Crustal deformation by ALOS-InSAR: The 2007 SW Off Sakhalin Earthquake (M_{JMA}6.4)

InSARによる2007年サハリン南西沖地震の地殻変動

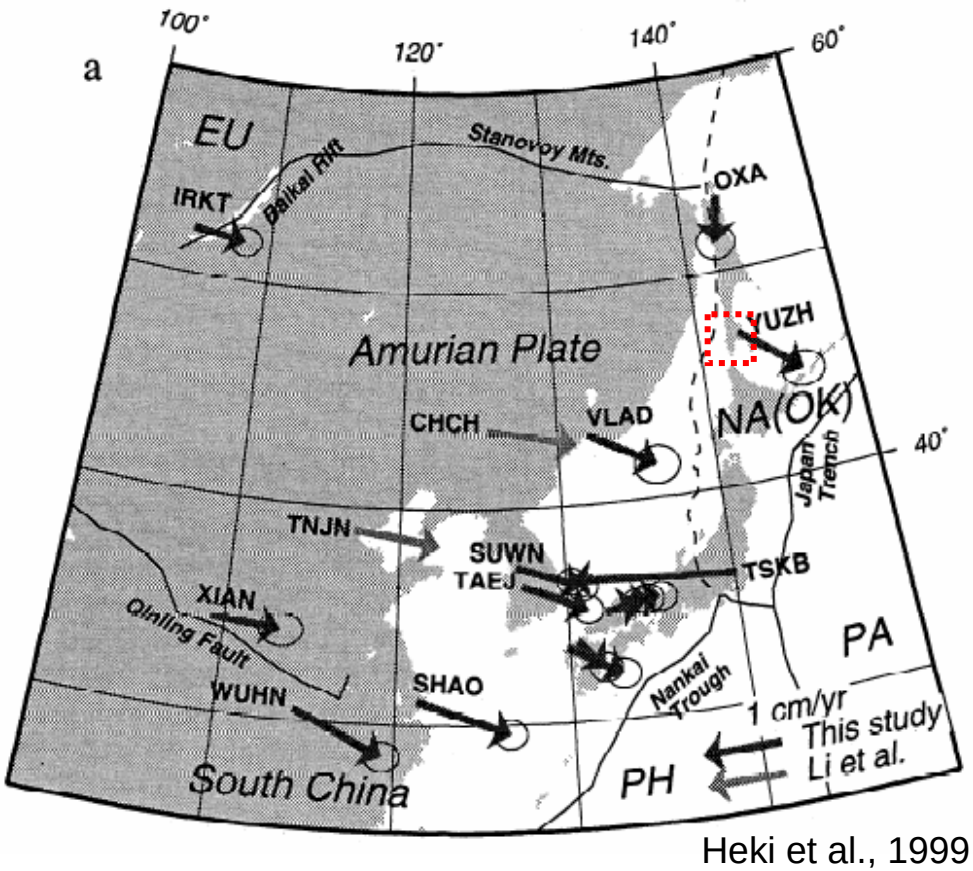
H. Takahashi & M. Ichiyanagi

Inst. Seismology & Volcanology

Hokkaido University, Sapporo, Japan

hiroaki@mail.sci.hokudai.ac.jp

Tectonic Setting: Plate kinematics

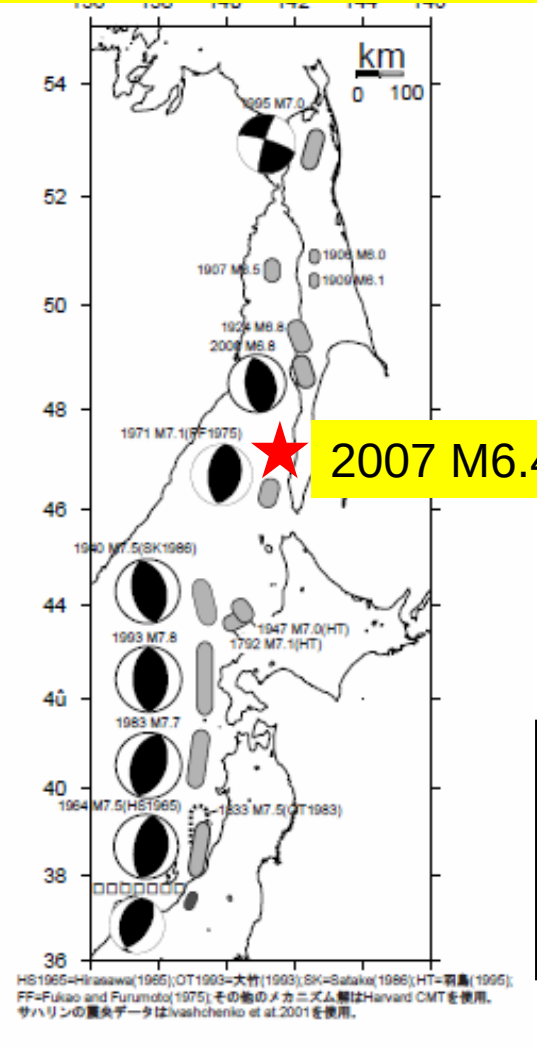


Heki et al., 1999

