



CRUSTAL DEFORMATION STUDY WITH SAR

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Topics

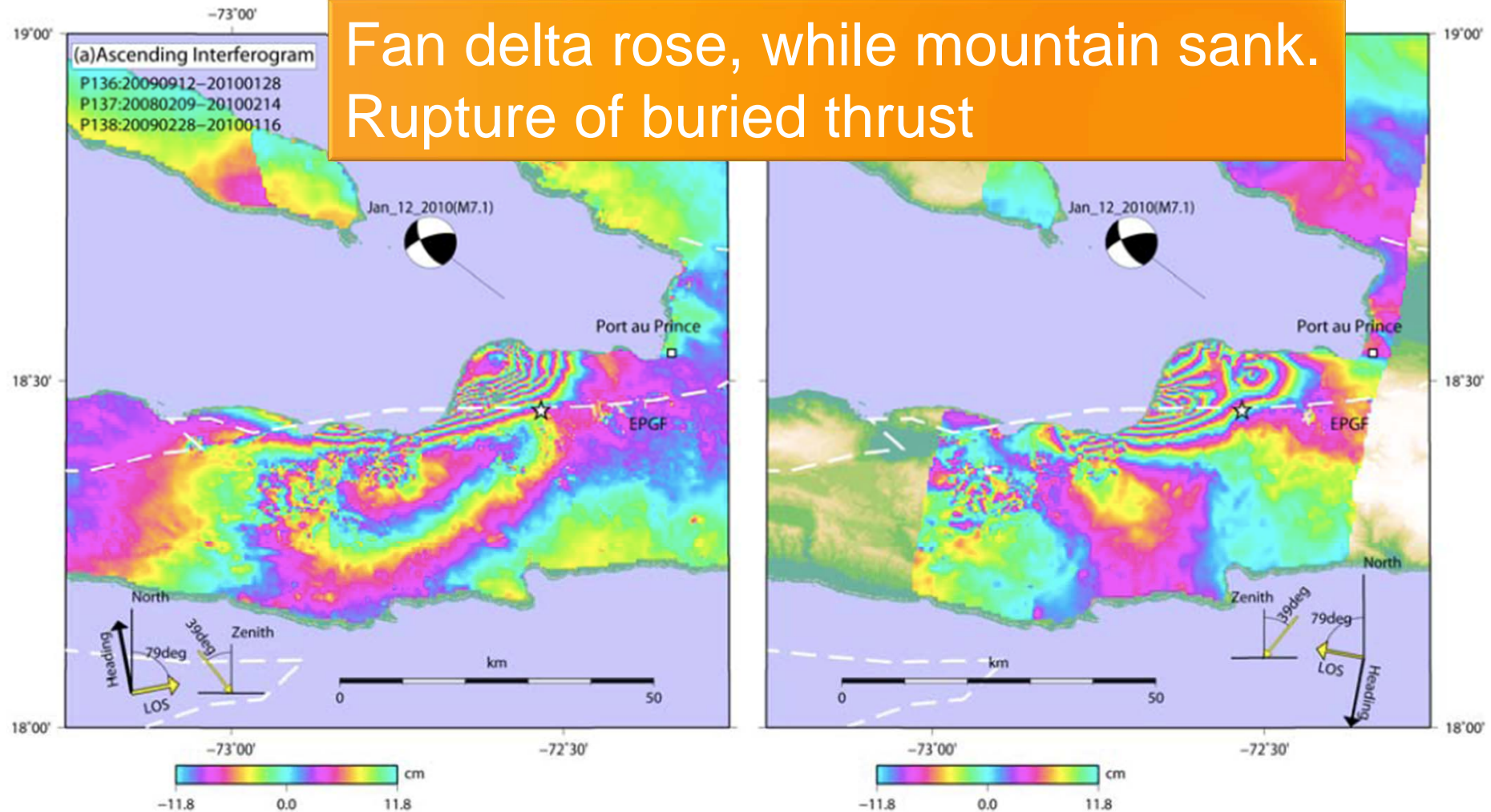
- ScanSAR-ScanSAR interferometry
- Time series analysis

EQ Study with ALOS/PALSAR

- Many important earthquakes during the operation of ALOS/PALSAR
 - 2008 Wenchuan, China; 2010 Haiti; 2010 Maule, Chile; 2010 El-Mayor Cucapah, Mexico; 2010 Darfield, NZ; 2011 Tohoku-Oki, Japan, etc
- Coseismic and postseismic deformations
- Fault models
- **These studies definitely deepened understanding of earthquake faulting!**

Haiti EQ: Coseismic Interferograms

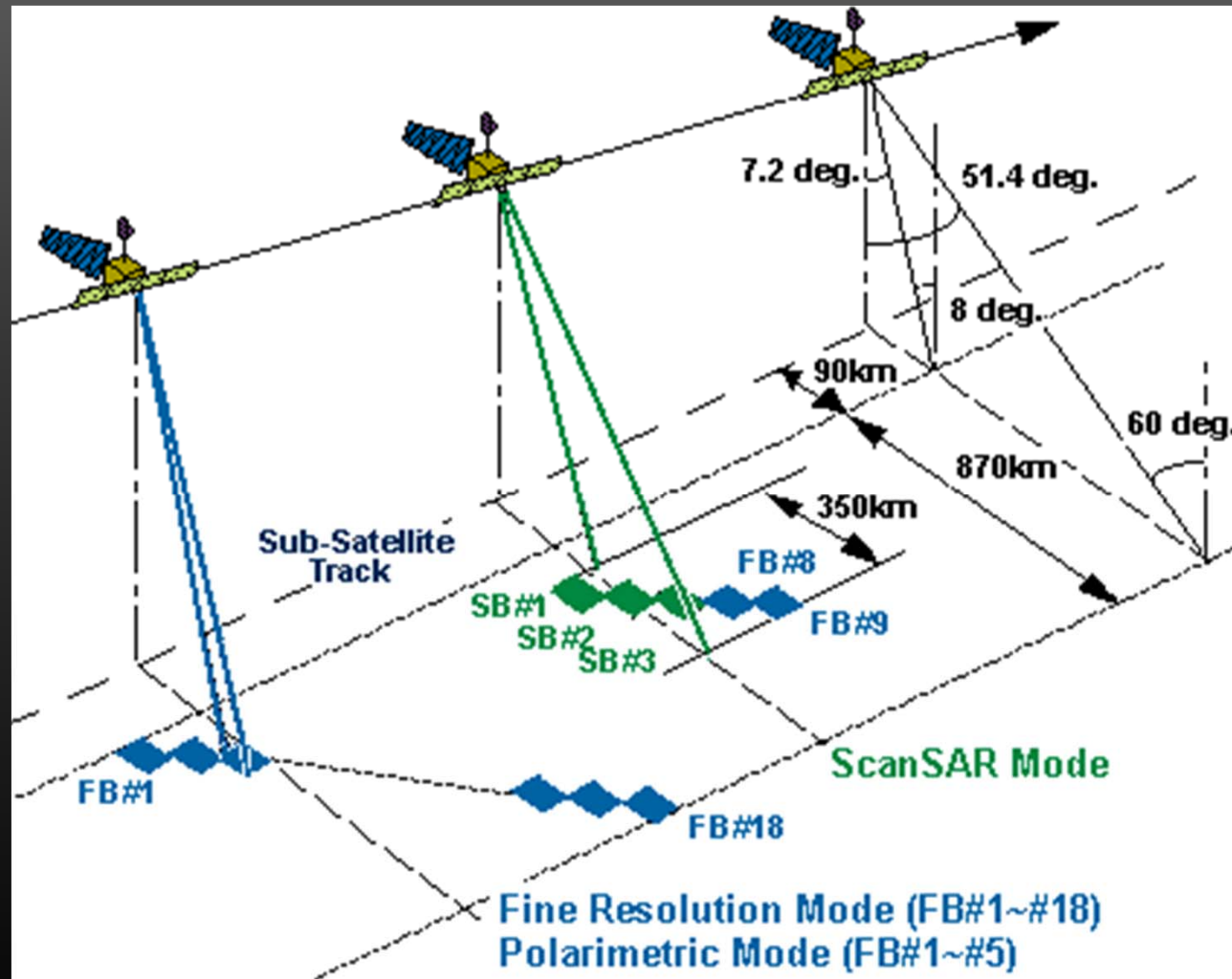
Fan delta rose, while mountain sank.
Rupture of buried thrust



Hashimoto *et al.*, *Nature Geoscience*, **4**, doi:10.1038/NGEO1115, 255-259, 2011.

