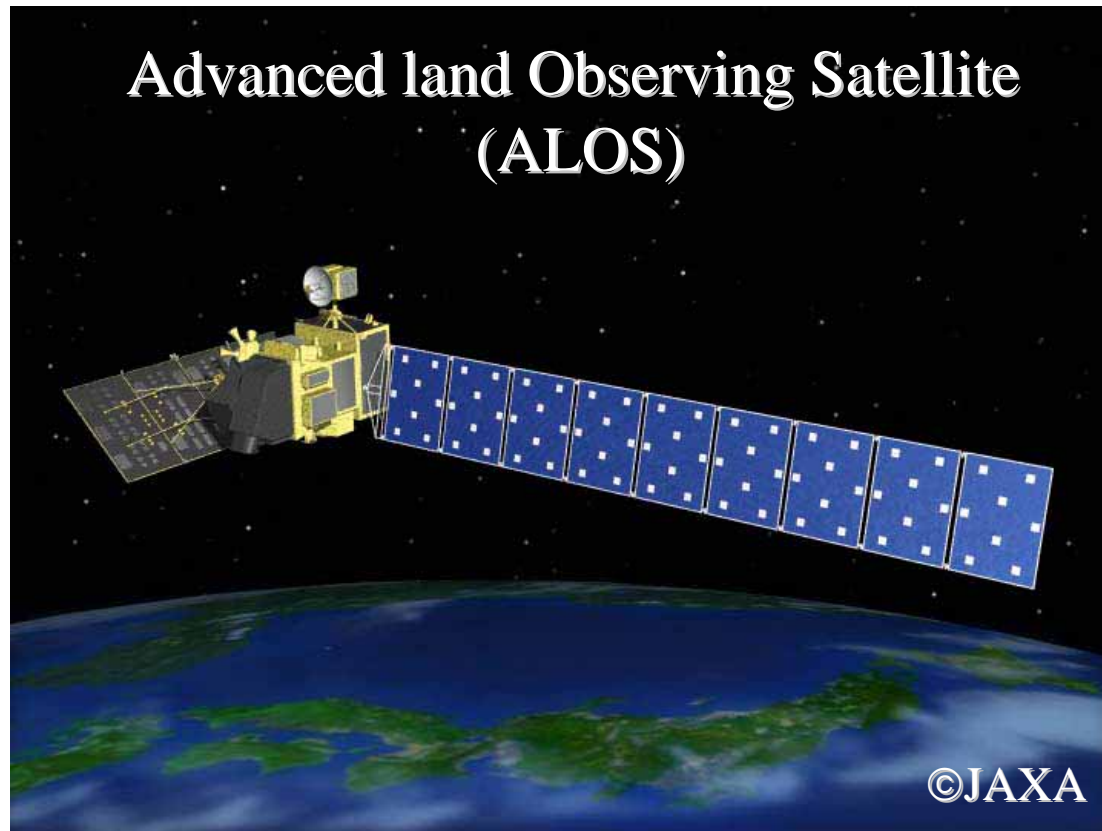


# ALOS Status and the Latest Results on its Applications for Geohazard or Environmental Studies

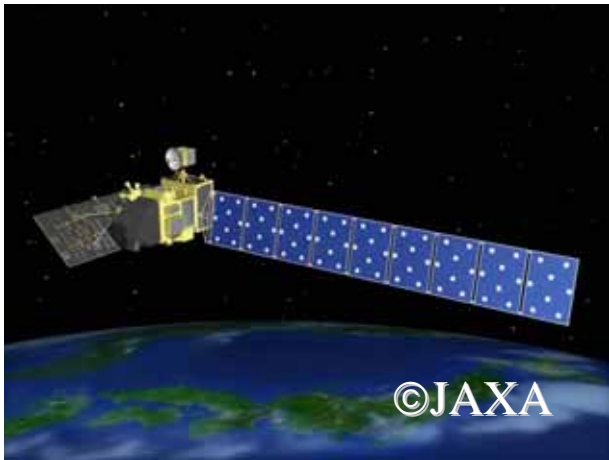


Makoto Murakami  
The Geographical Survey Institute

# Messages

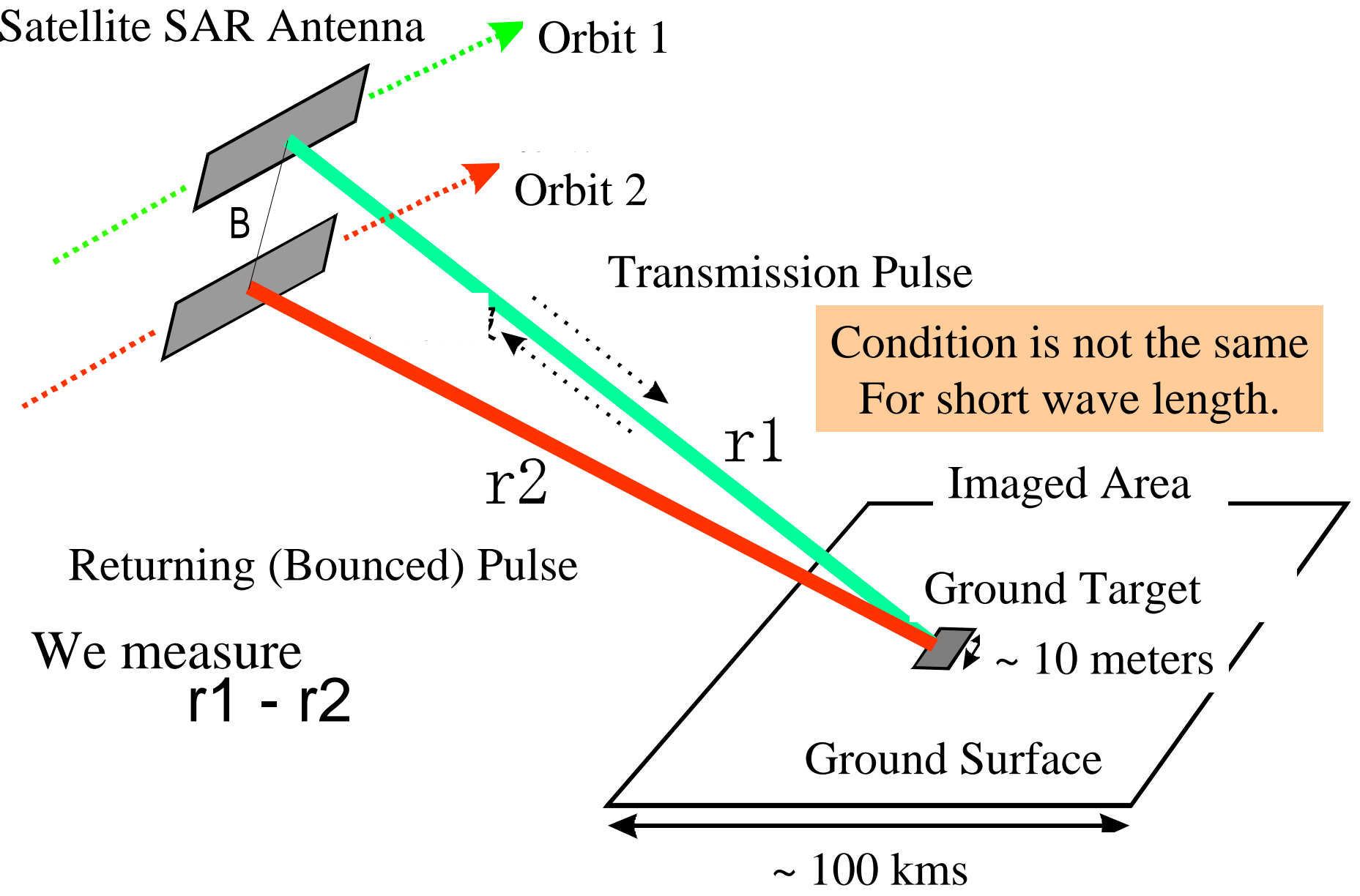
- Value of ALOS PALSAR (**L-band**) Data for Earthquake and Volcano Monitoring
- Need for Platform of Information and Data Exchange

# Advanced land Observing Satellite (ALOS)



Launch Date	Jan. 24, 2006
Design Life	3 -5 years
Repeat Cycle	46 days
Altitude	691.65 km
PRISM	Panchromatic
PALSAR	L-band SAR
AVNIR	Visible and Near IR Radiometer

# Satellite SAR Interferometry



Satellite SAR Antenna

Orbit 1

Orbit 2

Transmission Pulse

Condition is not the same  
For short wave length.