Amurian-Okhotsk boundary: ~1cm/yr EW convergence

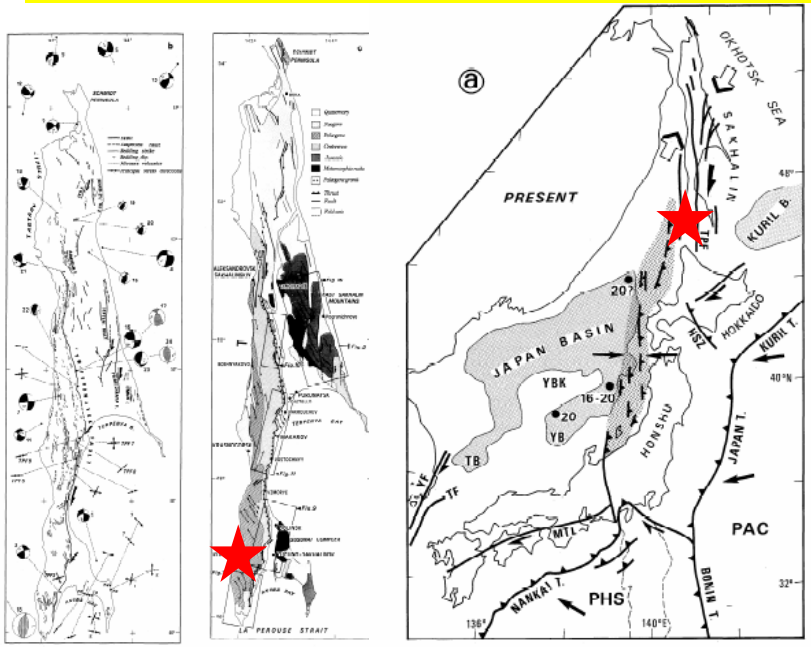
Seismic & Geological data

Focal mechanisms & Fault zone



2007 M6.4

Geological fault and regional tectonics

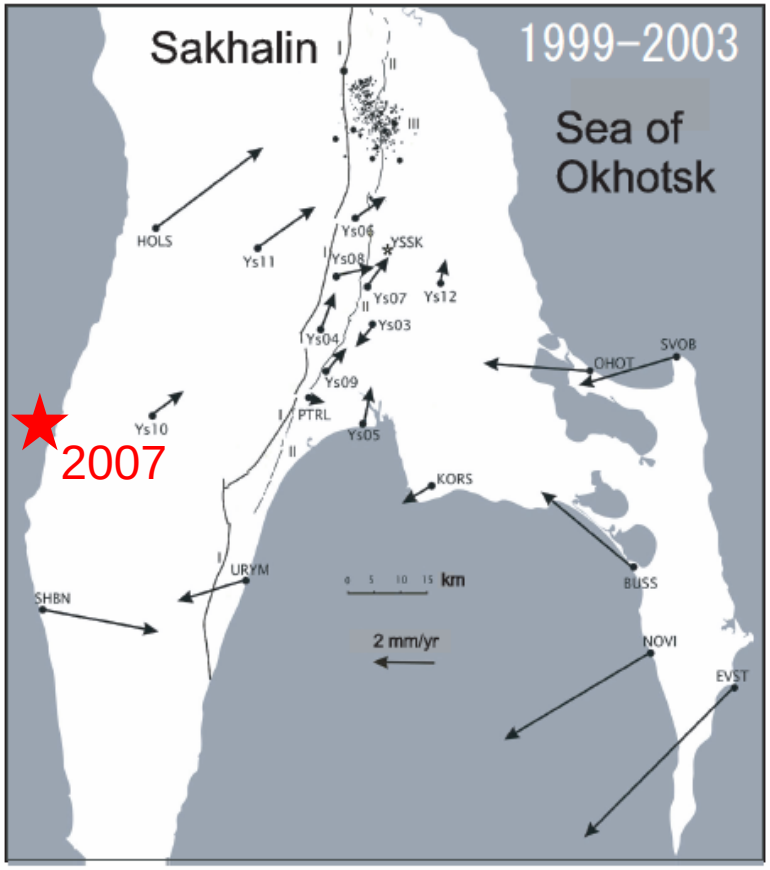


Fournier et al., 1994

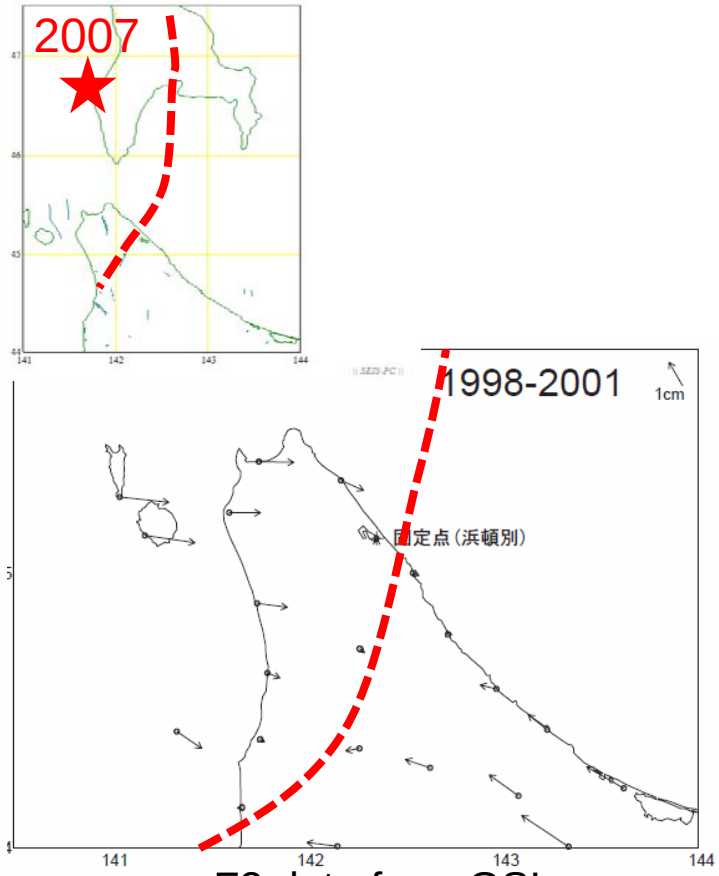
- EW P-Axis reverse fault mechanisms
- N-S trending geological fault system