SCANSAR-SCANSAR INTERFEROMETRY

2 Observation Modes of PALSAR



<http://www.eorc.jaxa.jp/ALOS/en/about/palsar.htm>

Maule, Chile EQ of Feb. 27, 2010

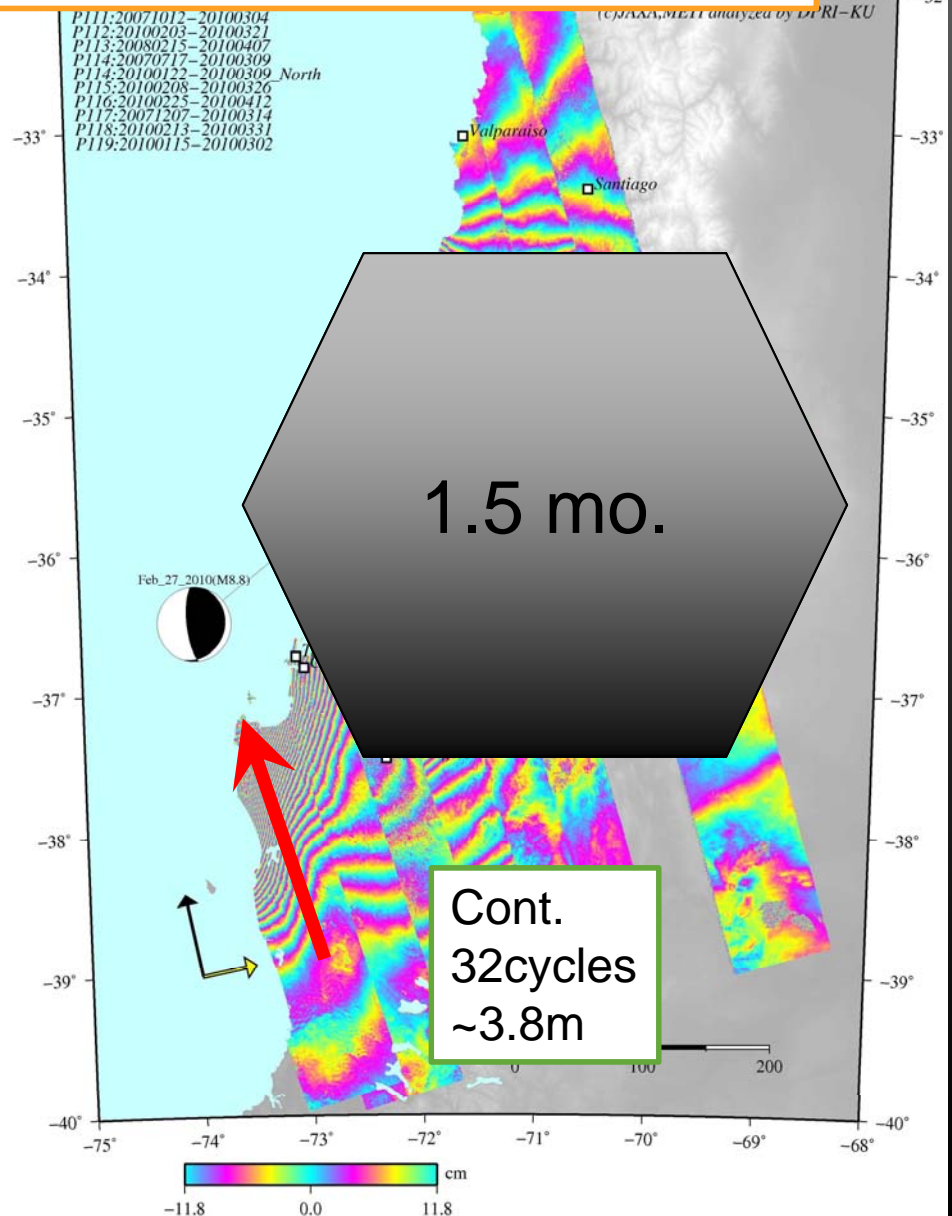
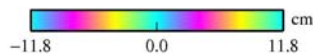
On the courtesy of
Dr. Taku Ozawa

Ext.
25cycles
~3m

Two days
aft. EQ

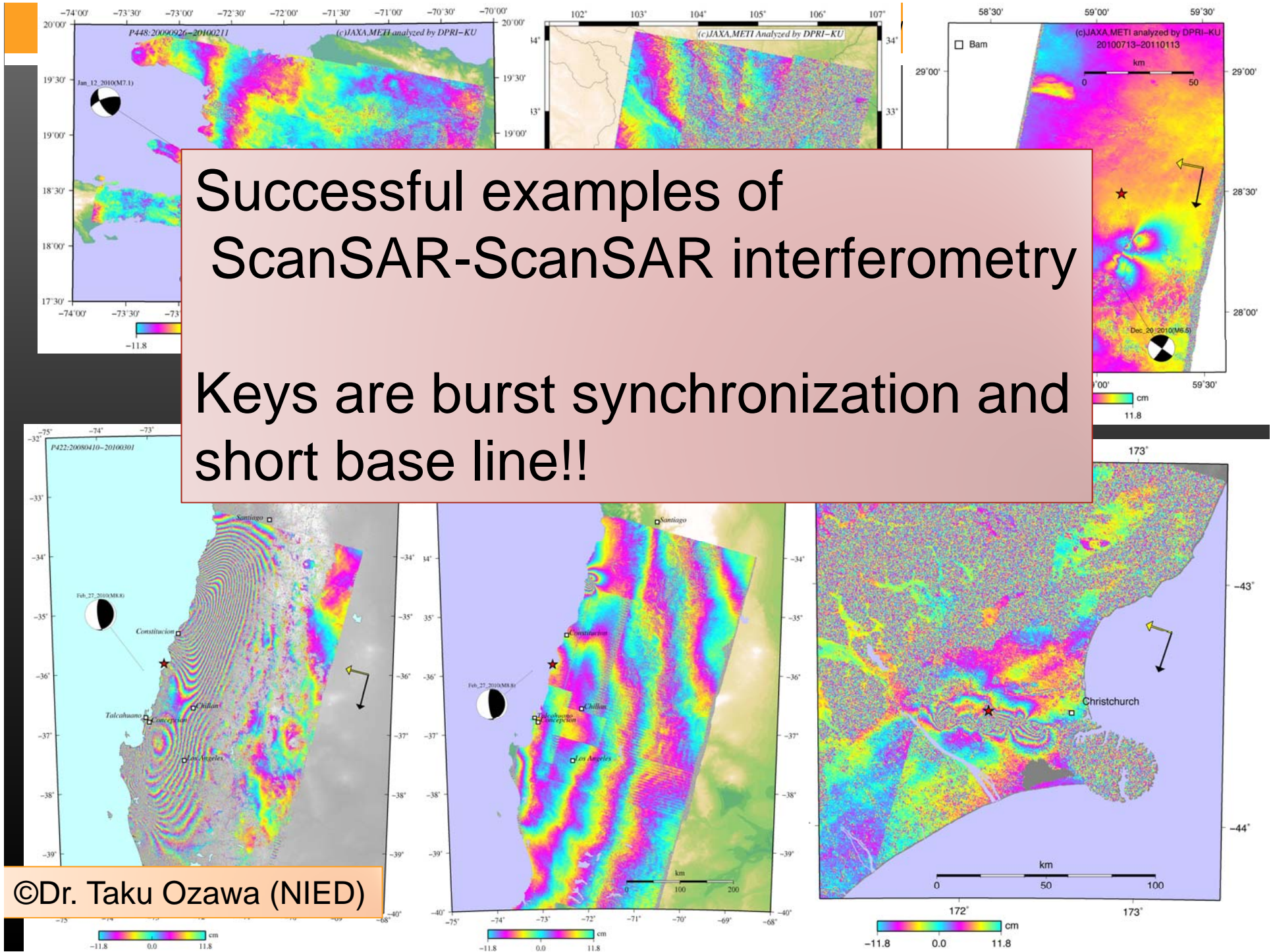
Ext.
12cycles
~1.4m

~99% coseismic deformation



Successful examples of ScanSAR-ScanSAR interferometry

Keys are burst synchronization and
short base line!!