Returning (Bounced) Pulse

We measure  
 $r_1 - r_2$

Imaged Area

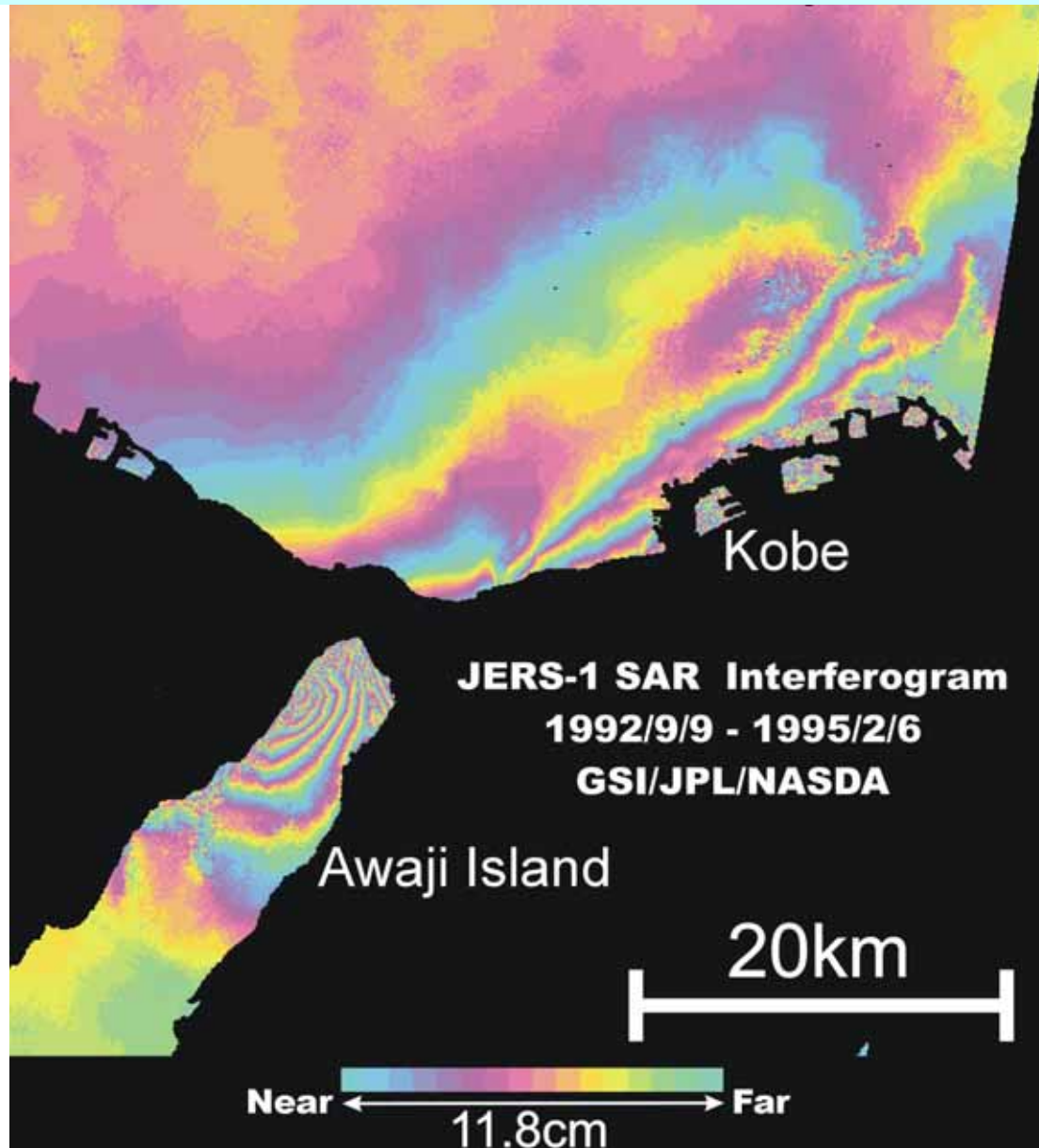
Ground Target

$\sim 10$  meters

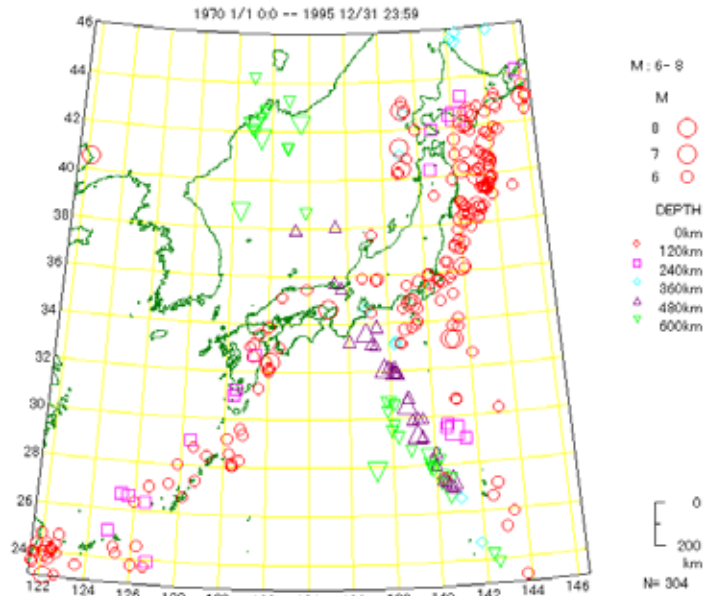
Ground Surface

$\sim 100$  kms

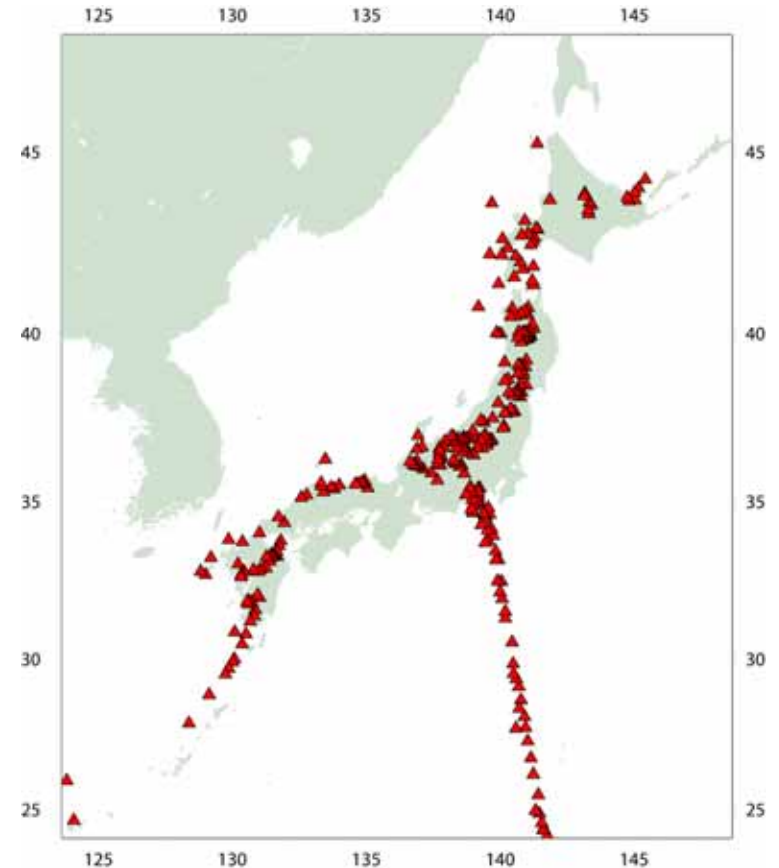
# JERS-1 InSAR Depicting Deformation Field Associated with 1995 Kobe Earthquake



# Seismicity and Volcanism around Japan



Seismicity (M>6)  
1970-1995  
JMA

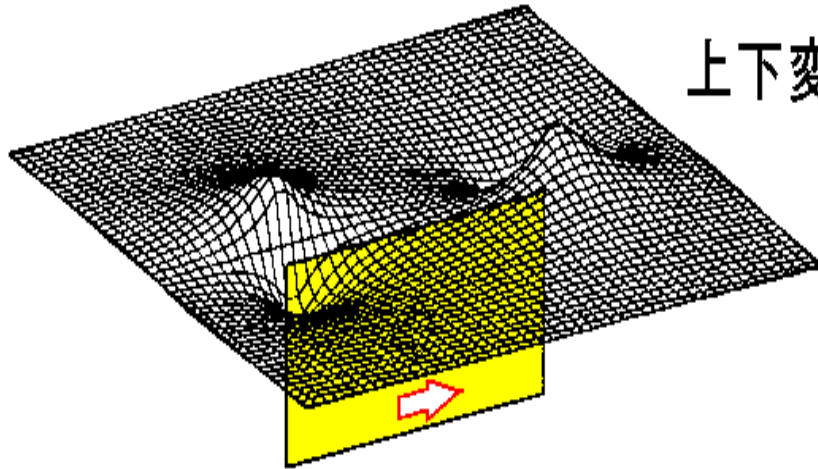


Quaternary Volcanoes  
Committee for Catalog of Quaternary Volcanoes in Japan

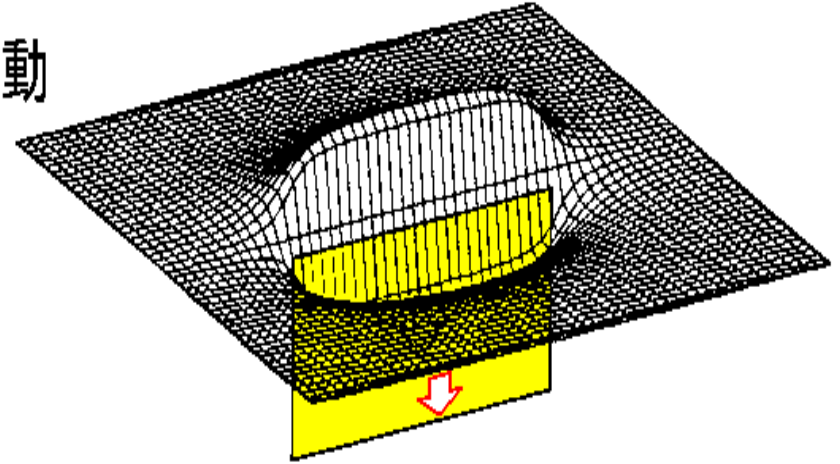
# Crustal Deformations Associated with Faulting

垂直横ずれ断層 Strike Slip

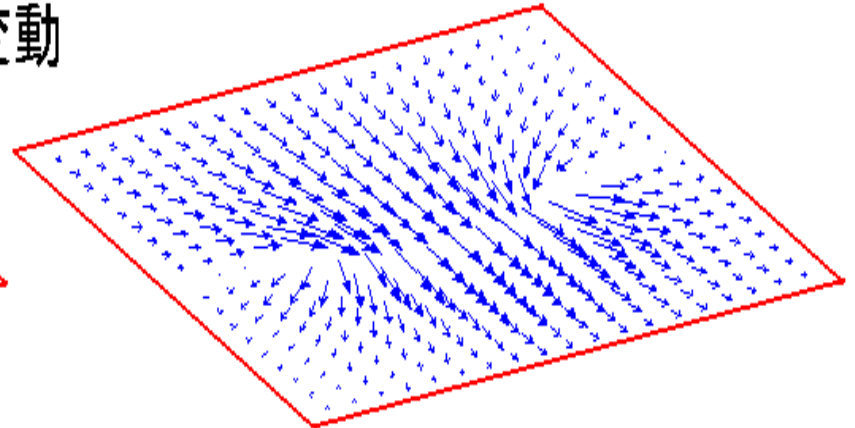
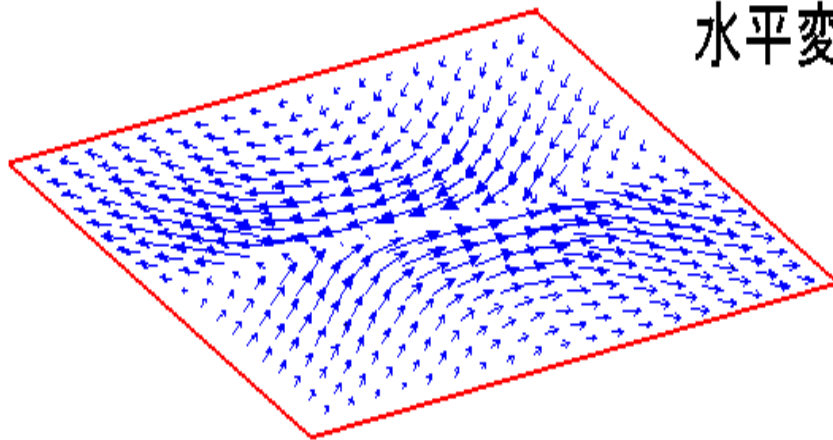
垂直縦ずれ断層 Dip Slip



上下変動



水平変動

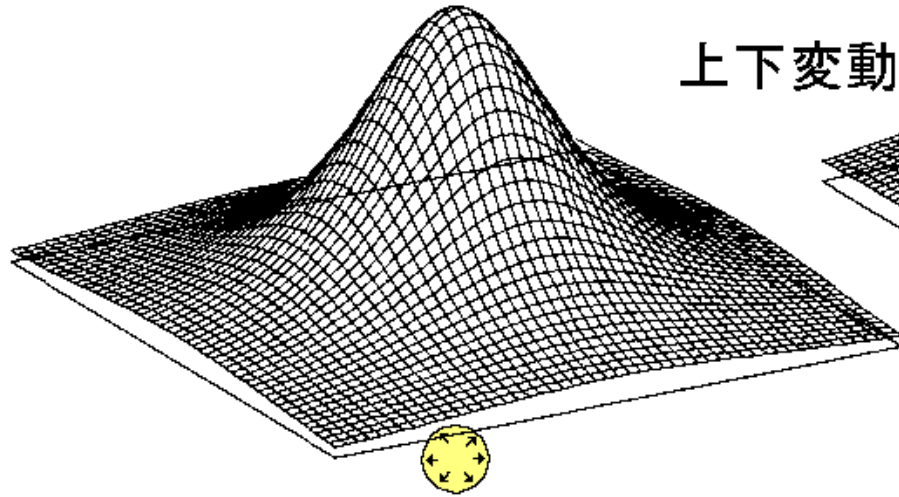




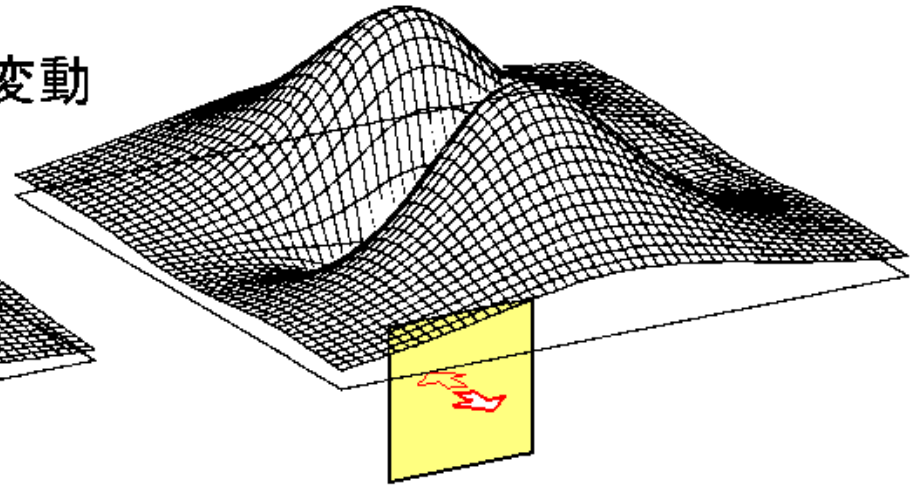
# Crustal Deformations Associated with Magmatic Sources