Geodetic data=Seismic data=Geological data

GPS velocity in S. Sakhalin & N. Hokkaido



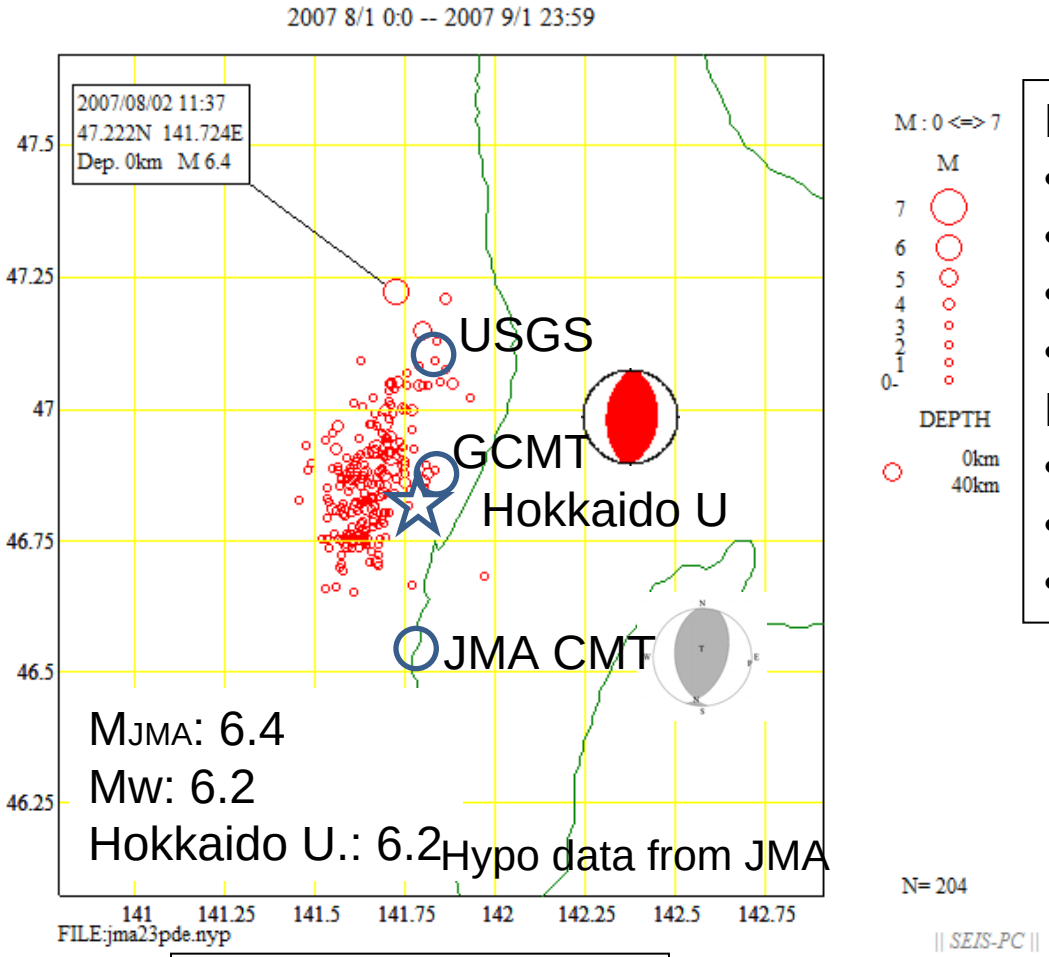
Vasilenko et al., 2004



F2 data from GSI

~1cm/yr convergence rate along S. Sakhalin and N . Hokkaido line

The 2007 Earthquake



Depth:
- GCMT: 12km
- JMA-CMT: 10km
- USGS: 14.1km
- HU: 12km

Dip:
- GCMT: 48deg
- JMA: 43deg
- USGS: 49deg

EW P-axis reverse fault

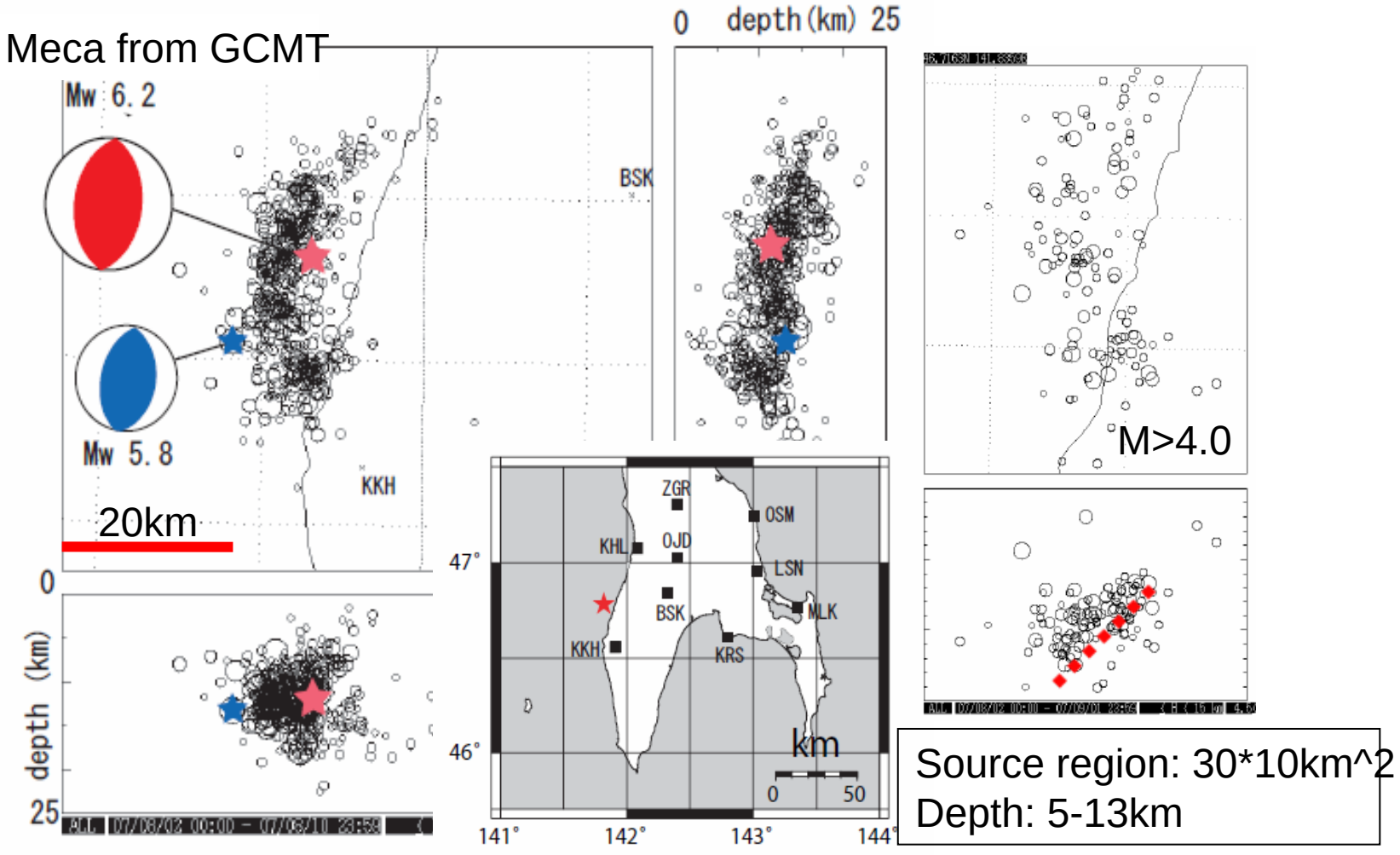
Damaged buildings

Intensity: 7-8（MSK)(JMA=5+~6-)
Death: 2

Photos by Lomtev et al., 2007 and Institute of Marine Geology and Geophysics, Russian Academy of Scienc

Aftershocks