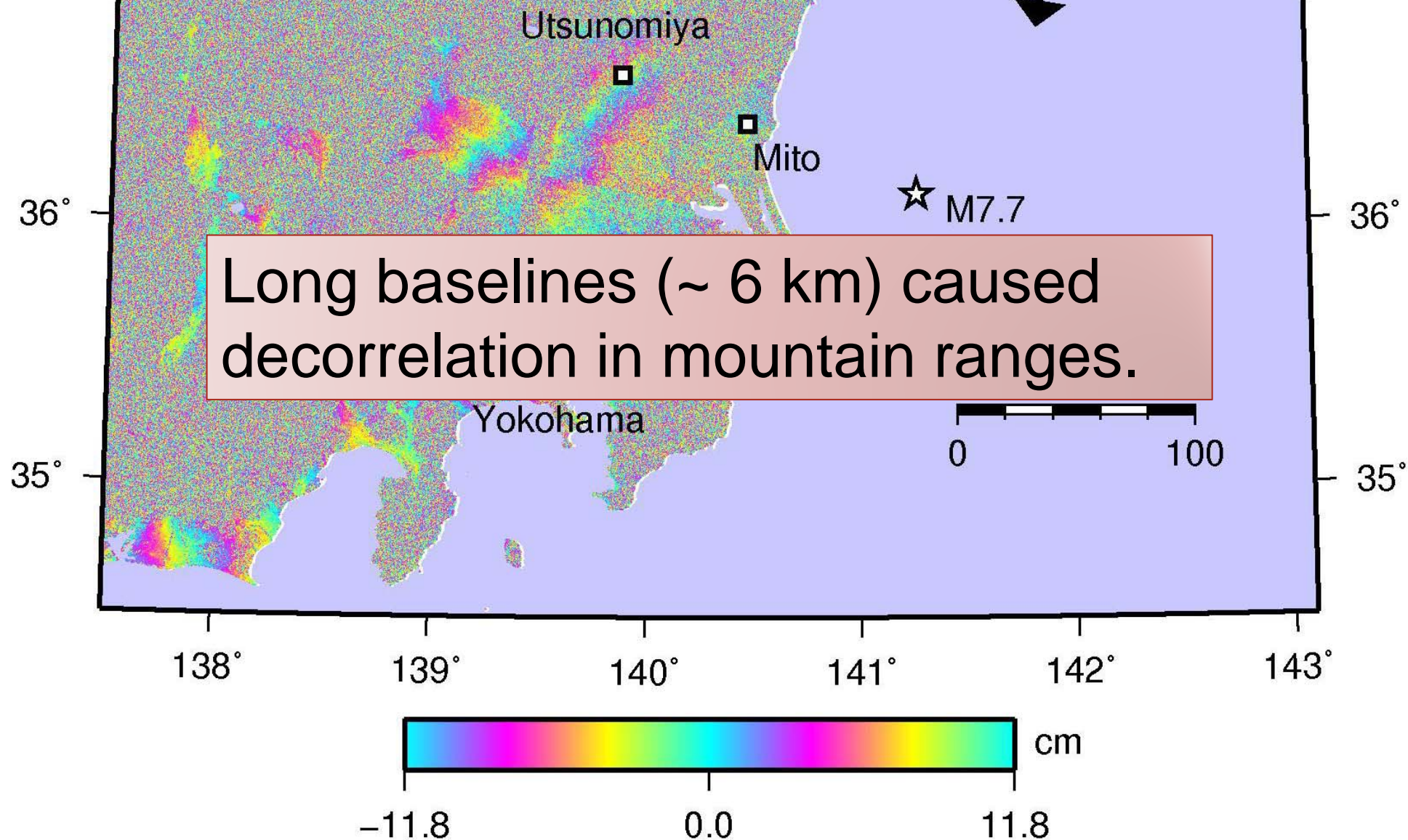


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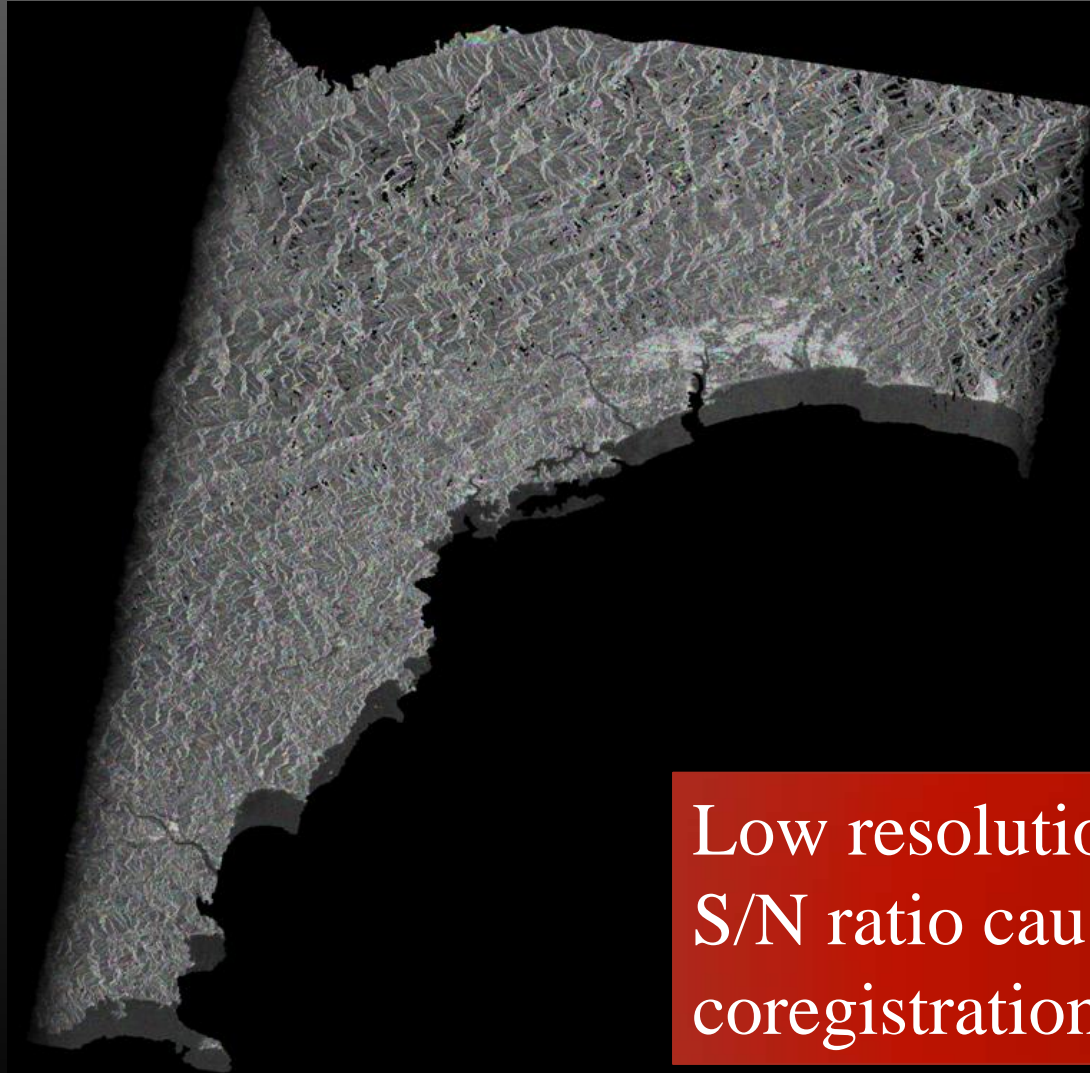
German-Japan Next Generation SAR Workshop

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ScanSAR: Path62 (20100715-20110417)



Failure of Coregistration



Low resolution and low S/N ratio cause failure of coregistration.