膨張源

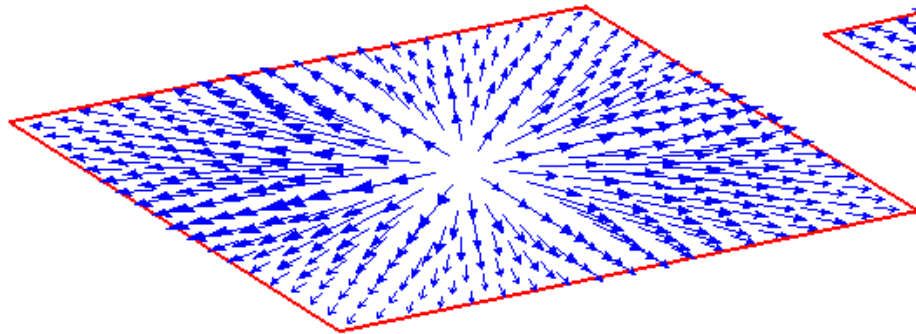
垂直開口断層



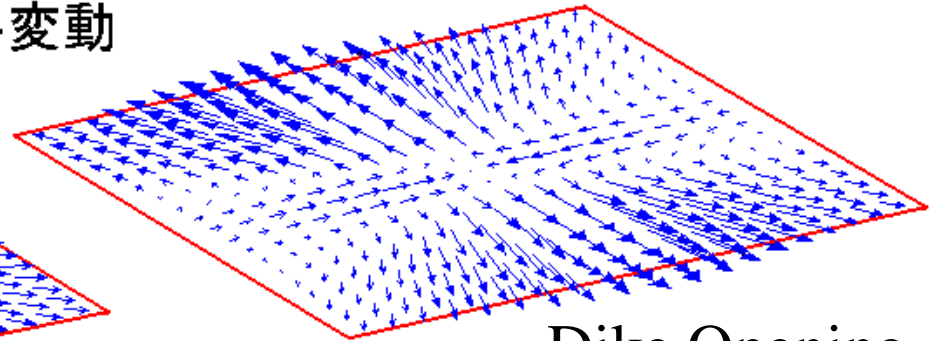
上下變動



水平變動



Point Source (Magma Chamber)



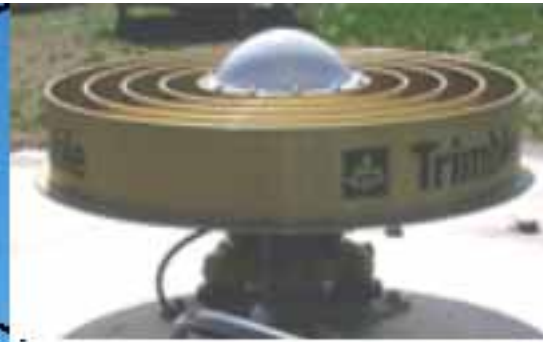
Dike Opening

Illustration by Okada (NIED)



# A Typical Site

5m



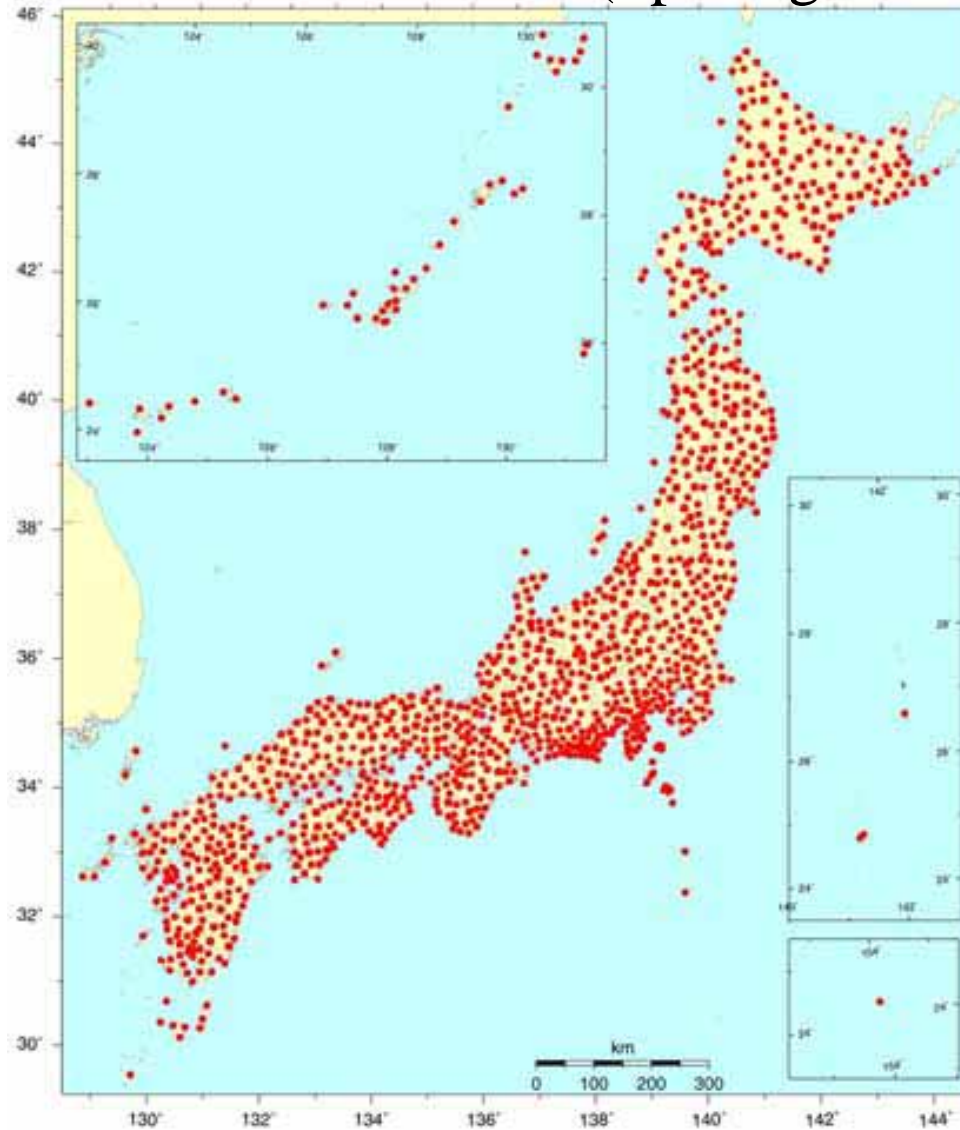
Antenna



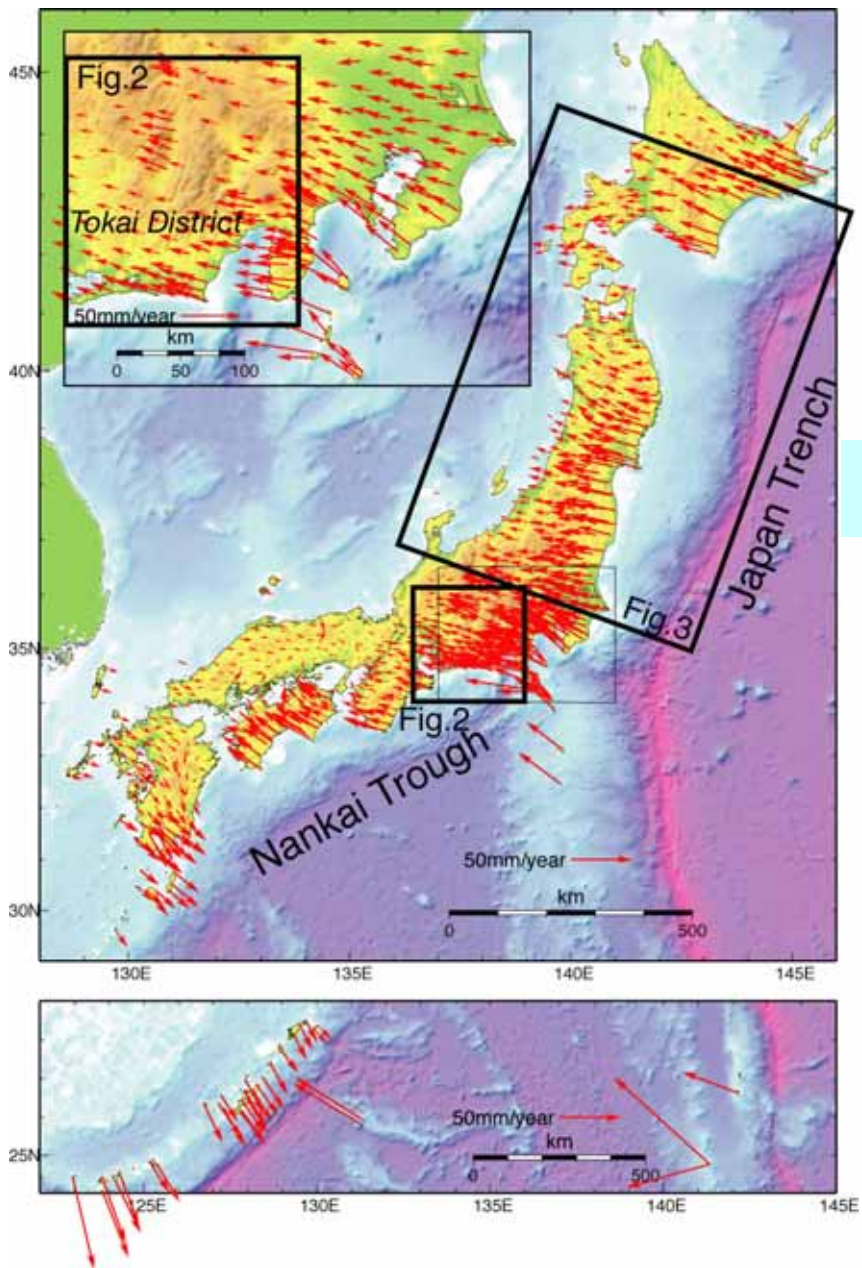
Receiver  
&  
Modem

# Distribution of GEONET Sites

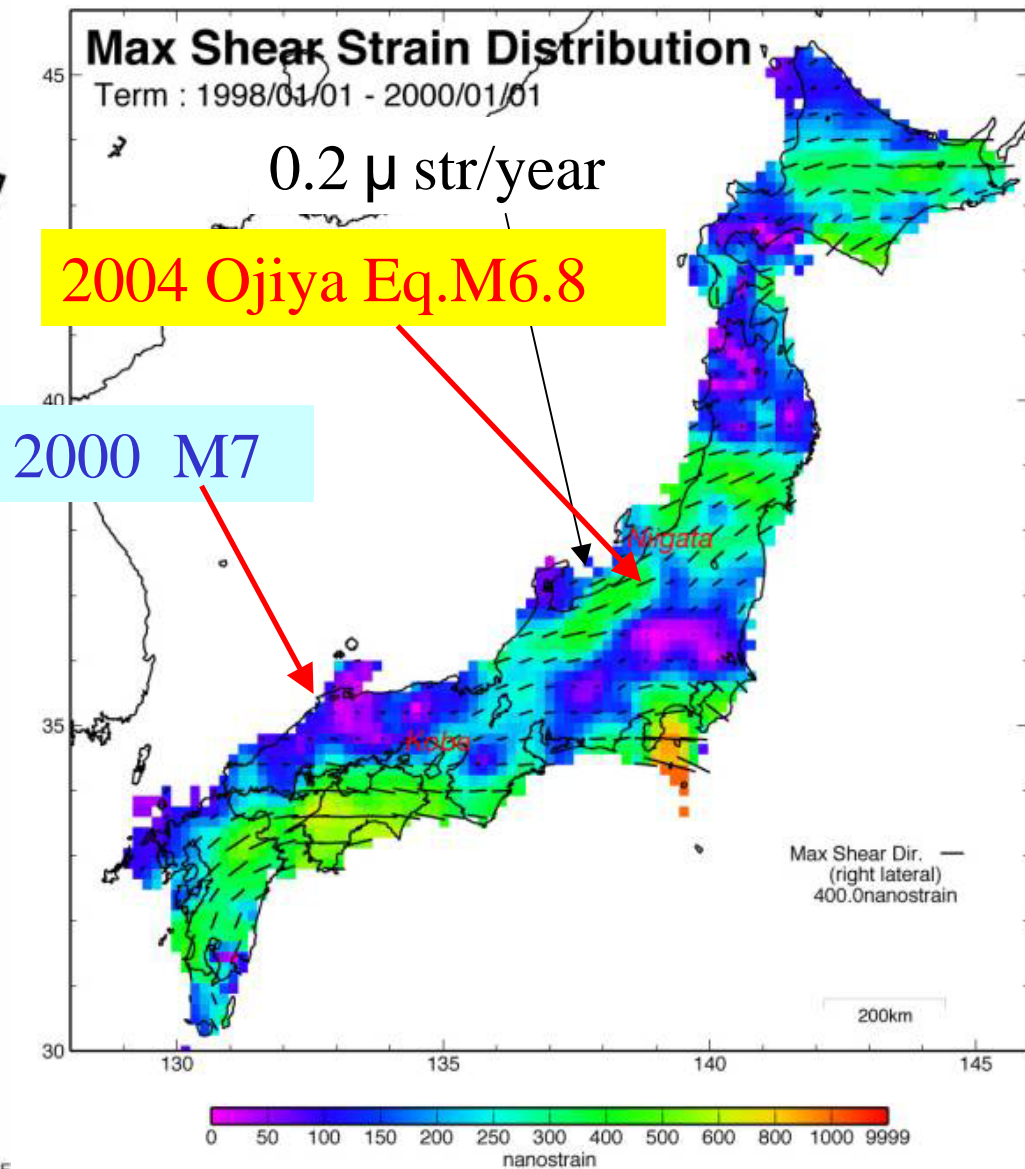
More than 1200 Stations (Spacing: 20~25km)