Meca from GCMT



Source region: 30*10km^2
Depth: 5-13km

Aftershock region come on shore in the southern edge

Uplifting along the coast line

Photo by : Lomtev et al., 2007 and Institute of Marine Geology and Geophysics, Russian Academy of Science

Uplifting region

70cm
By Takahashi's obs.

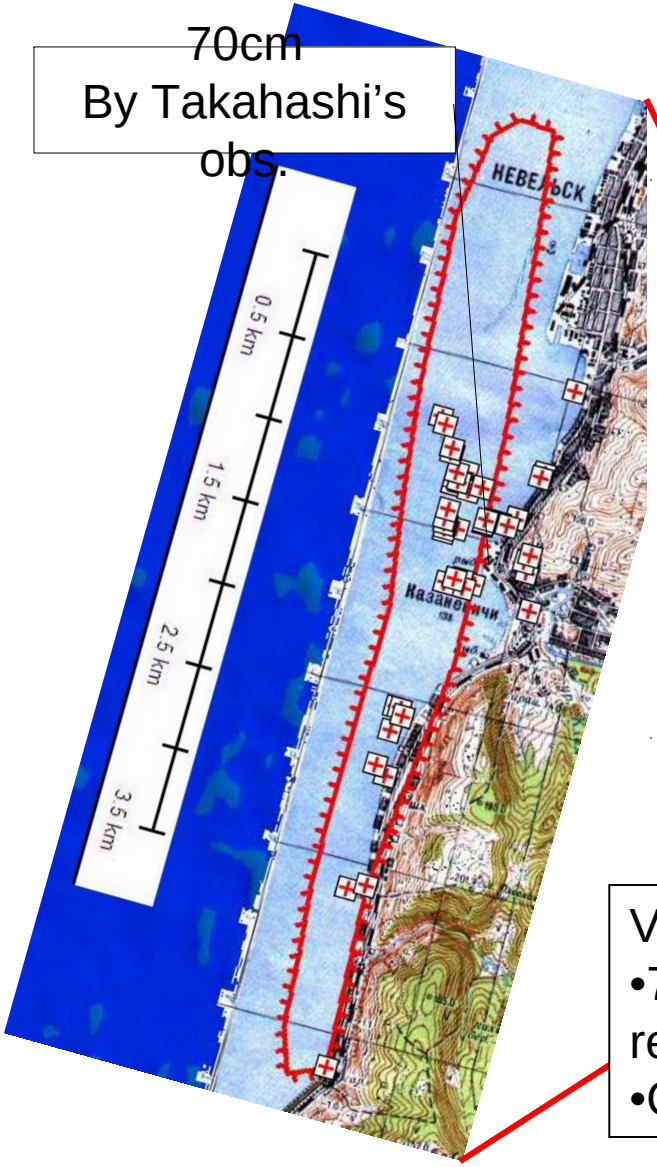


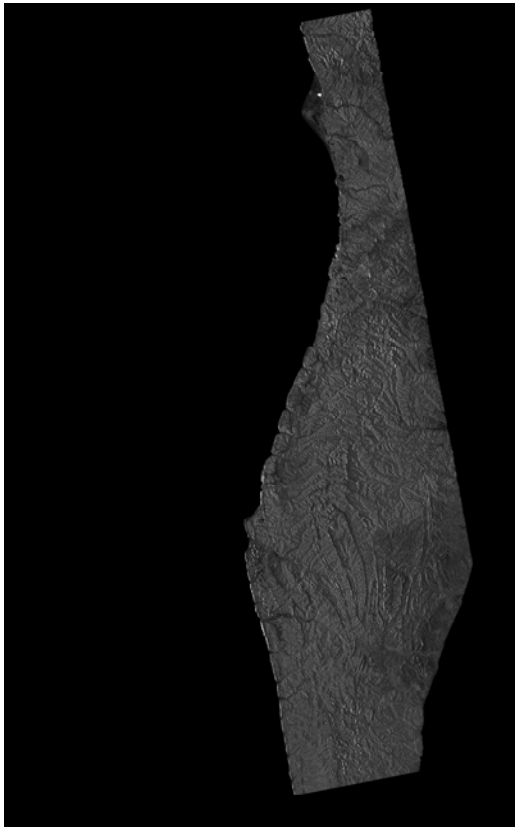
Photo and Data from
- *Lomtev et al., 2007*
- *Institute of Marine Geology and Geophysics, Russian Academy of Sciences*

Visible uplift:
- 70cm upheavals are observed by organic remains (seaweeds).
- Only southern part of aftershock region.

