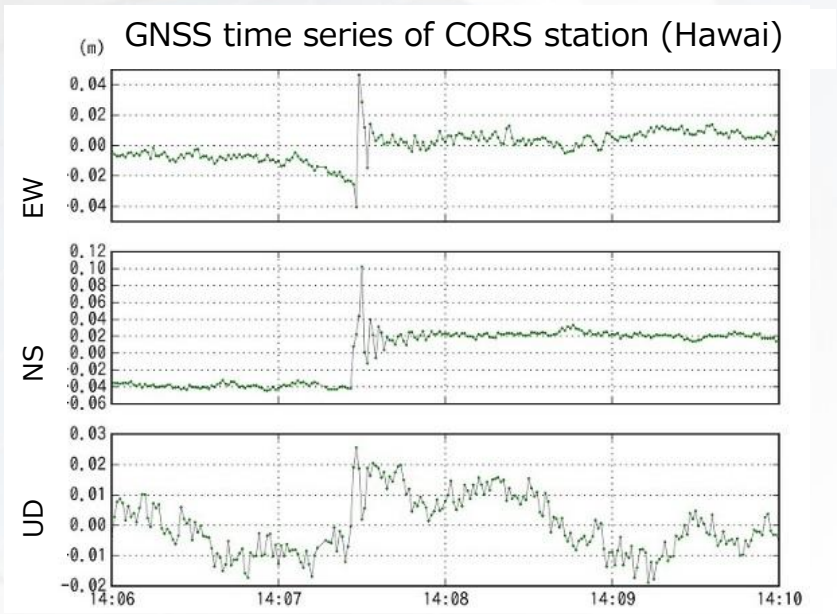
observed from different observing directions

* ALOS-2 can provide images from four directions; ascending right, ascending left, descending right and descending right

Central Tottori Earthquake (Mw 6.2)

- 2017/10/21 14:07 at Central area of Tottori Pref. depth 10km
- GNSS CORS network of Japan, GEONET detected 5cm displacement in real-time at a station nearest to the epicenter

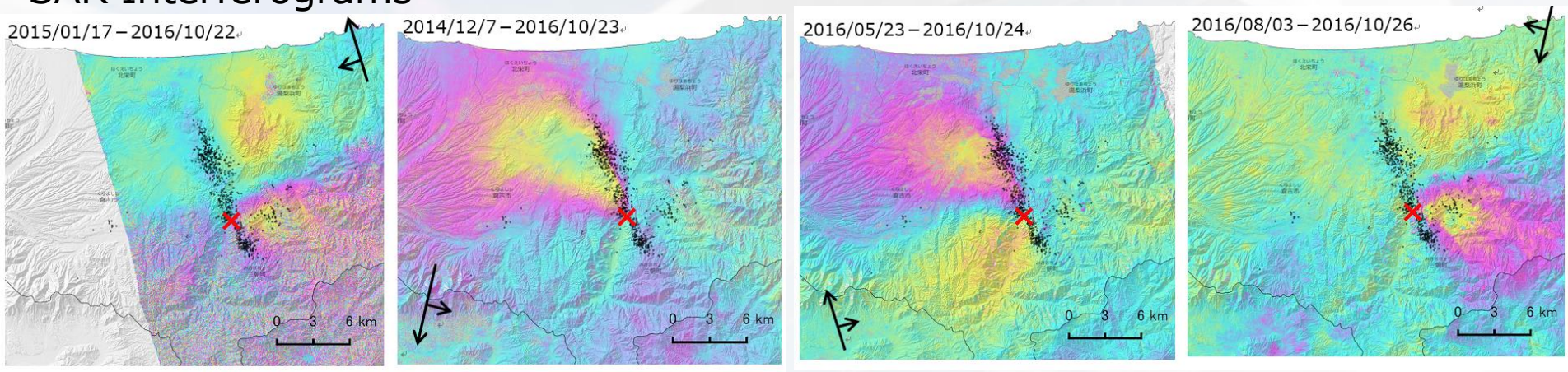




Central Tottori Earthquake (Mw 6.2)

- Four SAR intererograms from different observing directions with in 5 days (10/22~10/26)
- All of them detect coseismic displacement around the epicenter