# Hor. Displacements

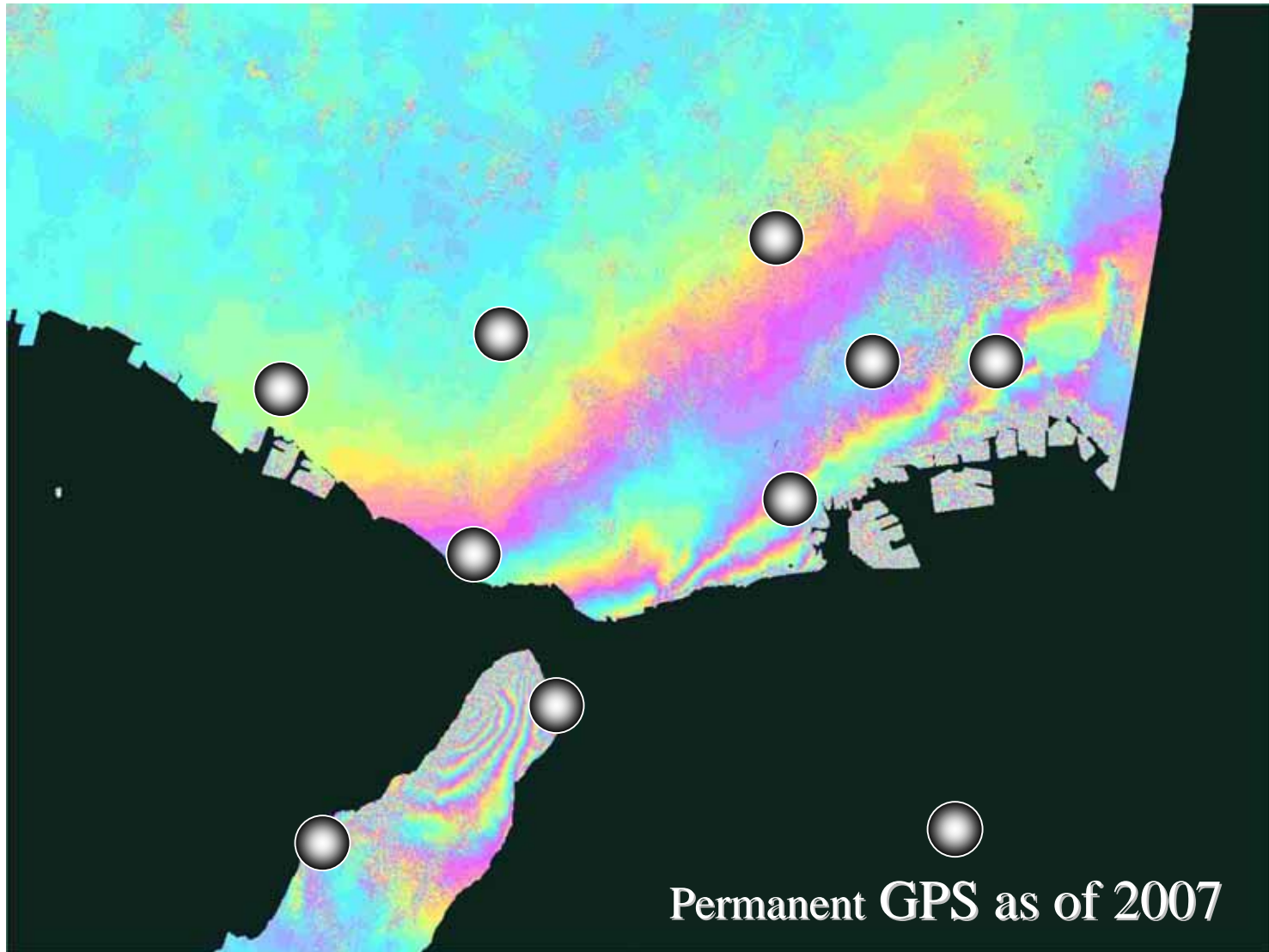


# Shear Strain Field





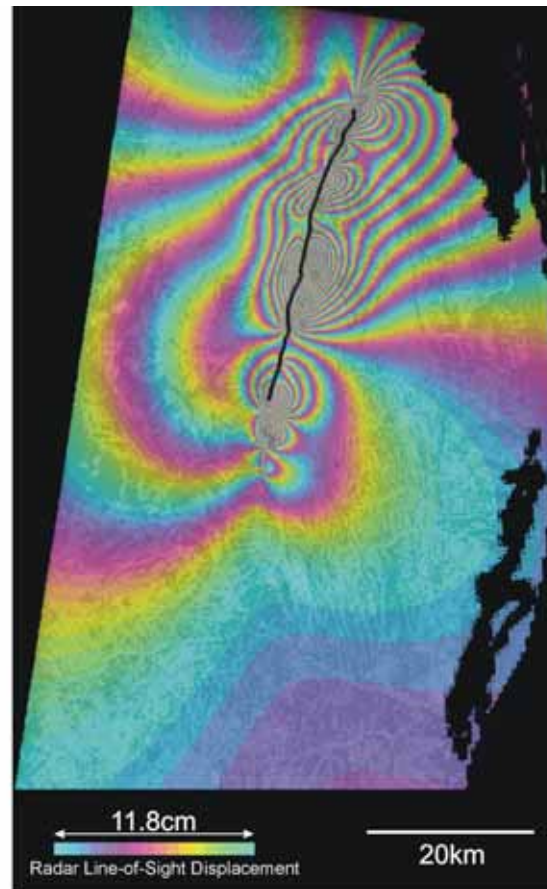
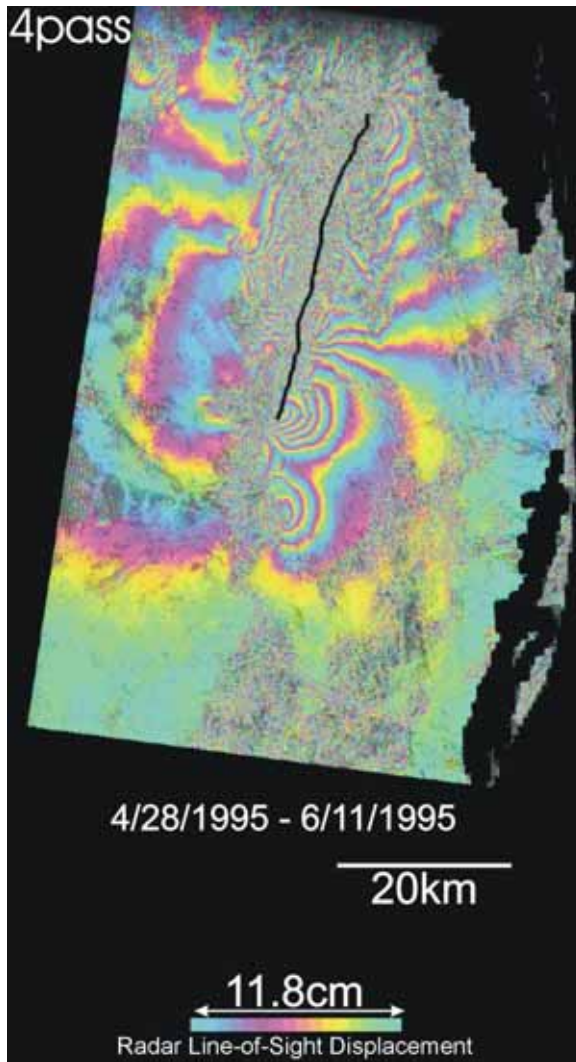
# JERS-1 InSAR Depicting Deformation Field Associated with 1995 Kobe Earthquake



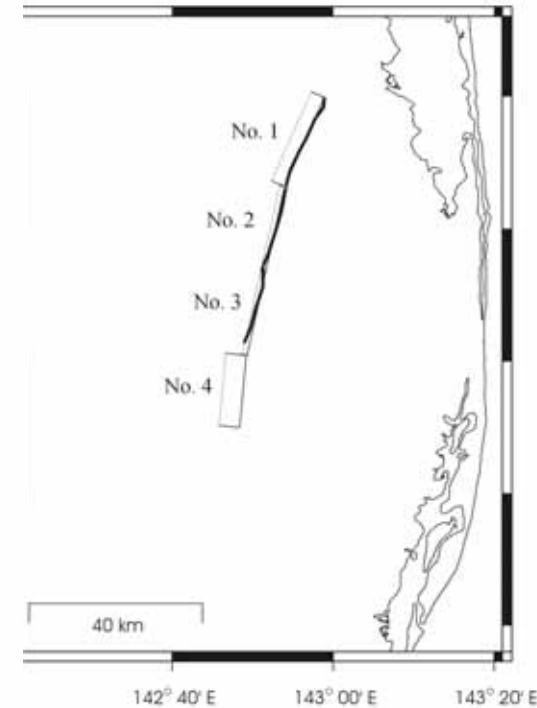
# JERS-1 InSAR (1995 North Sakhalin Eq. M7.8)

InSAR

Synthesized



SARの干渉図を元に得られた地震断層



## Multiple Segment Fault Model

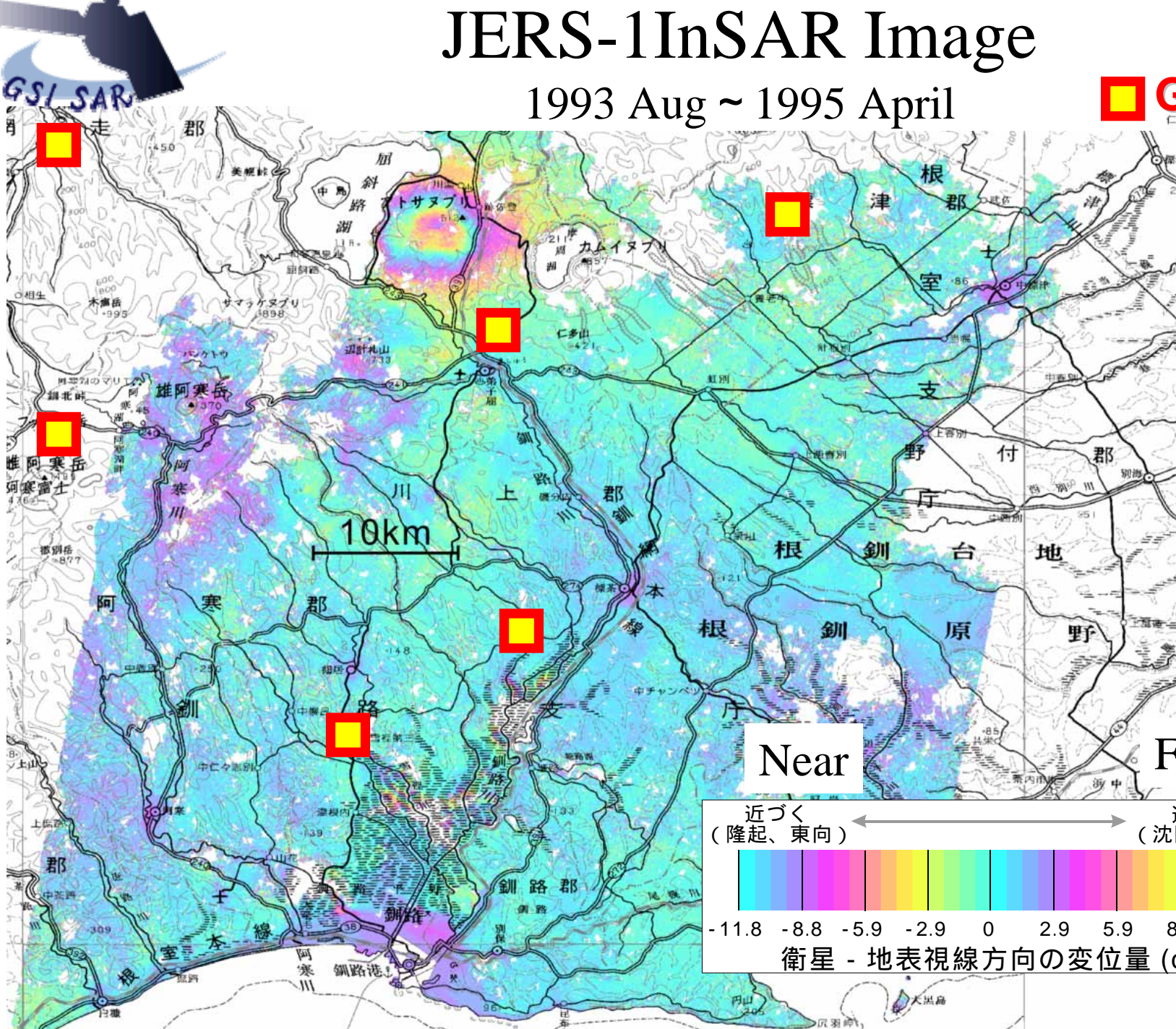
tion map of estimated four subfaults obtained from SAR interferogram data. Each rectangle represented line on rectangle indicates the bottom edge of the number of each fault corresponds to that in the map shows the location of the mapped earthquakes (Ishii *et al.* [1996]).