Summary of SS Interferometry

- Close to routine processing
- Key to success
 - ✓ Perpendicular baseline
 - ✓ Burst synchronization
 - ◆ **S/N ratio**

TIME SERIES ANALYSIS IN EPICENTRAL REGIONS

Frontier of Earthquake Science

Preseismic strain accumulation

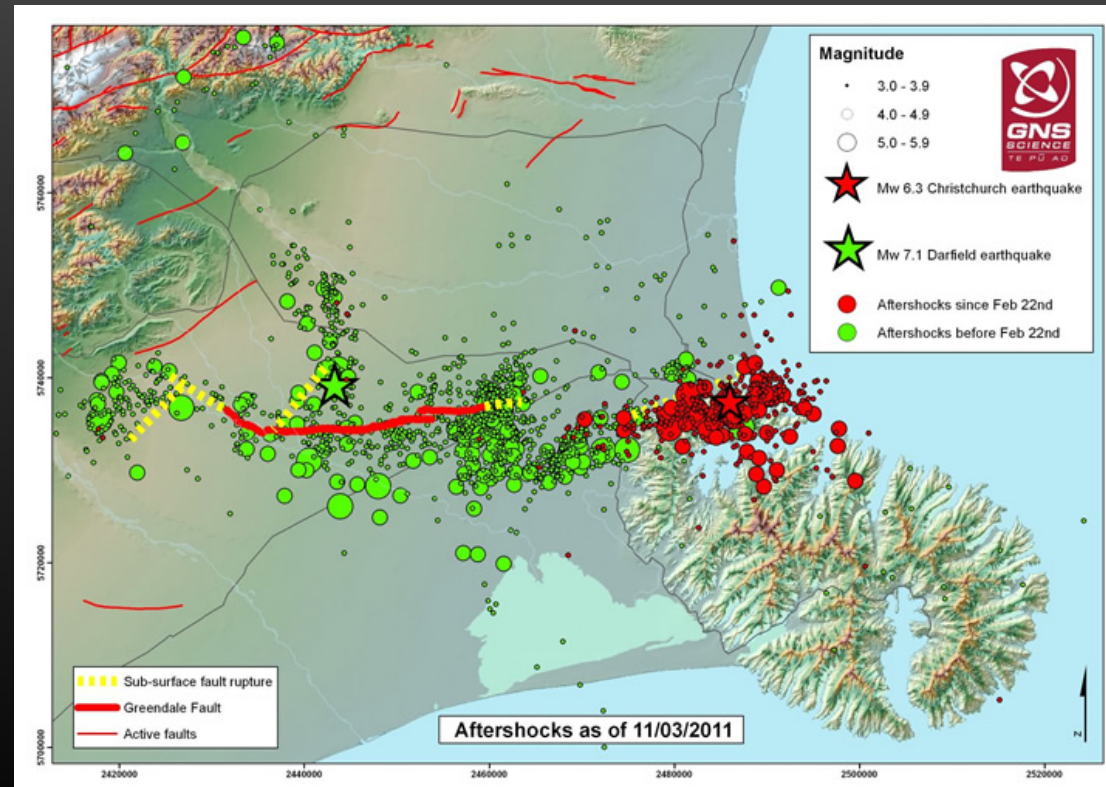
- ✓ Understanding of earthquake generation process
- ✓ Contribution to disaster mitigation

Why Do We Need L-band SAR?

- We do not know where, when and how earthquake occurs.
- Earthquake is complex!!
 - High spatial resolution
 - Wide swath
 - High coherence of L-band SAR

Darfield, NZ, EQ of Sept. 3 (Mw7.0)

- EQ in a plane of South Island, NZ
- Surface ruptures
- No previously recognized active faults