ALOS data analysis

ALOS-PALSAR data
•Path: 397, Frame: 920-930
•Master: 2007/06/28
•Slave: 2007/08/13
•Ascending
•Bp=254m
•Off-nadir angle: 34.3deg

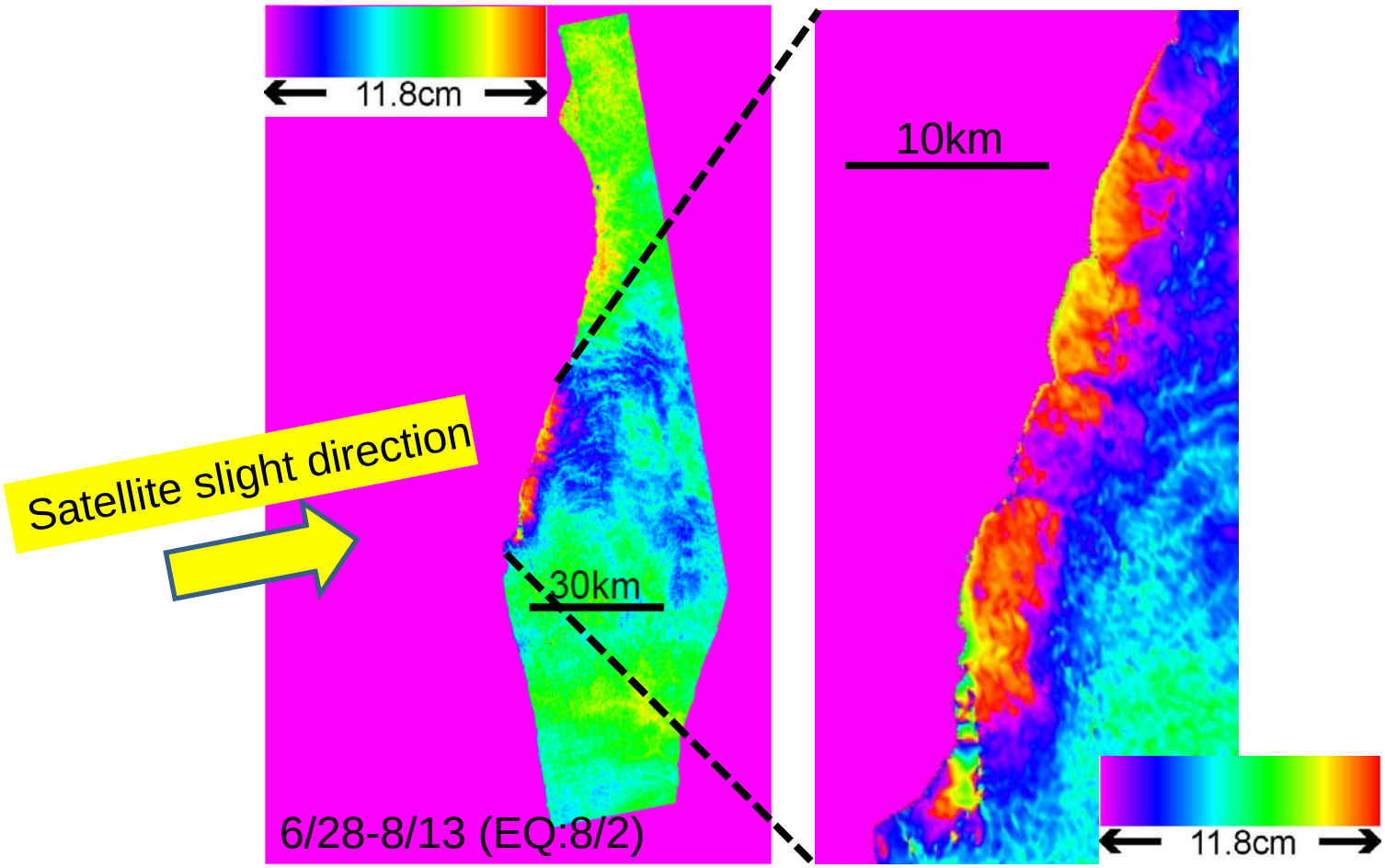
Software
•SIGMA-SAR ver. 480-07090301 by JAXA-Shimada (1999).
•SRTM



Acknowledgements

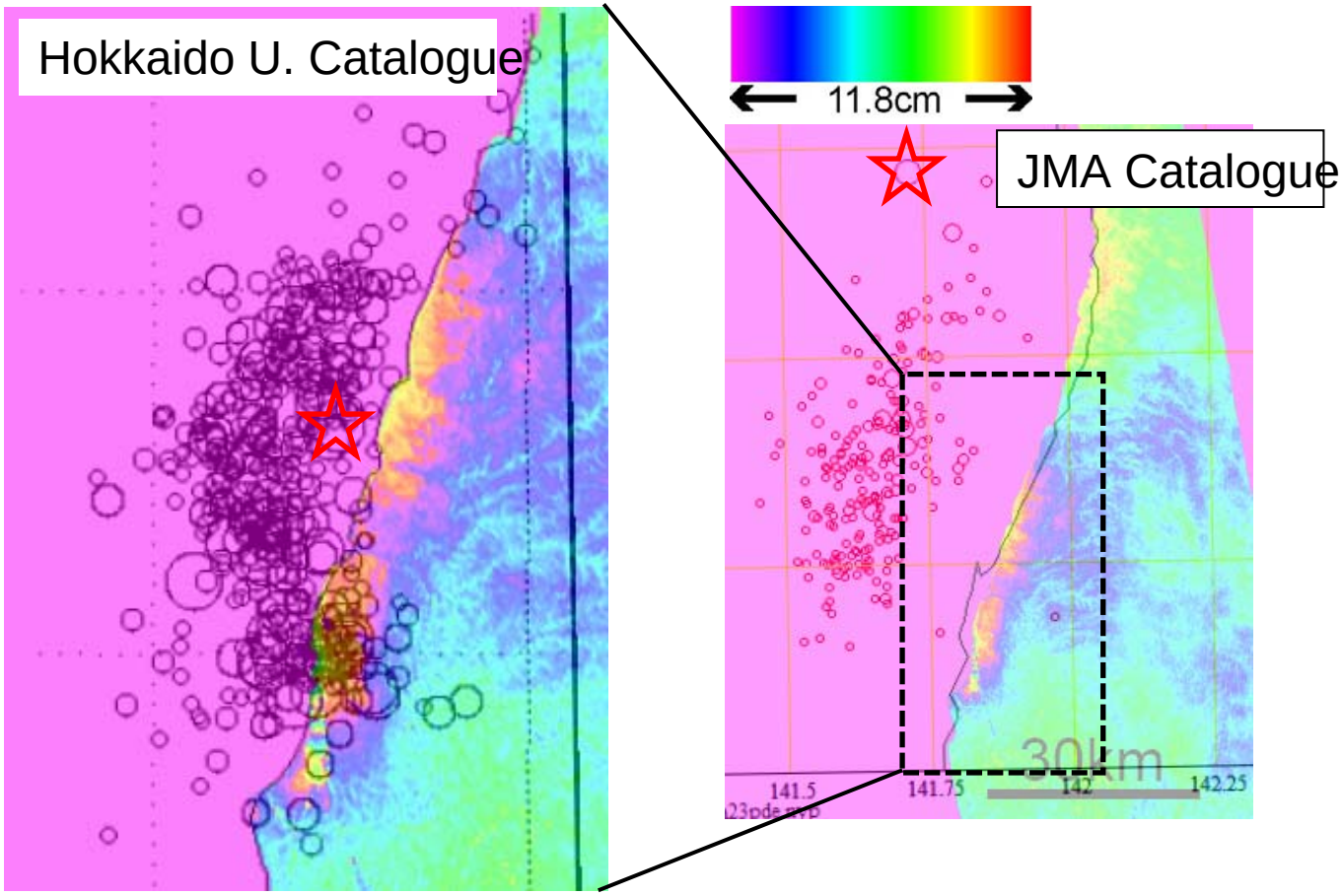
- We are grateful to Dr. M. Shimada, JAXA, for the use of his SIGMA-SAR interferometry software [M. Shimada, 1999], and Dr. Y Miyagi, JAXA, for valuable comments.