Fig. 9. Simulated interferogram based on our optimal

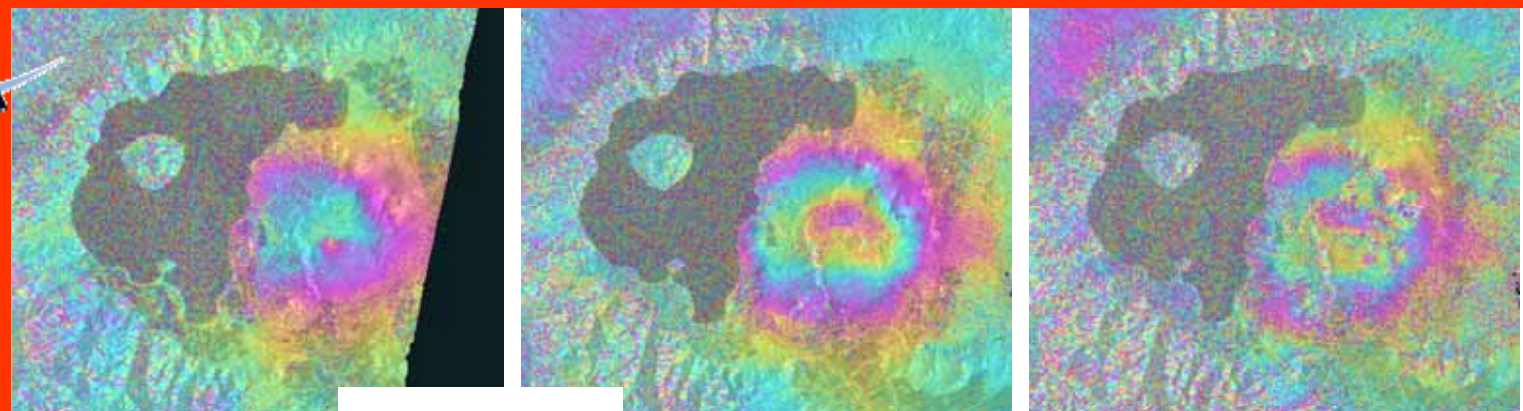


# JERS-1 InSAR Image

1993 Aug ~ 1995 April





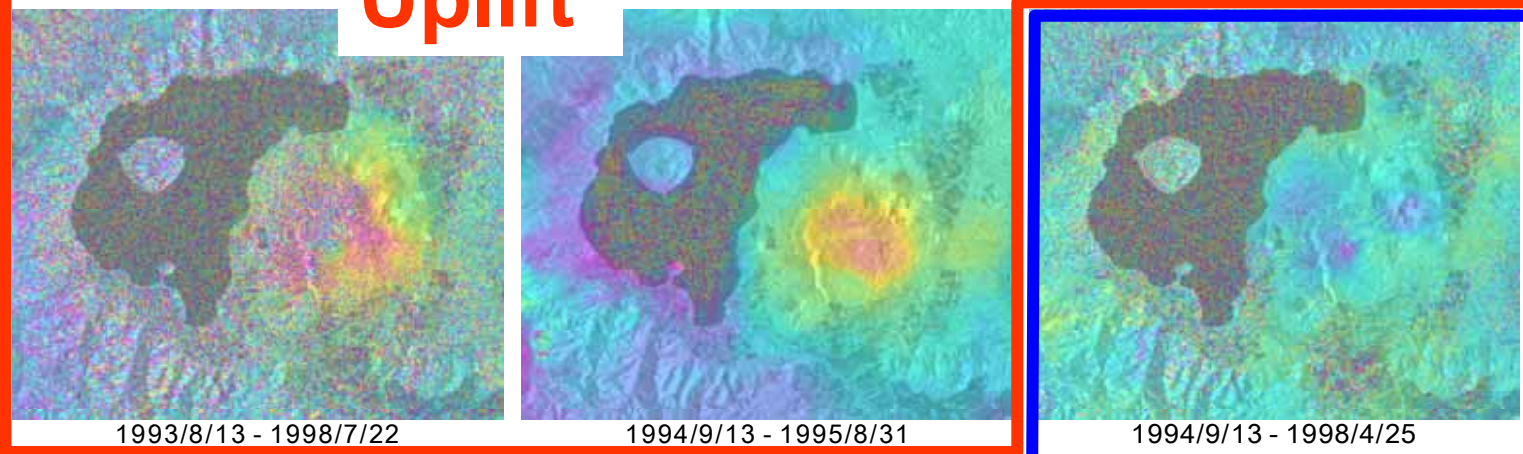


1993/5/18 - 1997

1993/8/13 - 1995/4/21

1993/8/14 - 1995/4/22

**Uplift**

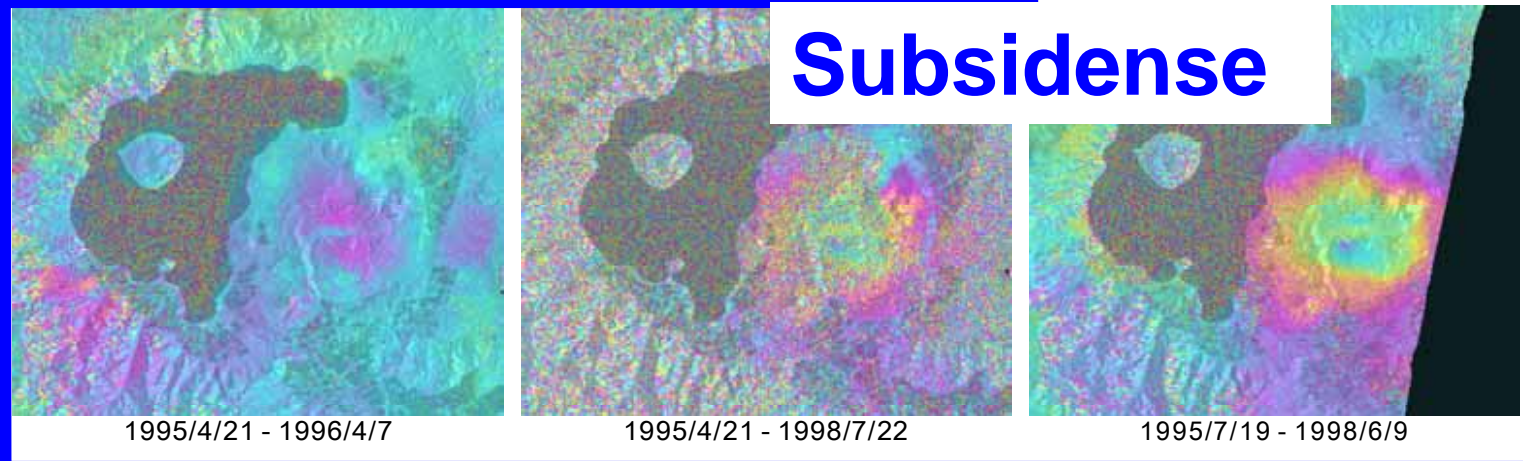


1993/8/13 - 1998/7/22

1994/9/13 - 1995/8/31

1994/9/13 - 1998/4/25

**Subsidence**



1995/4/21 - 1996/4/7

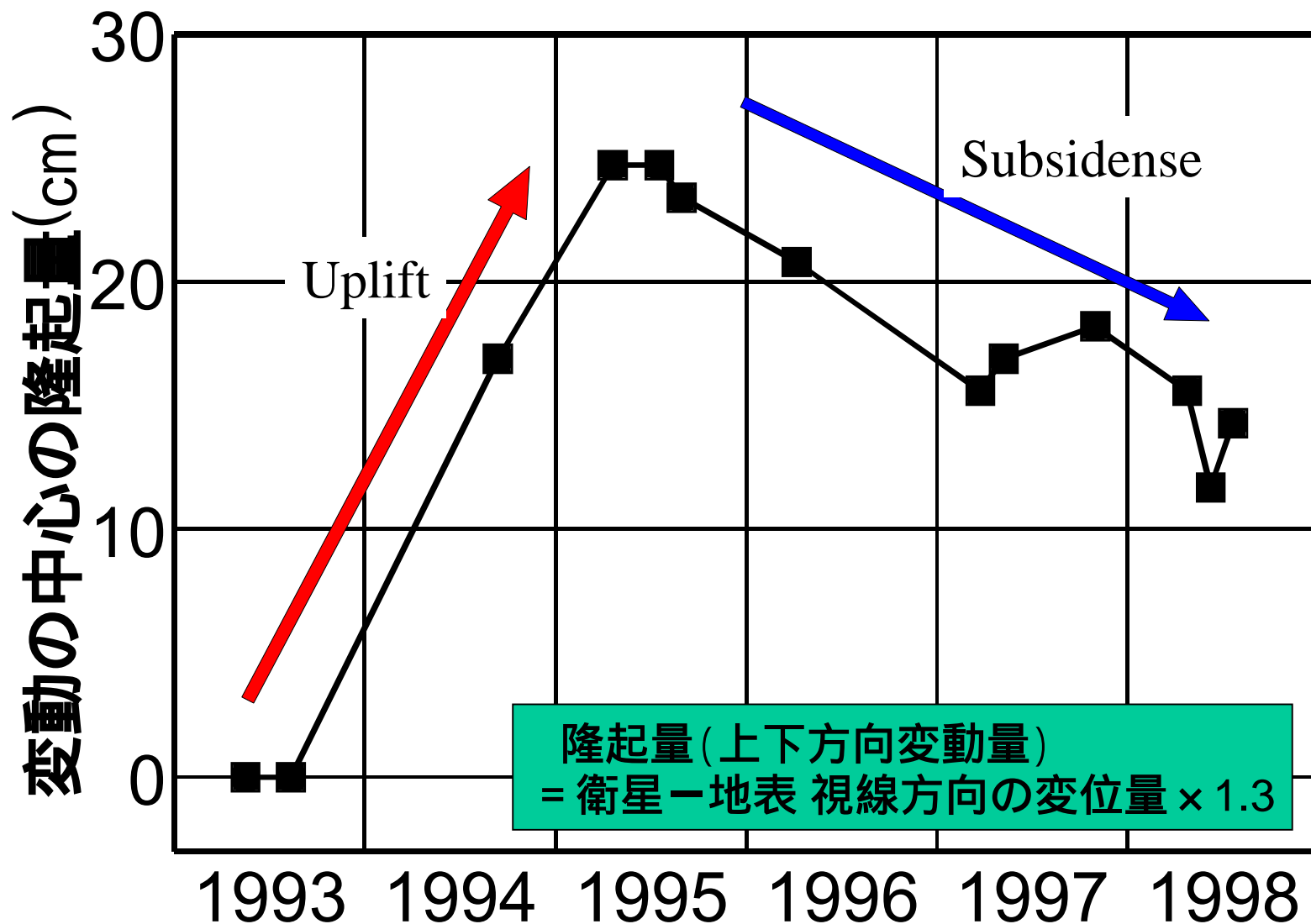
1995/4/21 - 1998/7/22

1995/7/19 - 1998/6/9

Evolution



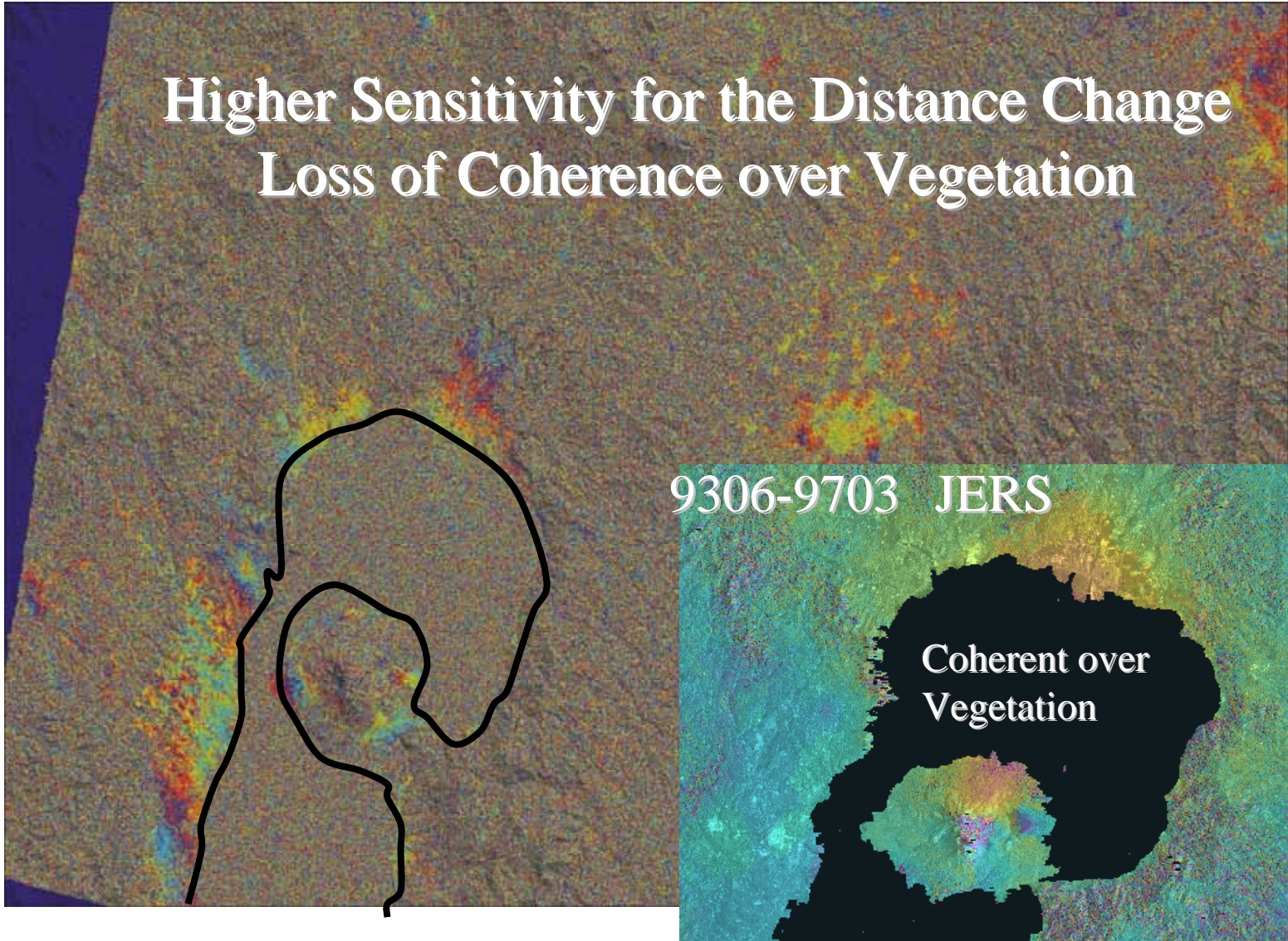