From the website of GNS

Surface Ruptures



From the website of GNS

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172°

173°

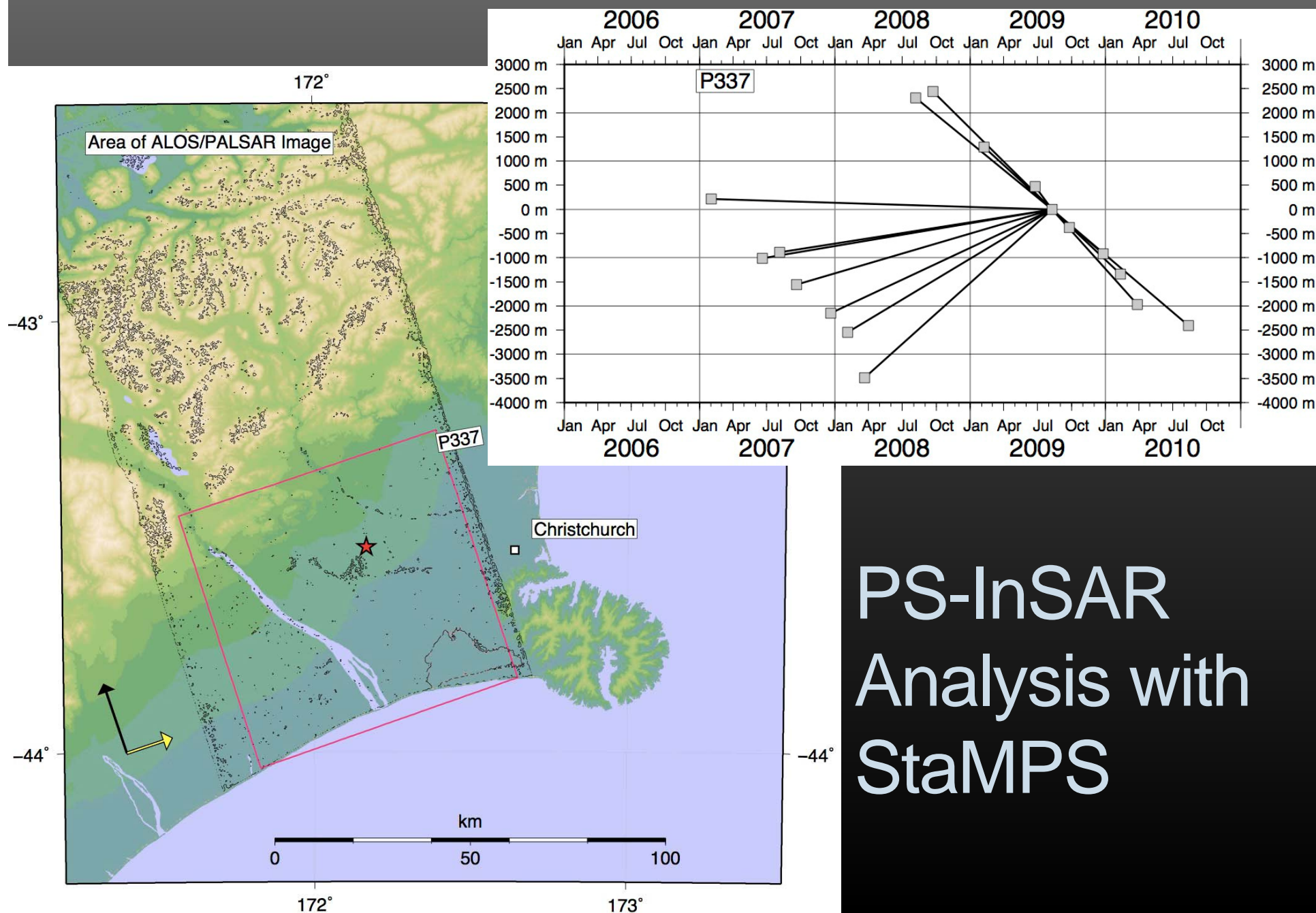
Ascending Interferogram

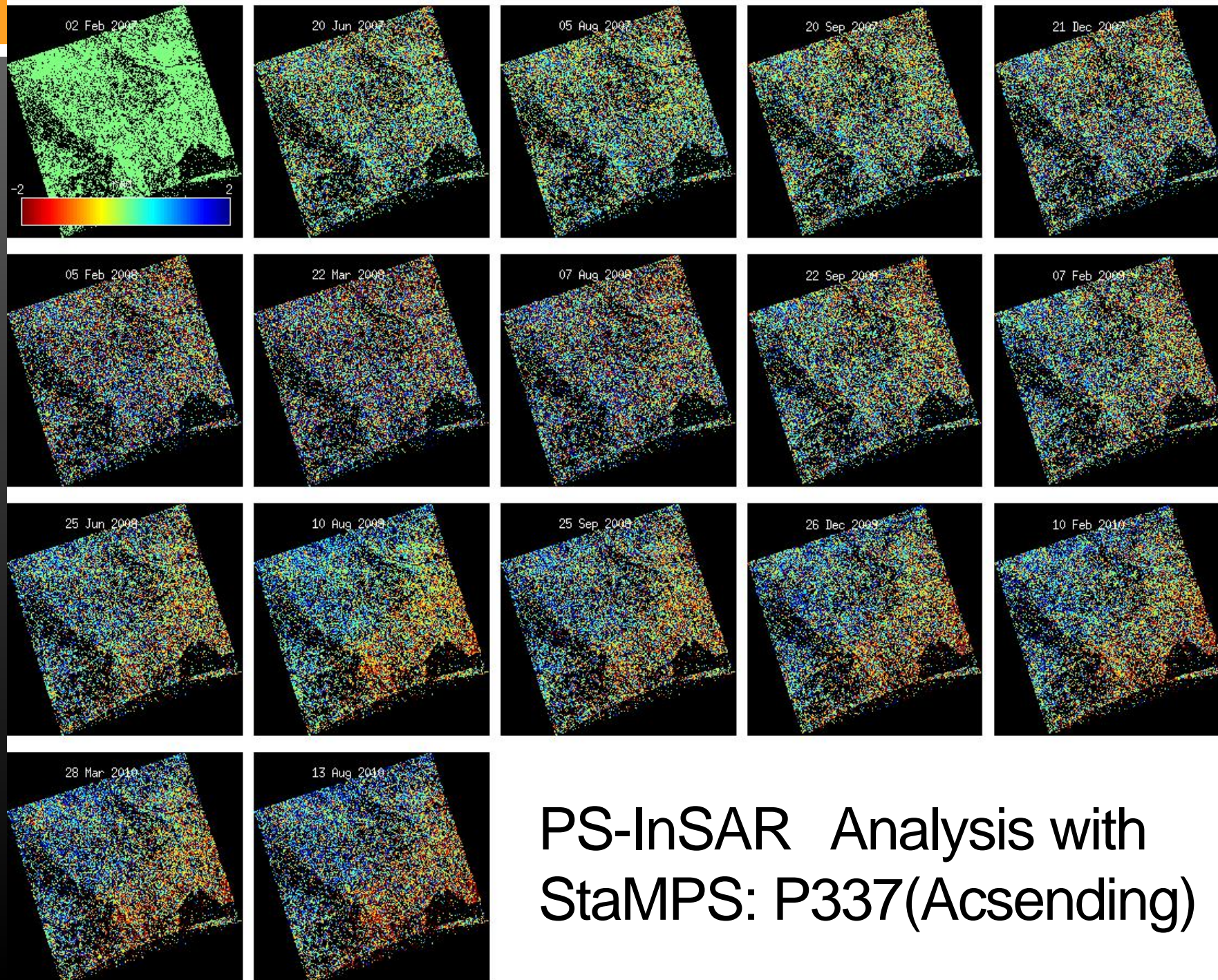
(c) JAXA METI analyzed by DPRI-KU
P147-20100813-20100911
P147-20100813-20100928