Interferometric SAR image



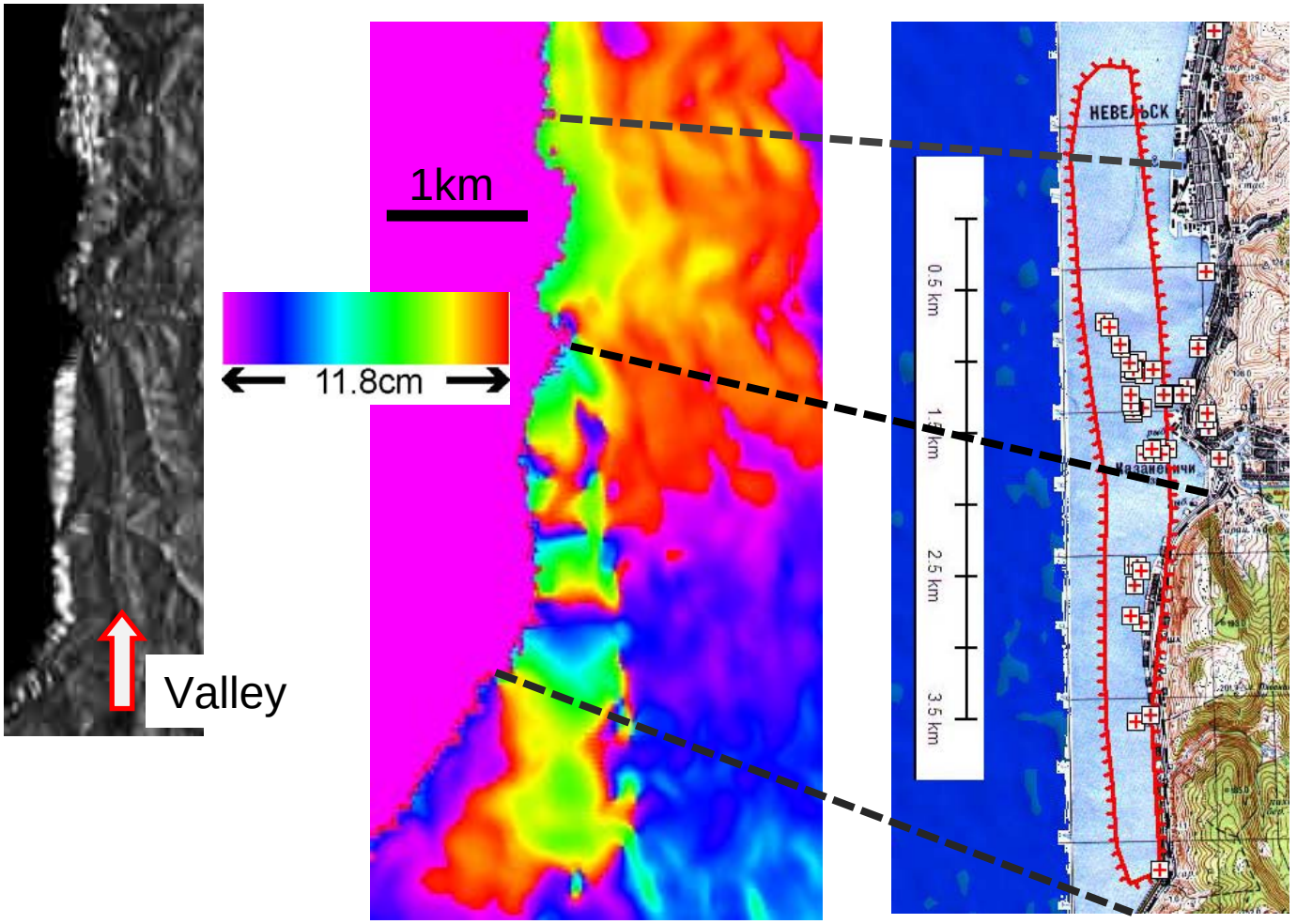
Coseismic signal was clearly observed

Aftershocks & Crustal deformation



Aftershock region by Hokkaido U. fit well with the InSAR data

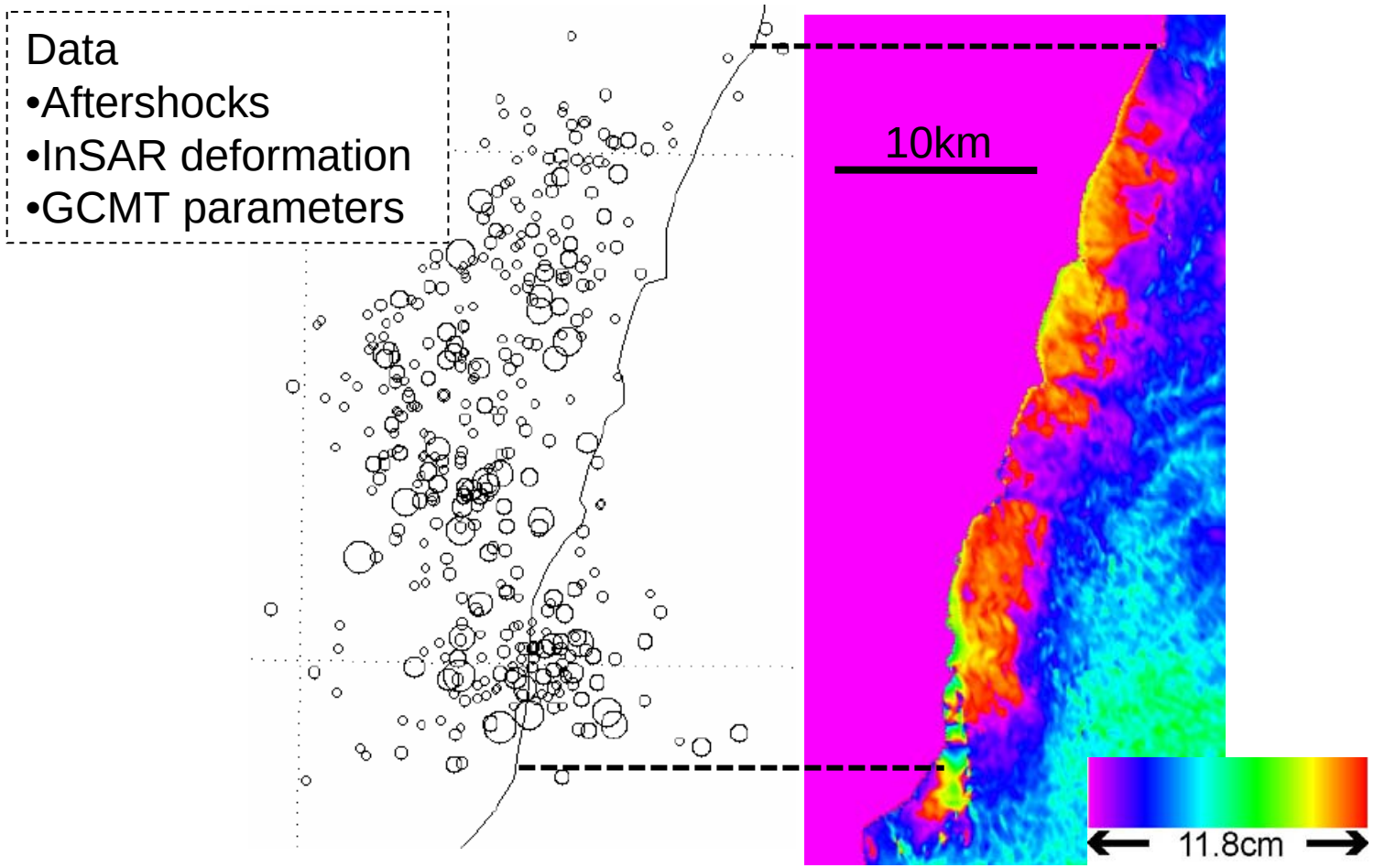
Uplifting and InSAR image: Local area



Lomtev et al., 2007

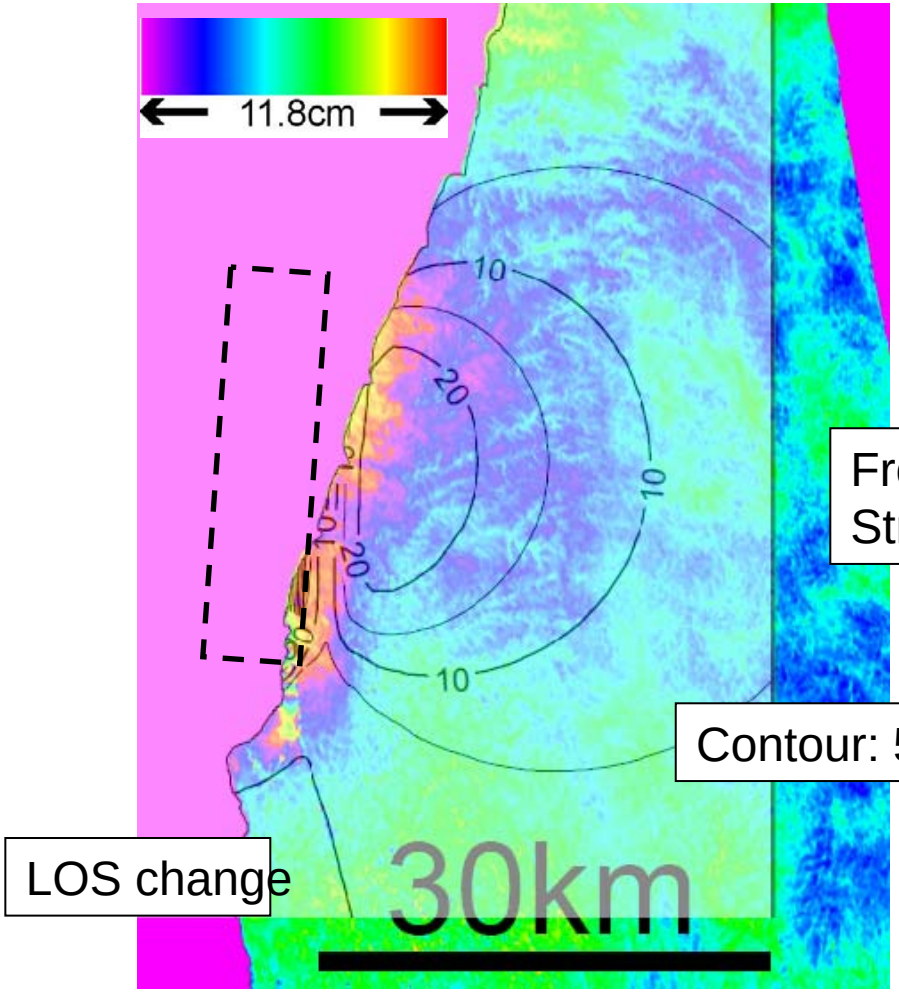
Visible uplifting region = InSAR observation

Fault model estimation… Preliminary…



Obs. and Calc.