## Temporal Evolution of Vertical Displacement



# ERS Interferogram (C-band)

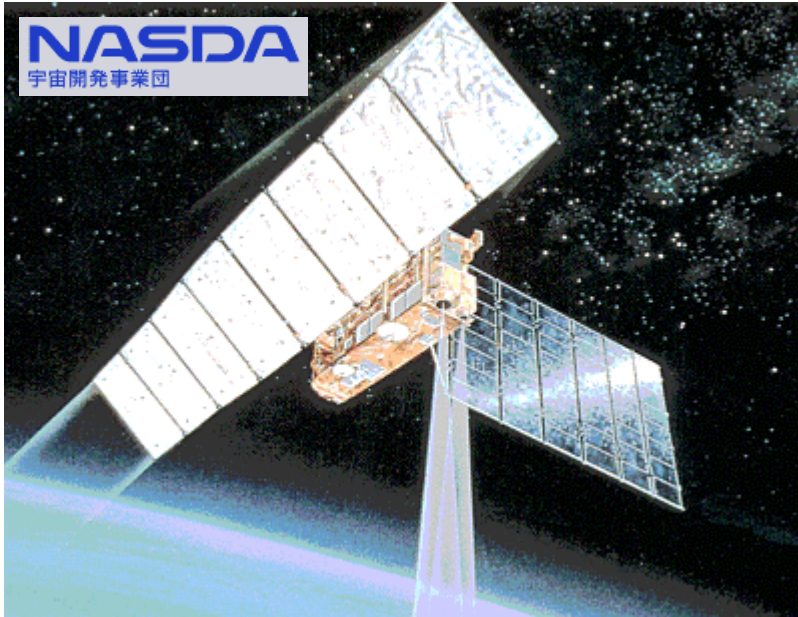
14-JAN-1996 18-MAY-1997

Higher Sensitivity for the Distance Change  
Loss of Coherence over Vegetation





# L-band SAR JERS-1 and ALOS



JERS-1

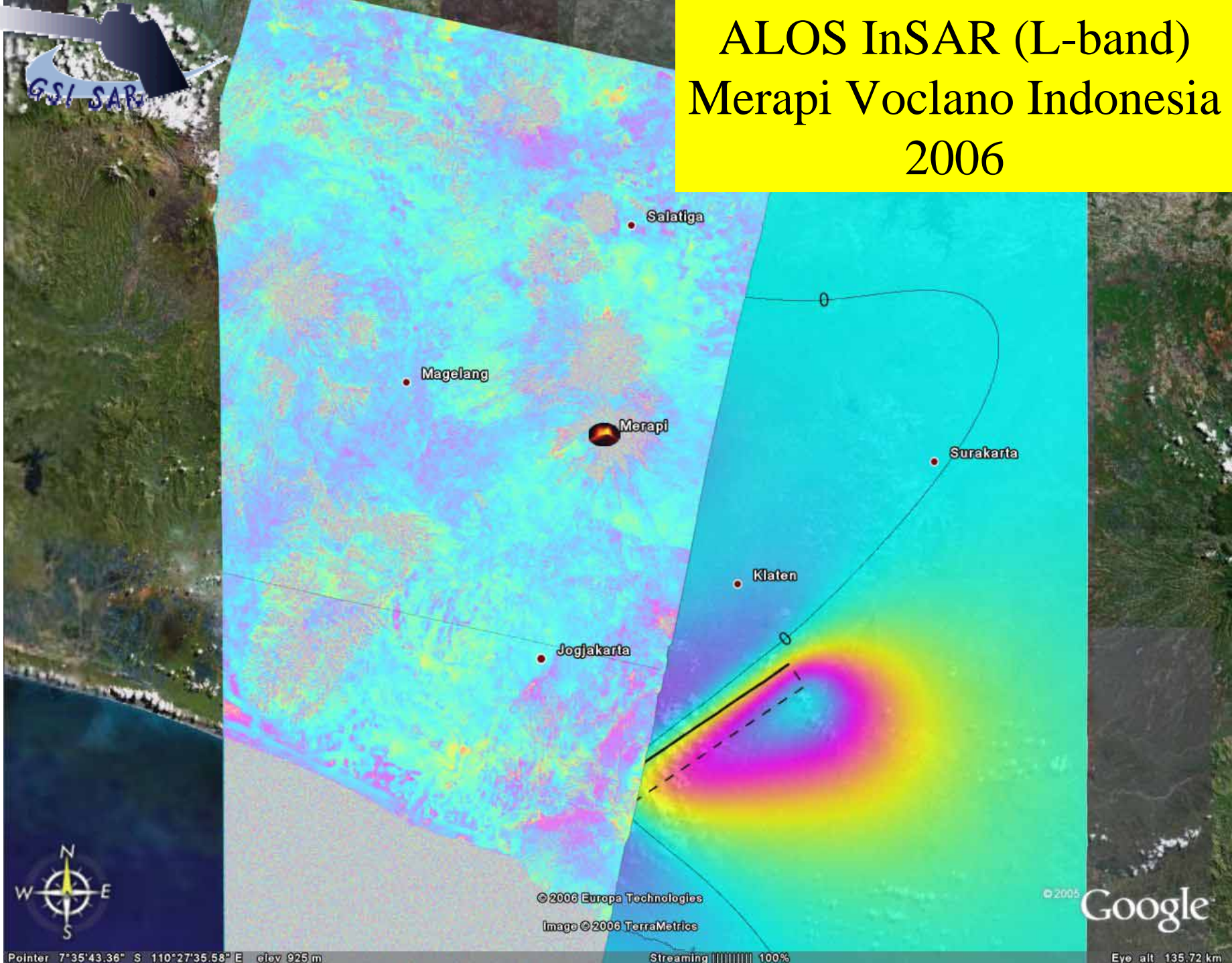
1992 Feb ~ 1998 Oct



ALOS

2006 January

# ALOS InSAR (L-band) Merapi Voclano Indonesia 2006



Pointer 7°35'43.36" S 110°27'35.58" E elev 925 m

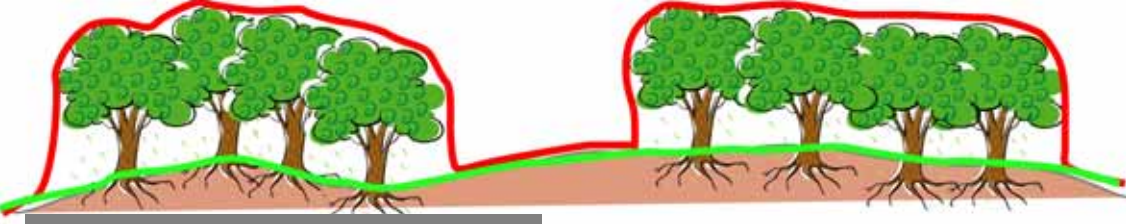
© 2006 Europa Technologies  
Image © 2006 TerraMetrics