SAR Interferograms



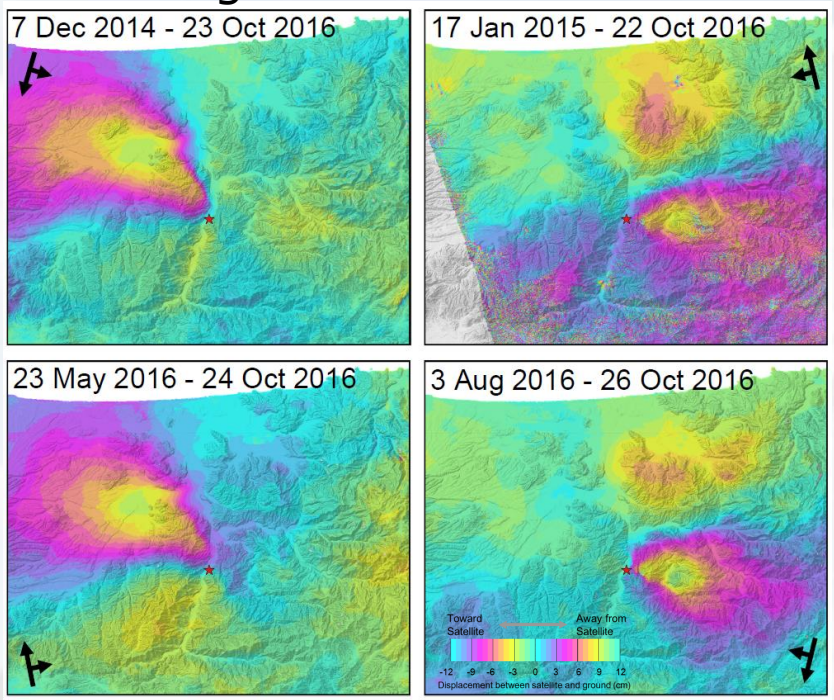
×: epicenter
・: hypocenter distribution

Analysis by GSI from ALOS-2 raw data of JAXA

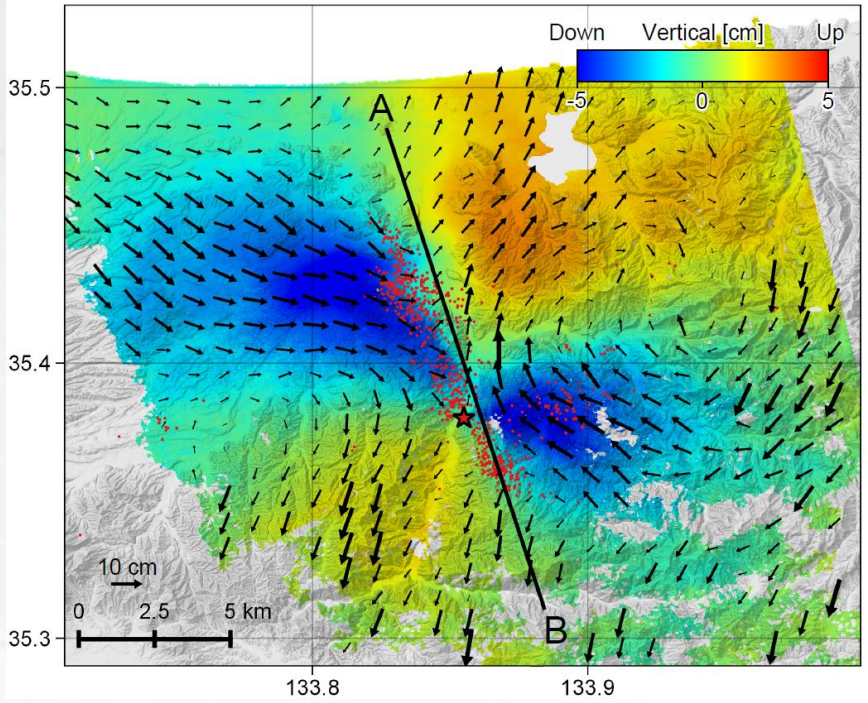
Central Tottori Earthquake (Mw 6.2)

- Full 3D coseismic displacement field was retrieved from four independent SAR interferograms with different observing directions