10 cycles
range increase

13 cycles
range decrease

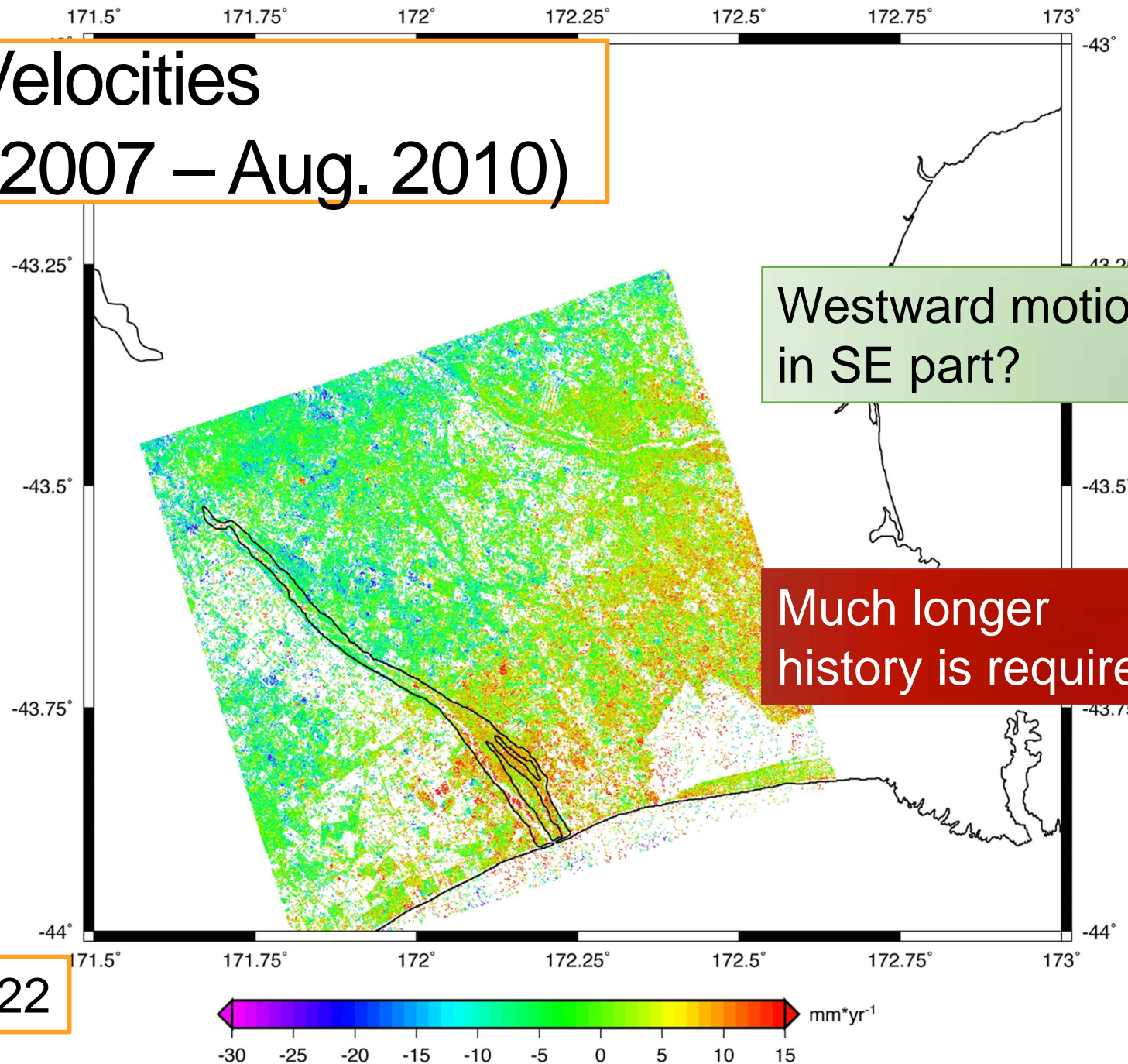






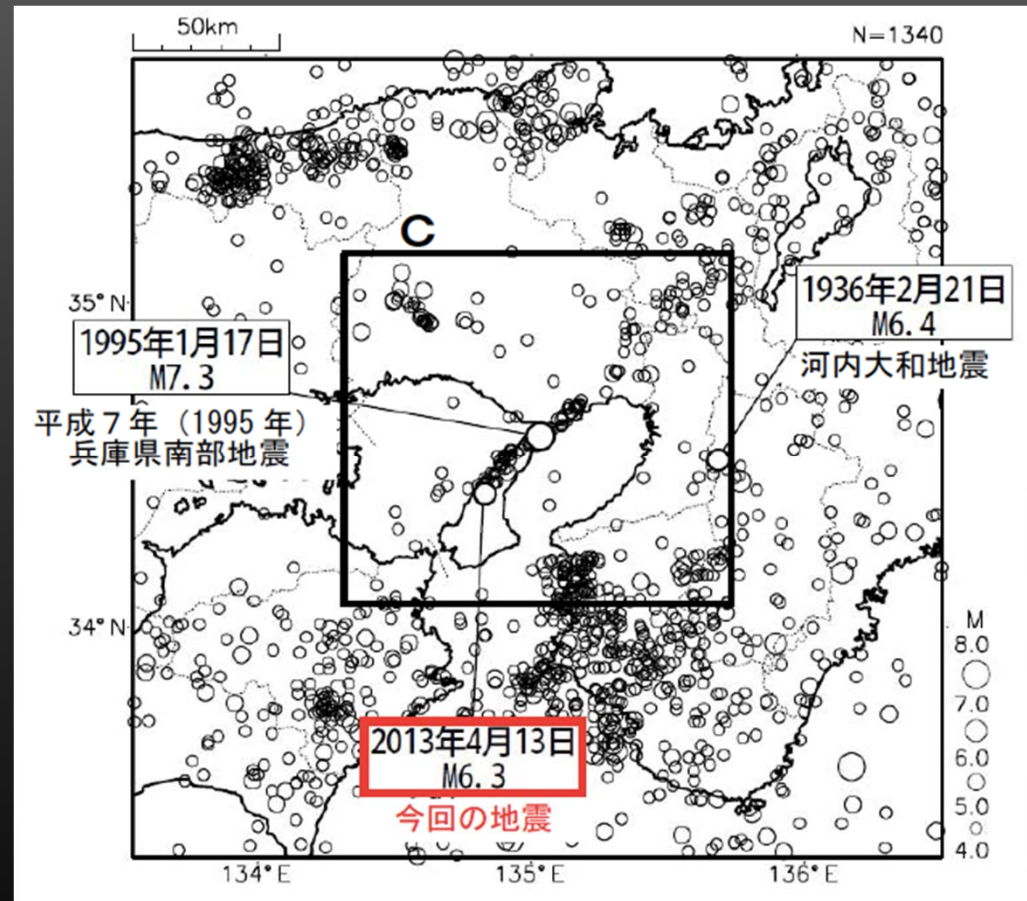
PS-InSAR Analysis with
StaMPS: P337(Acsending)

LOS Velocities (Jan. 2007 – Aug. 2010)



2013 Awaji EQ (Mjma6.3)

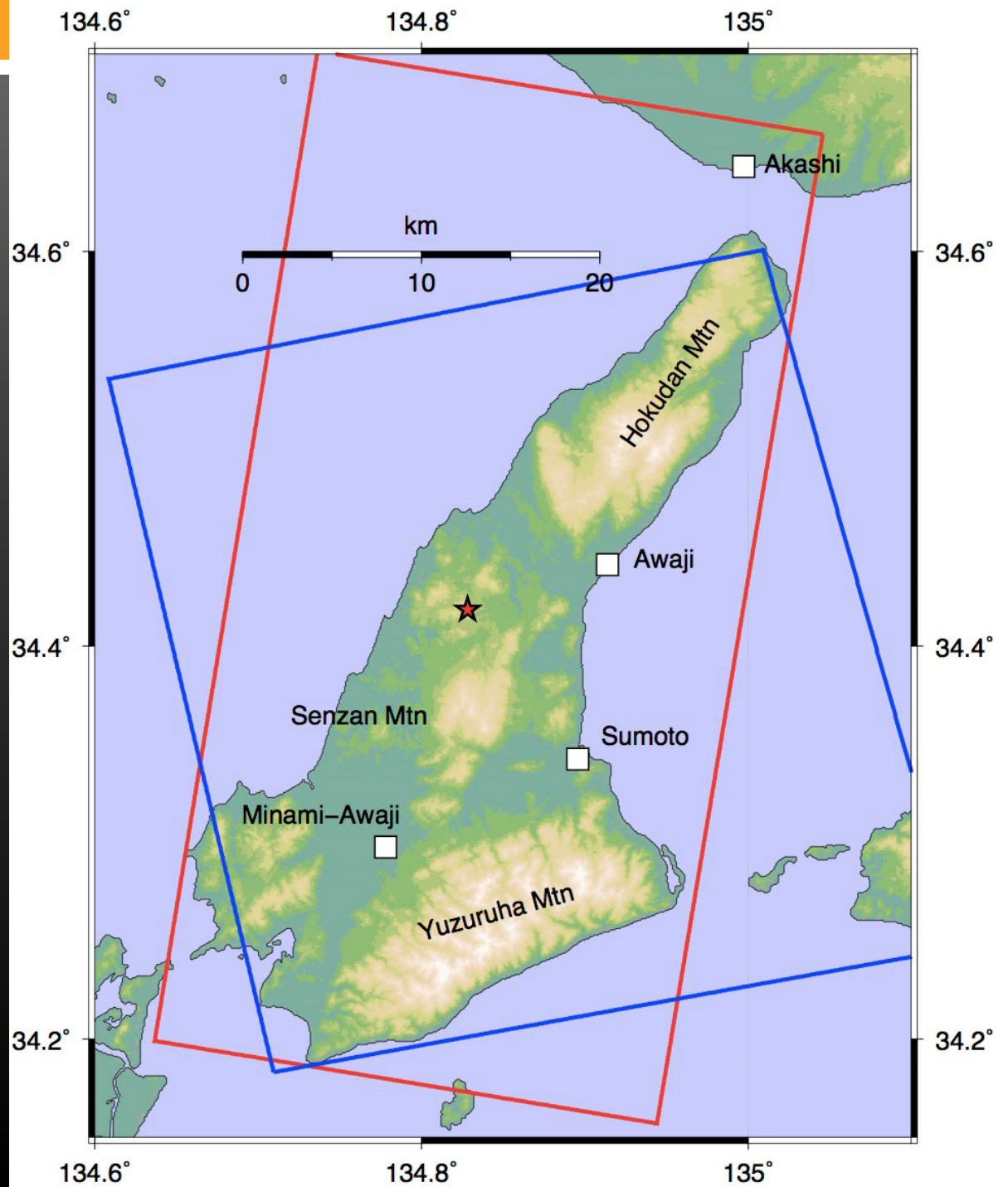
- Largest EQ since the 1995 Kobe EQ
- SW edge of the Kobe EQ fault
- ~ 15 km deep
- Different mechanism



Japan Meteorological Agency,
*Monthly Report on Earthquakes and Volcanoes
in Japan April 2013*

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Area of TerraSAR-X and ALOS/PALSAR Images