Streaming 100%

© 2006 Google

Eye alt 135.72 km



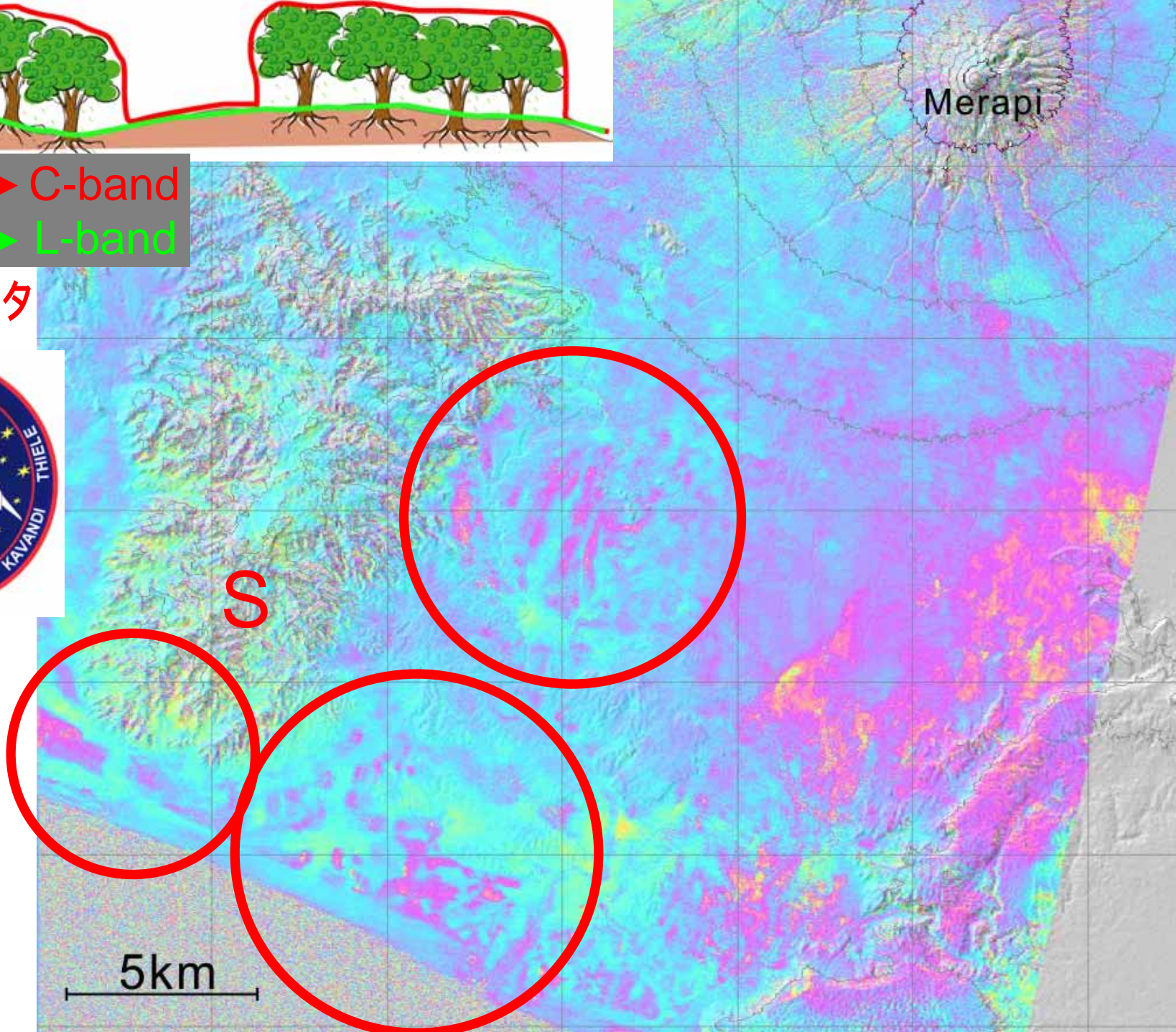


→ C-band  
→ L-band

地形データ

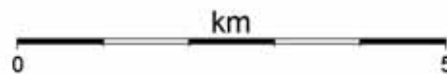
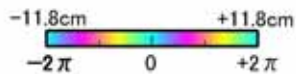
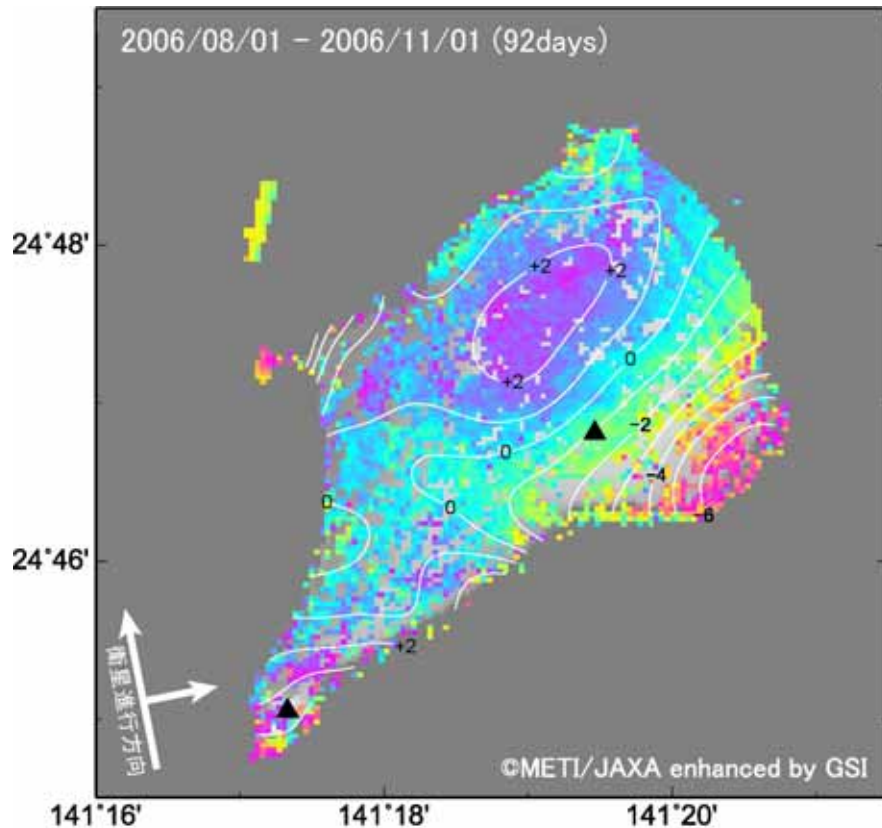