Interferograms



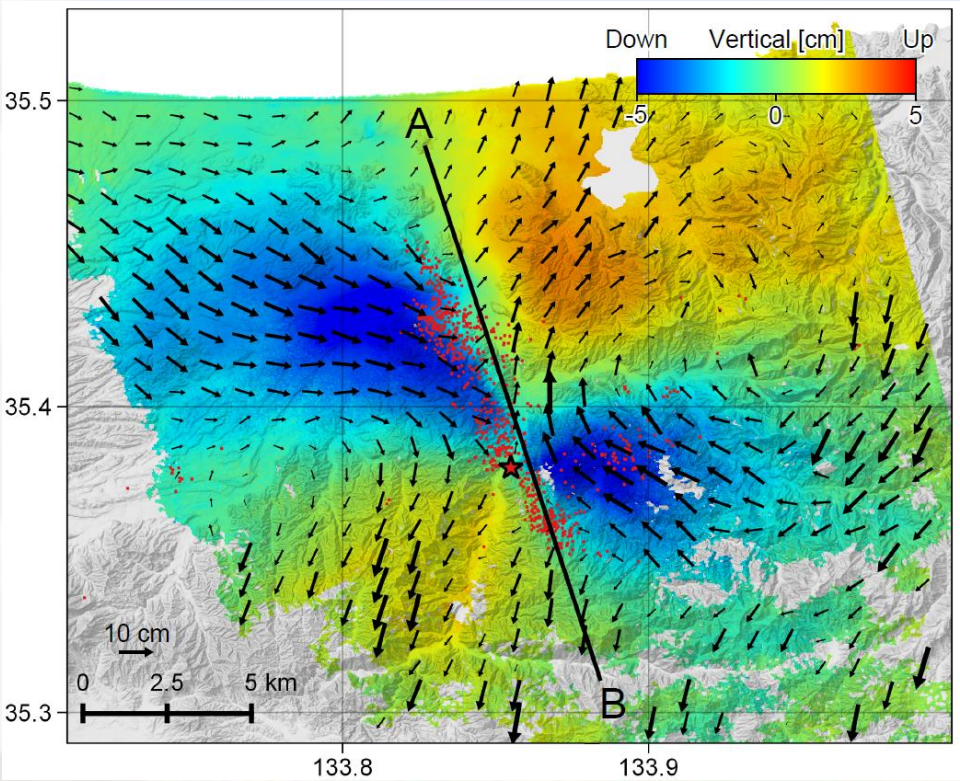
3D displacement



Analysis by GSI from ALOS-2 raw data of JAXA

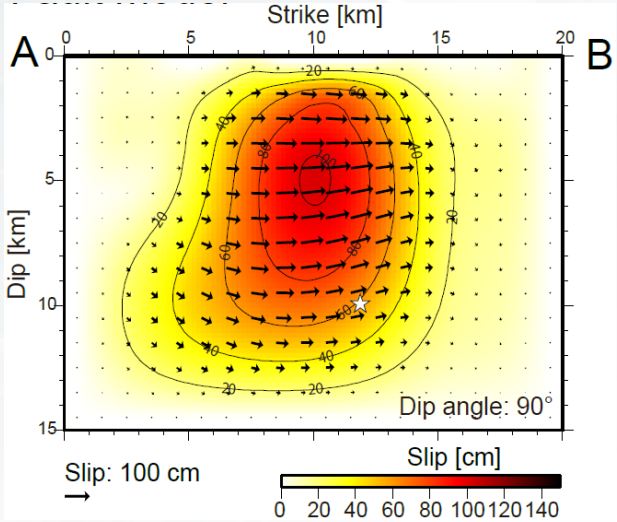
Central Tottori Earthquake (Mw 6.2)

- Four quadrant displacement pattern by pure left lateral strike slip
- Slip distribution was estimated from 3-D displacement



- High precision
  EW and UD: ~1 cm
  NS: ~4 cm
- high resolution: ~10 m

Fault model



Summary

- GSI is monitoring ground deformation of Japan with SAR interferograms of ALOS-2.
- Once disaster events occur, GSI emergently conducts InSAR analysis of ALOS-2.
- We retrieve full 3-D coseismic displacement field of 2016 Central Tottori Earthquake from four SAR interferograms of ALOS-2 observed from different directions.
- The precision of displacement field is about 1cm in NS and UD components, about 4cm in EW components.
- SAR interferograms from four different directions also enabled us more robust estimation of source fault mechanism.

Thank you for your attention!

For more details, please see GSI web page, The 2016 Central Tottori Earthquake (http://www.gsi.go.jp/cais/topic161027-index-e.html)