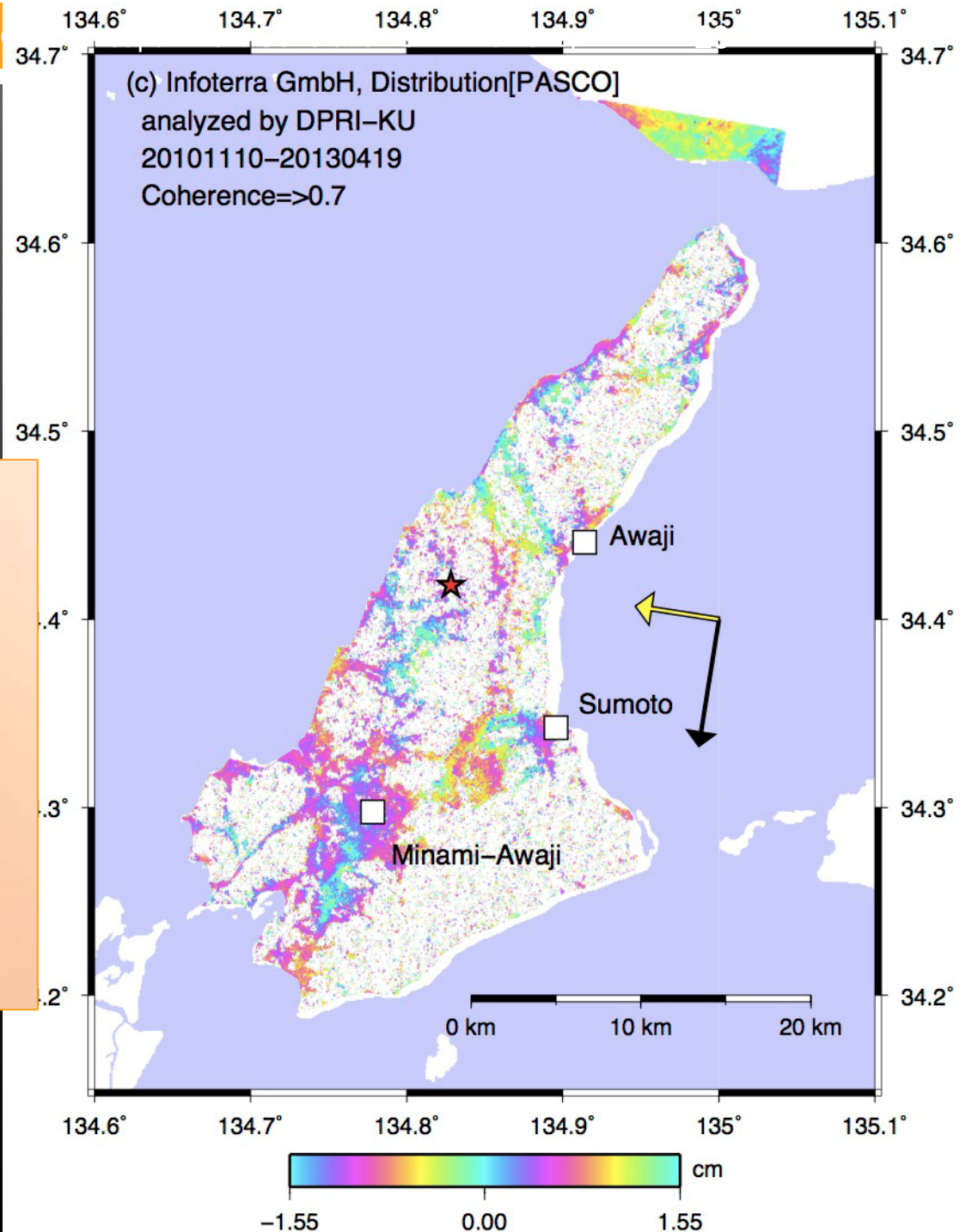
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TerraSAR-X Coseismic Interferogram

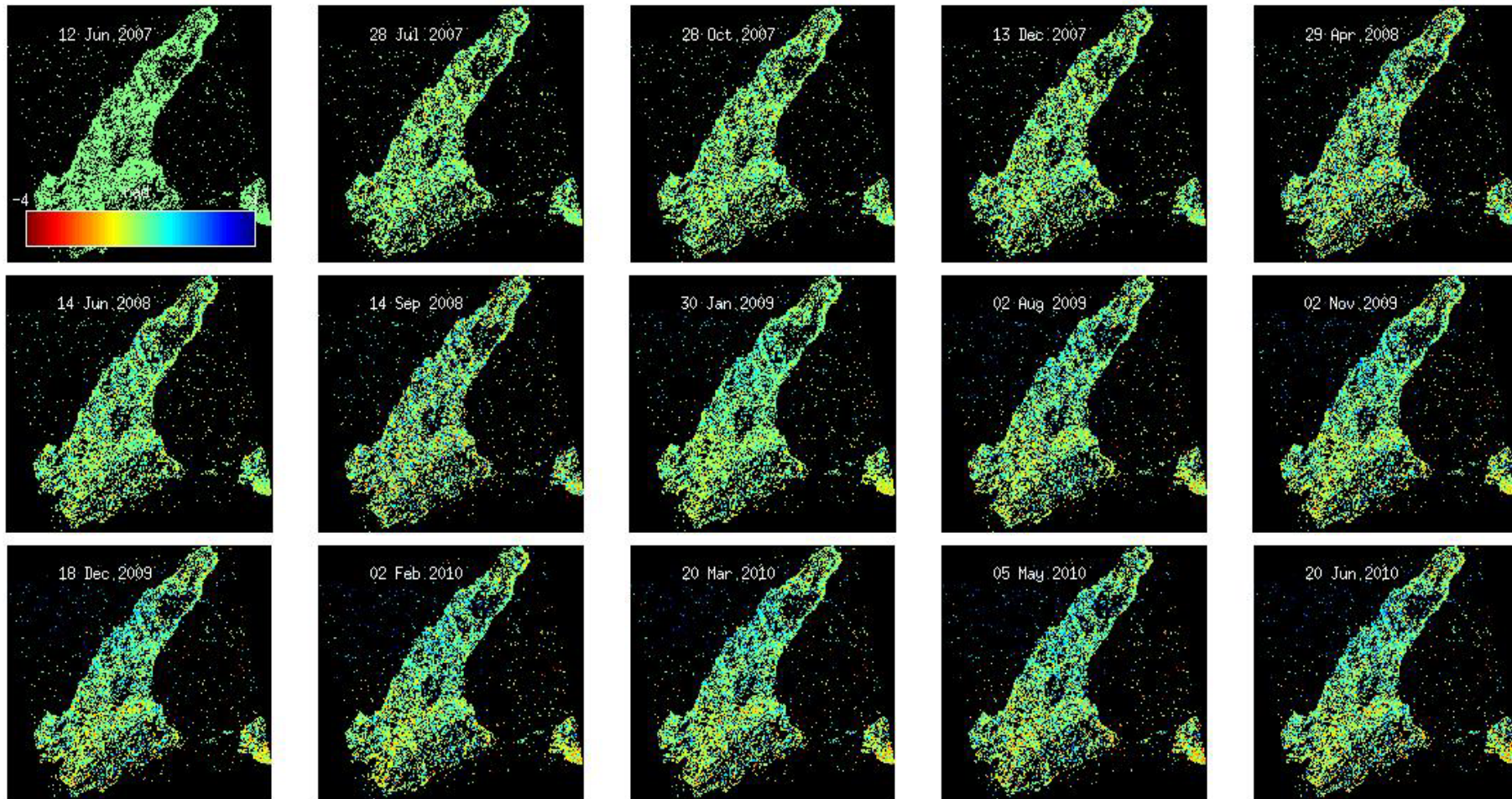
Low coherence in
mountains

Range decrease
around the
epicenter?