-Single fault model-

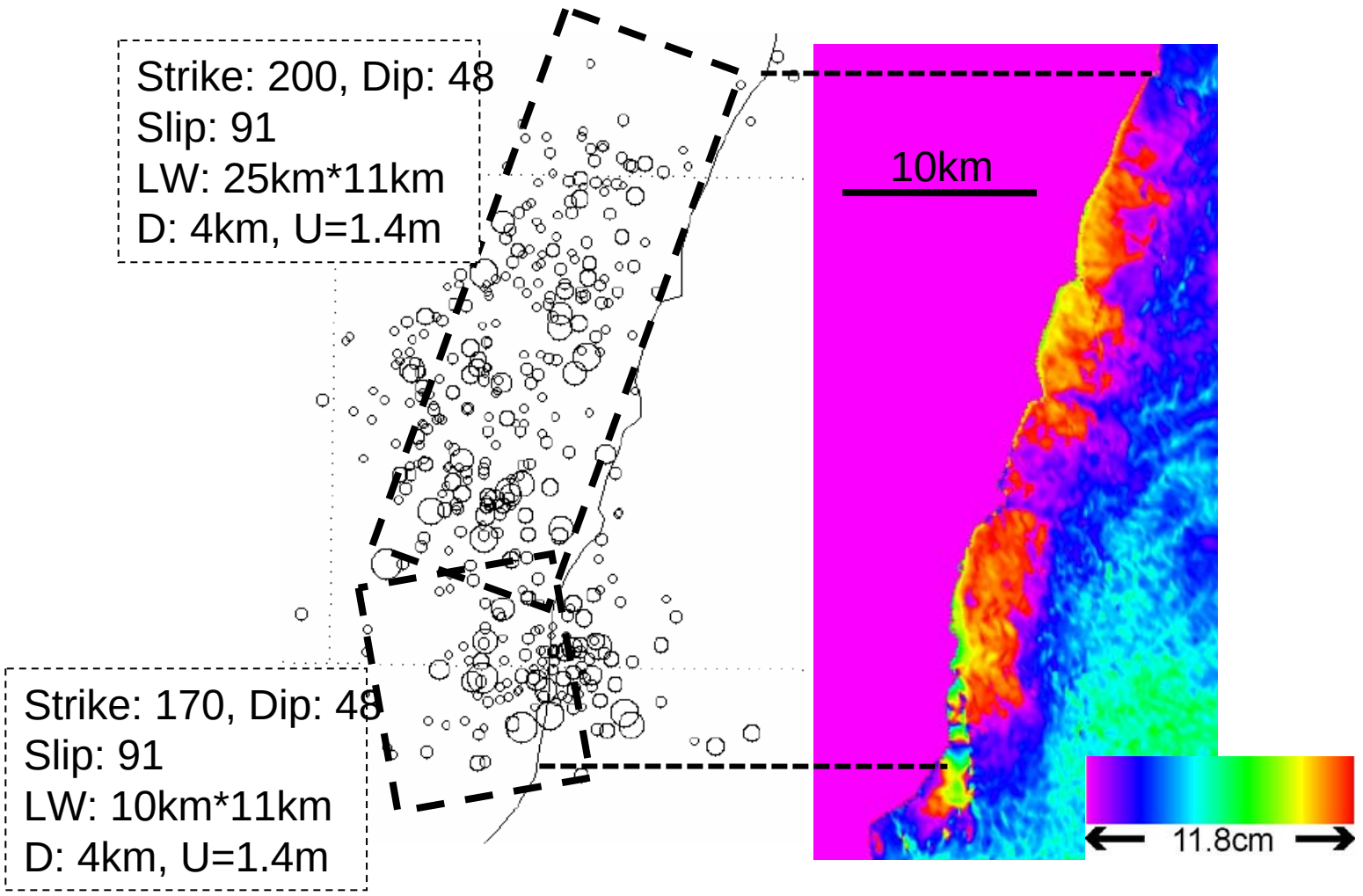


From GCMT
Strike:184,Dip:48,Slip:91

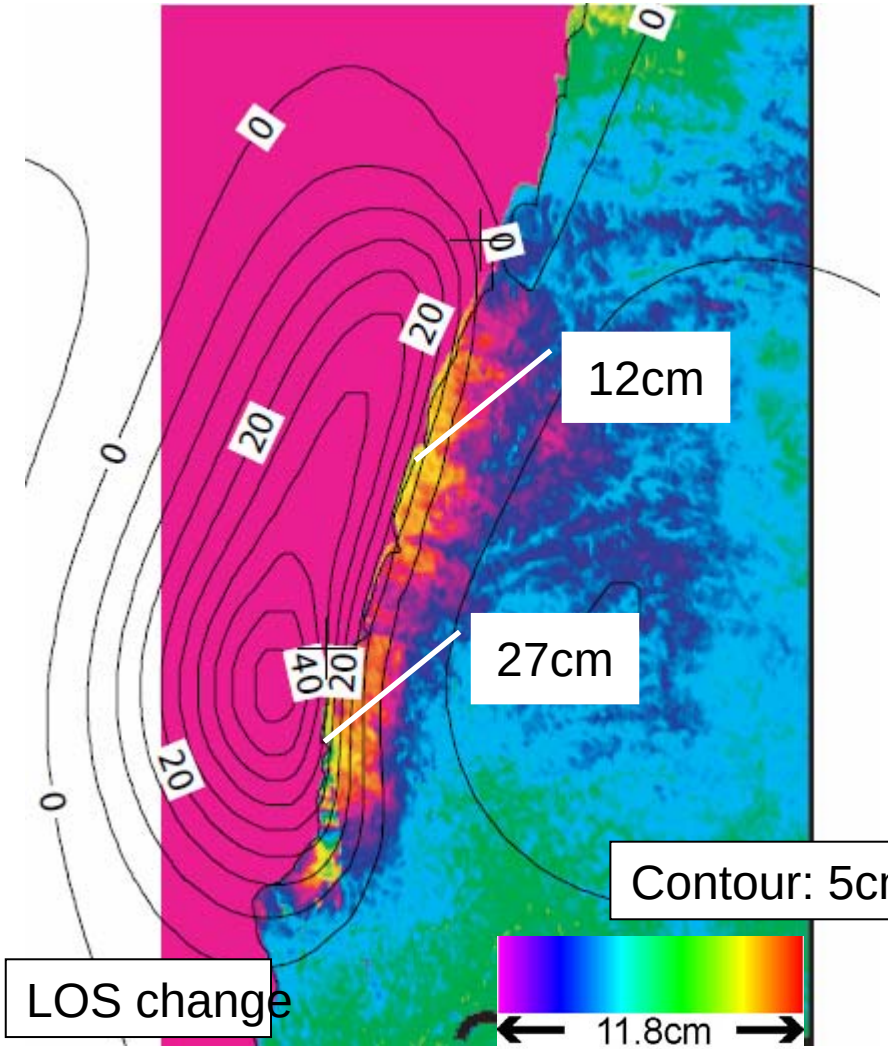
Contour: 5cm

LOS change

Double fault

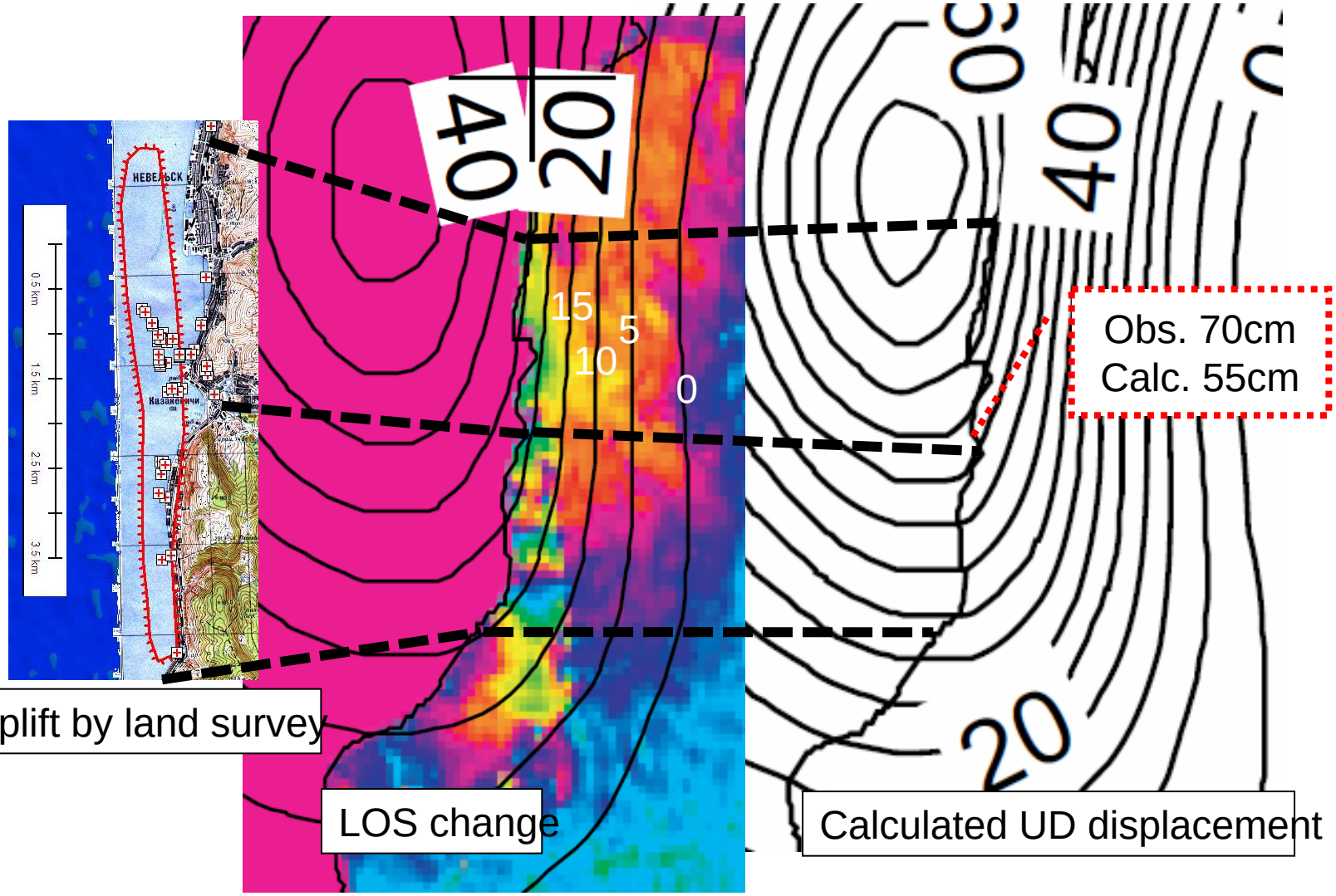


Obs. Vs Calc.