On the courtesy of PASCO



PS-InSAR Analysis with StaMPS: P415 (Ascending)



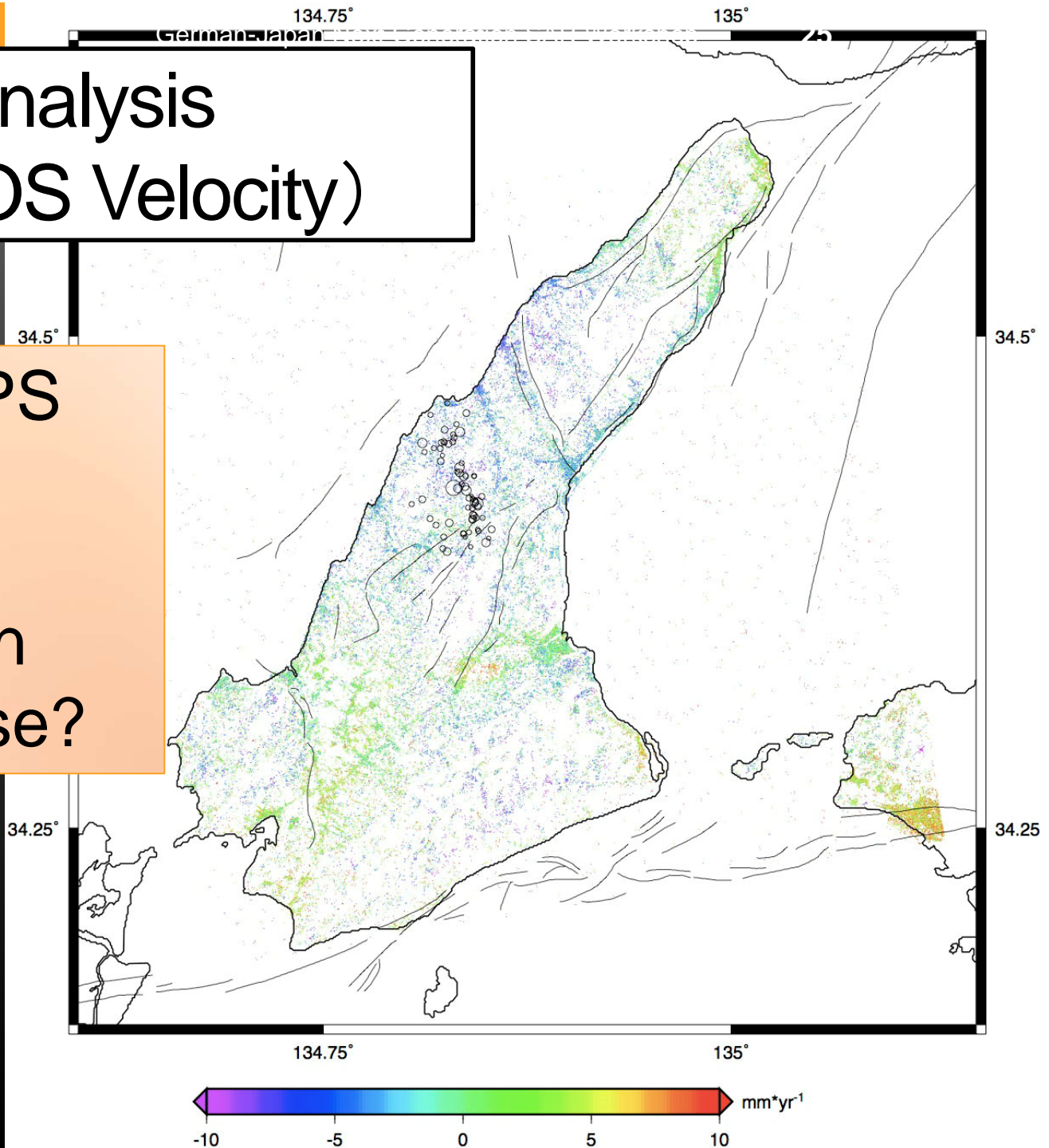
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PS-InSAR Analysis (Average LOS Velocity)

Not enough PS
(97230)

Epicenter is in
range increase?

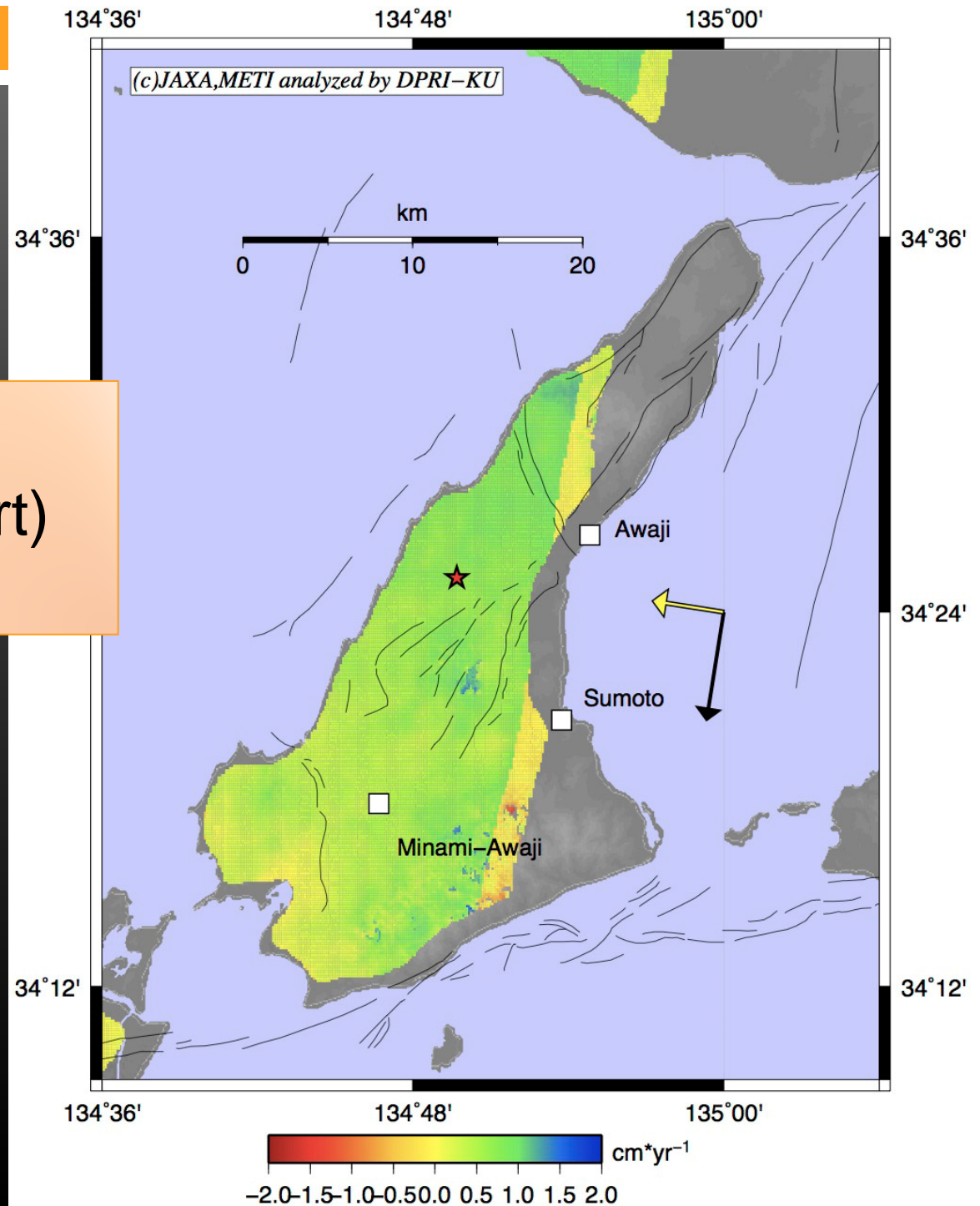
Circles denote
epicenters of
aftershocks
On the courtesy of
Prof. Shibutani



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Stacking Analysis

ALOS/PALSAR
P67, F2910-2950 (part)
Dec.2006 – Jan. 2011



Summary of Time Series Analysis

- No detectable deformation
- History of ALOS is short!
- Less PS's in mountains

➤ SBAS

➤ More frequent observation

ALOS-2 and ALOS Next-Generation: Pros.

- Satellite for the exclusive use of SAR
 - ✓ More chance of observations than ALOS
- High resolution and wide swath images
 - ✓ Enough coverage
 - ✓ Easy to process

ALOS-2 and ALOS Next-Generation: Challenge

**Time series analysis with ScanSAR
images** requires

- Frequent and stable acquisition,
- Intensive researches and developments,
- Involvement of researcher from other field,
- International collaboration.

Thank you for your attention!