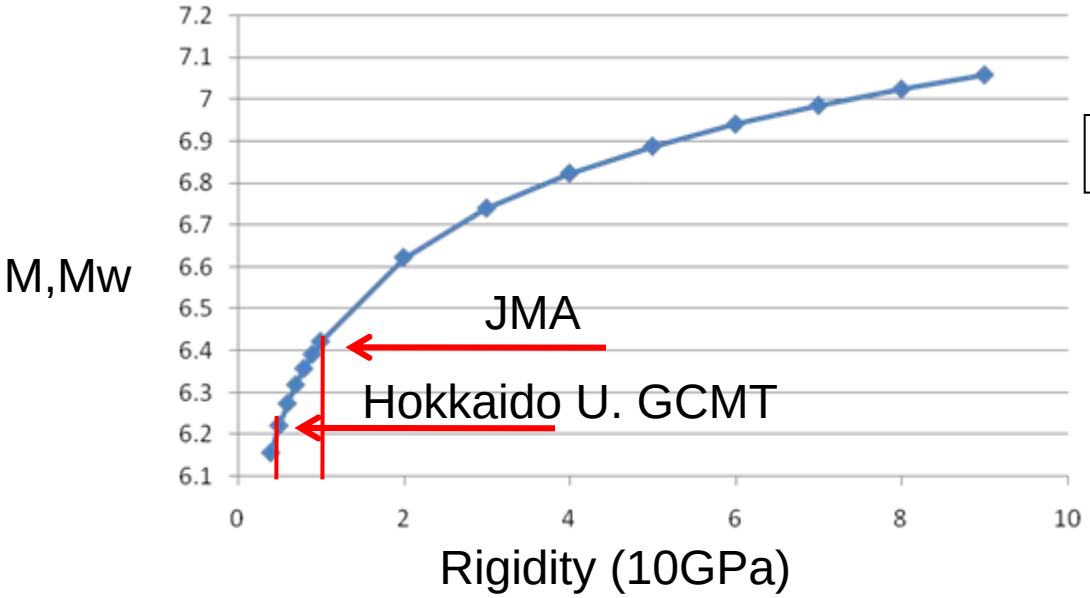


Well explain observed data

Detailed shot



Mw, Rigidity, Source process



L=35km!

Very small rigidity?

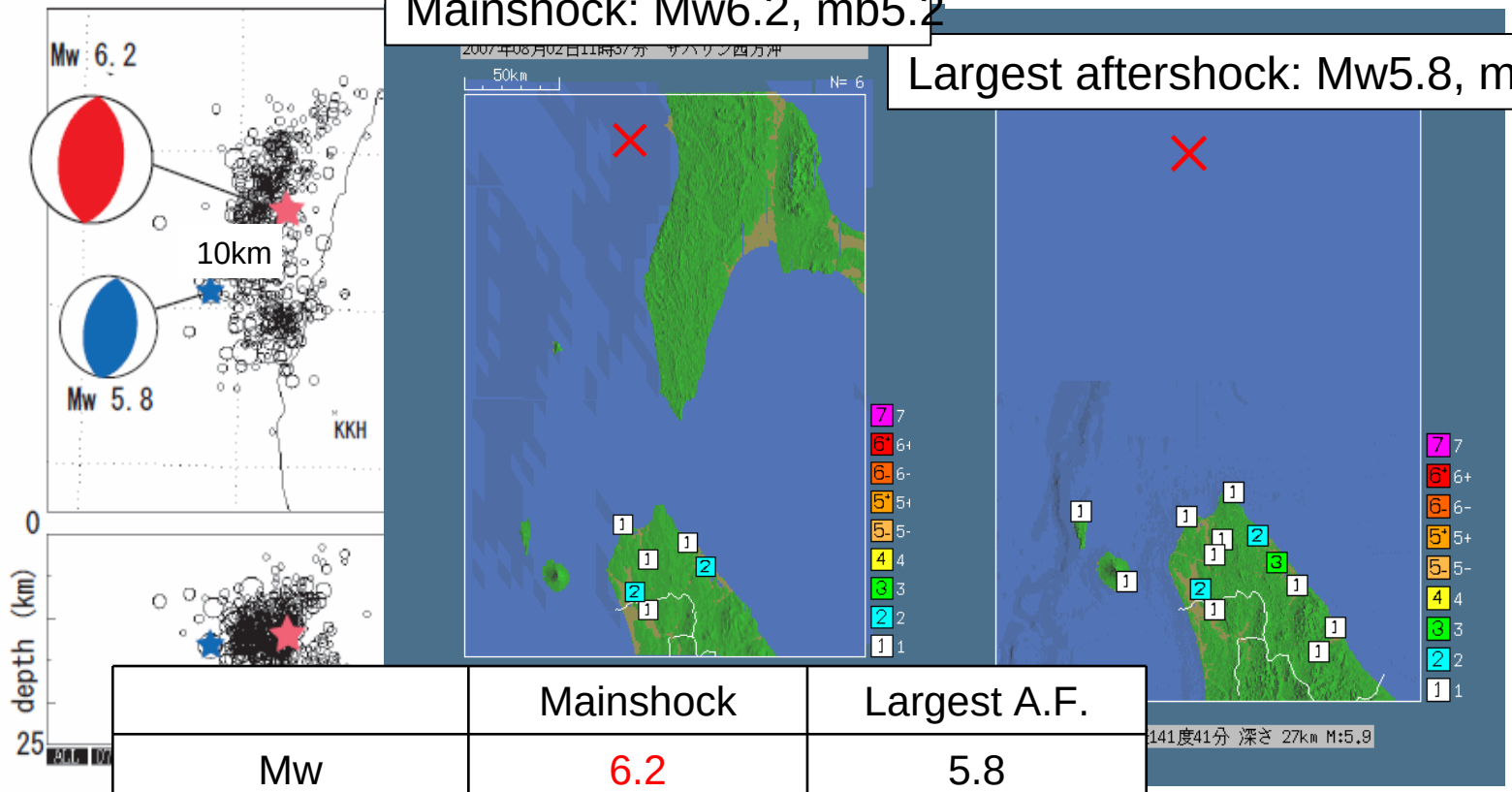
From GCMT:
Mw6.2 mb5.3
Half duration: 3.0sec
Centroid-Hypocenter: 8.7sec

Another factors? Gas & Oil?

Intensity data

Mainshock: Mw6.2, mb5.2

Largest aftershock: Mw5.8, mb5.6



	Mainshock	Largest A.F.
Mw	6.2	5.8
mb	5.3	5.6
Largest Intensity	2	3
Felt region	Narrow	Wide

Anomalous source process?

Summary

- InSAR deformation well fit with well-defined aftershock region.
- InSAR deformation well fit with visible uplift region along the coast line.
- InSAR deformation is roughly explained by double fault model.
- InSAR & aftershock region show possible very small rigidity and/or another factor to explain the large deformation in the south.