Cバンド

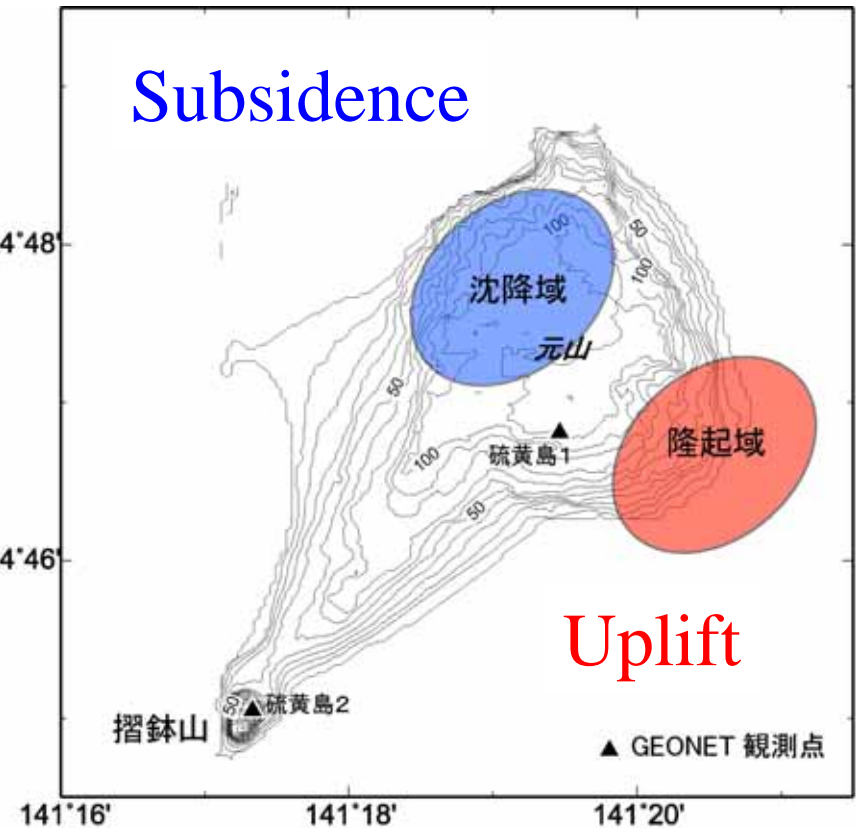


5km

# ALOS PALSAR InSAR of Iwojima Island 2006/08-2006/11



国土地理院の解析結果

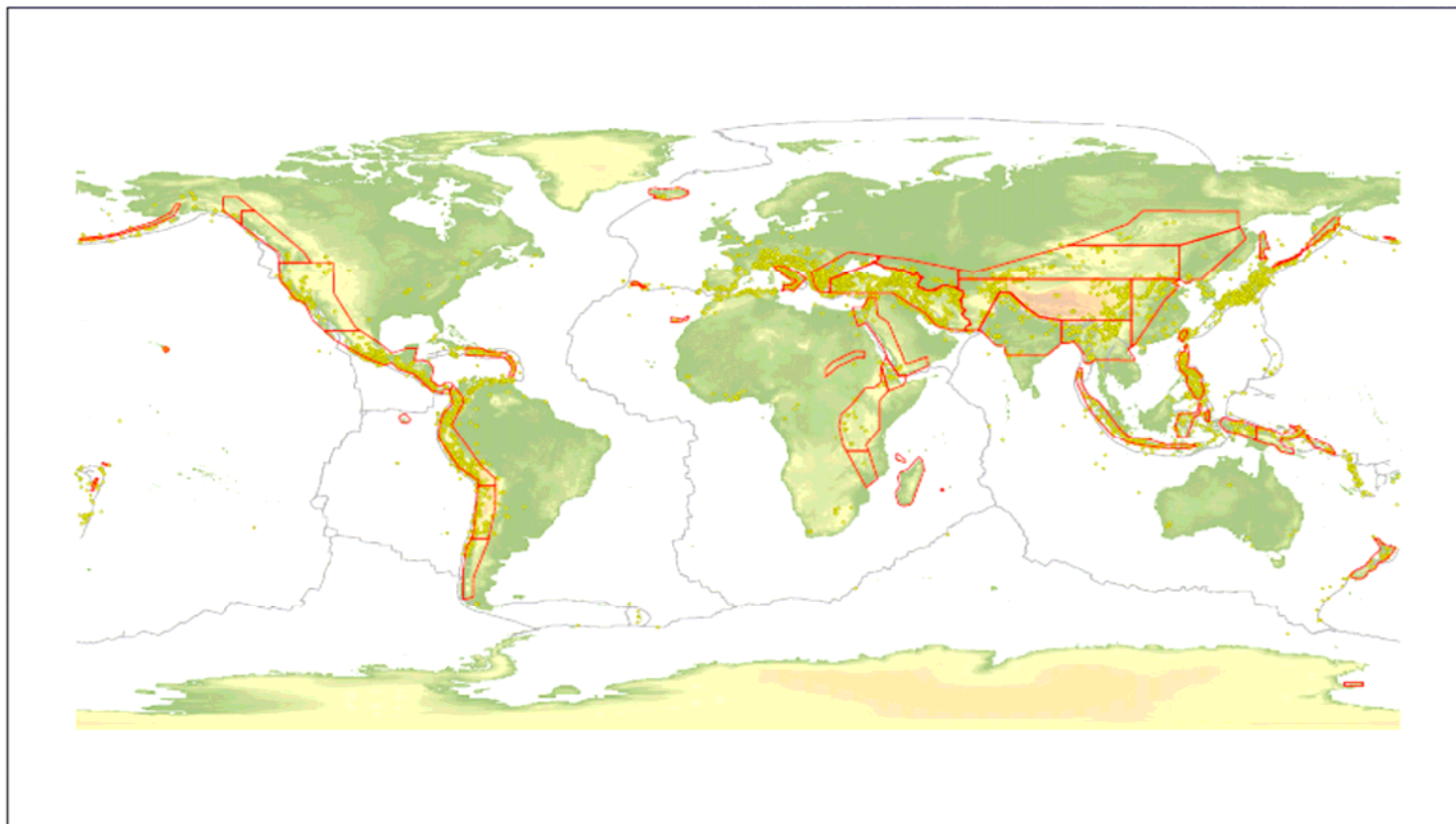


100m/500years



# Area of Intensive Observation by ALOS

国土地理院による世界の地殻変動帯に関するALOS PALSAR観測要求地域



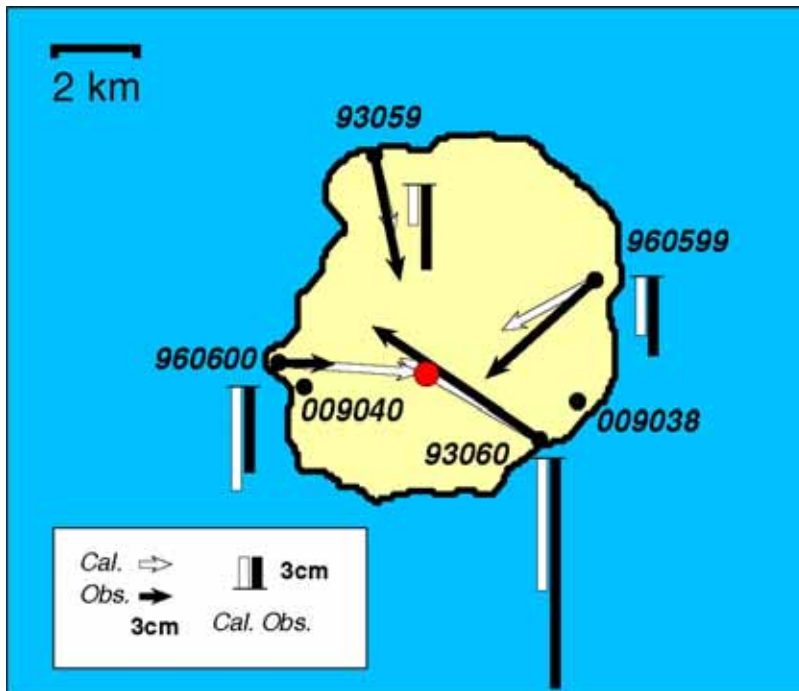
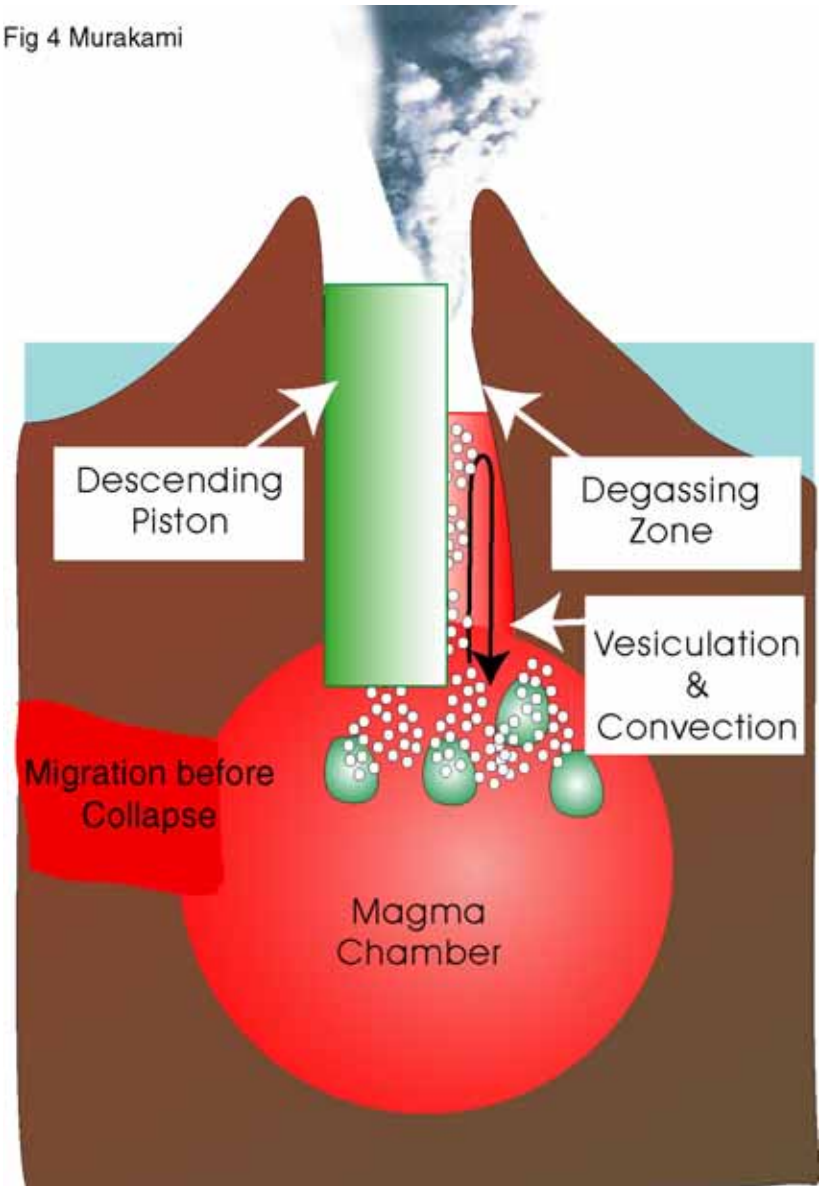
- Crustal World
- Significant Earthquakes



# Case Study: 2000 Eruption of Miyake Volcano, Japan



Fig 4 Murakami



# Challenges

- Enhance our Knowledge about Diversity of Volcanic Events
  - Geological Study
  - Global Observation by Satellite about On-going Volcanic Events on the Earth
- Chances of Contribution of Volcanic Disaster Mitigation

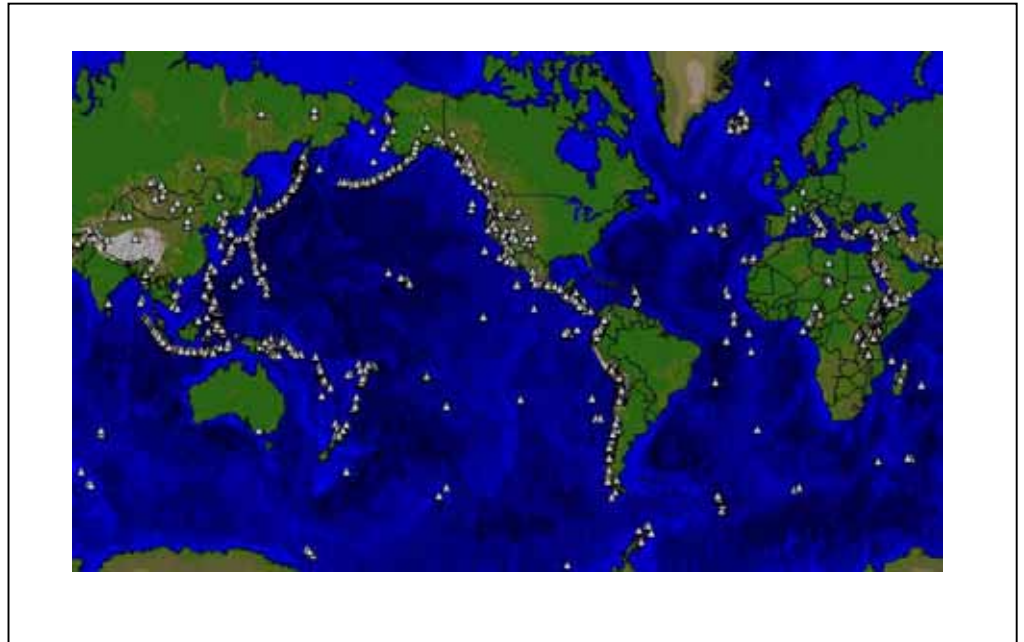
Need for Some Mechanism to Host Exchange of Information and Knowledge Gained by ALOS and in-situ Observations: GEOSS ?

# Summary

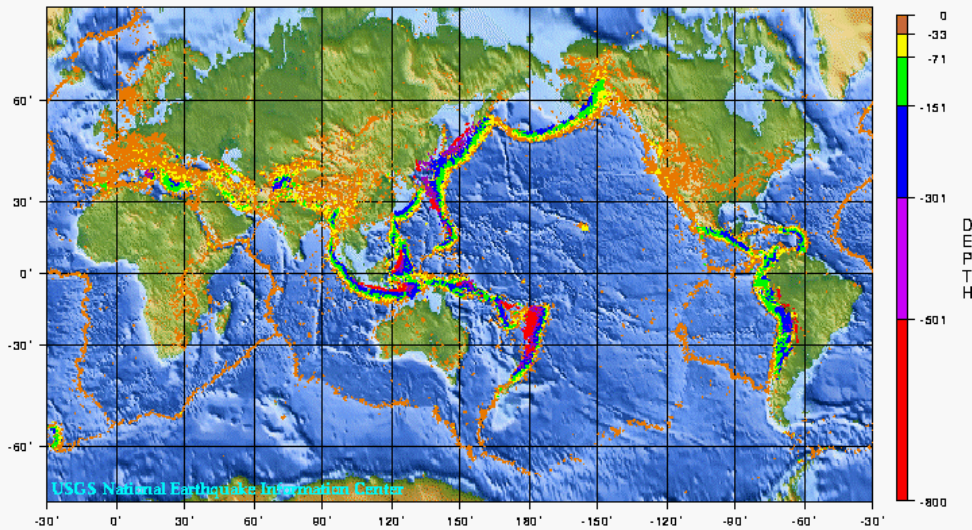
- ALOS PALSAR Working Well
- Excellent Data Source for  
Earthquake and Volcano Monitoring
- Mechanism for Data and Knowledge  
Exchange

# World Seismicity & Volcanism

Seismicity  
USGS



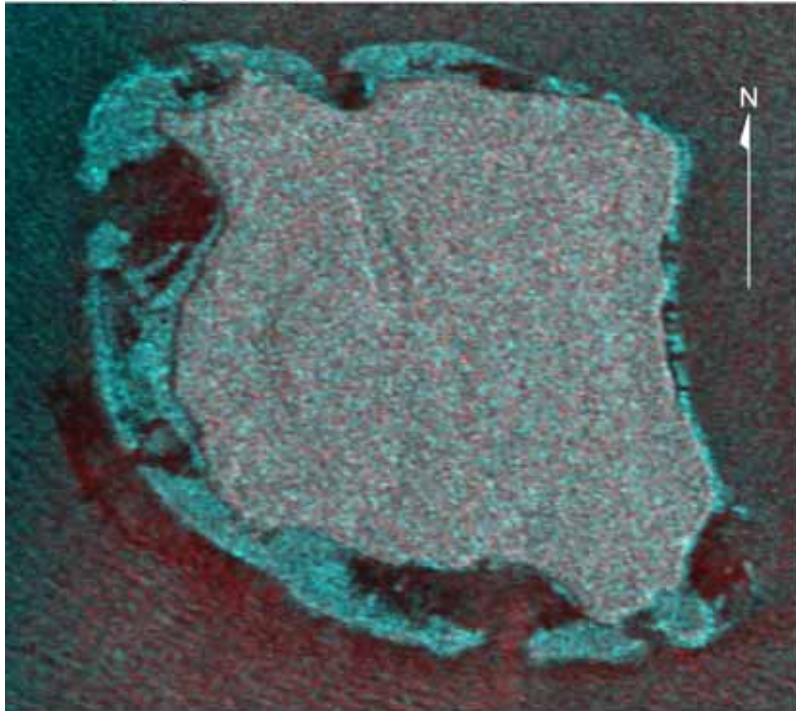
World Seismicity: 1975 - 1995



Volcanoes  
Smithsonian Institution

# Permanent Uplift of North Sentinel island by the 2004 Smtora Earthquake

Analysis by GSI, Japan from ENVISAT ASAR raw data



人工衛星画像解析によって判別した2004年(一部2005年)スマトラ島沖地震に伴う隆起・沈降域

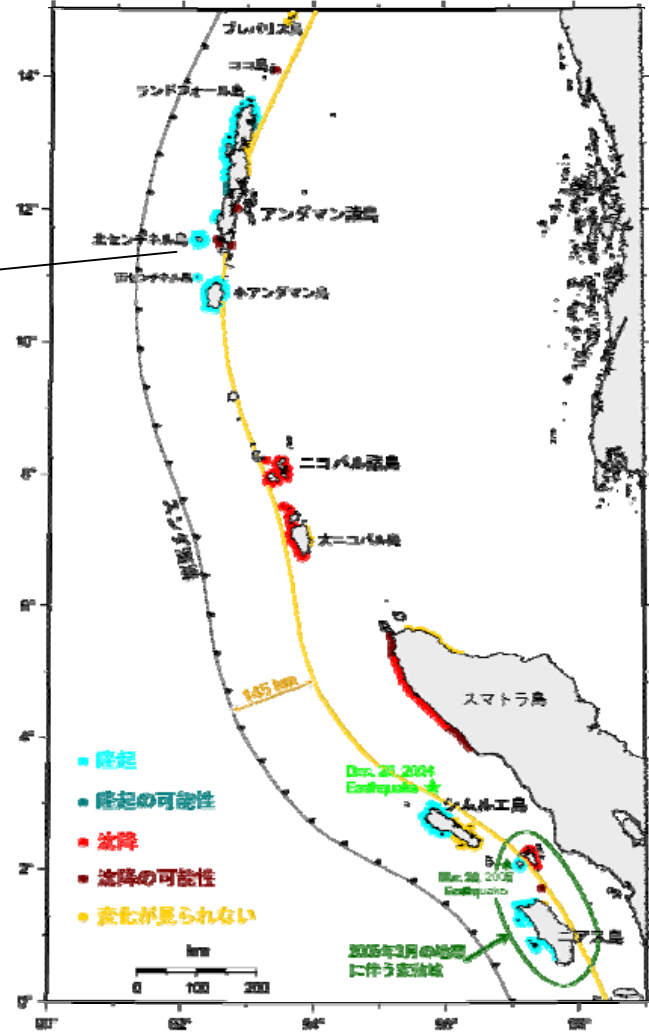
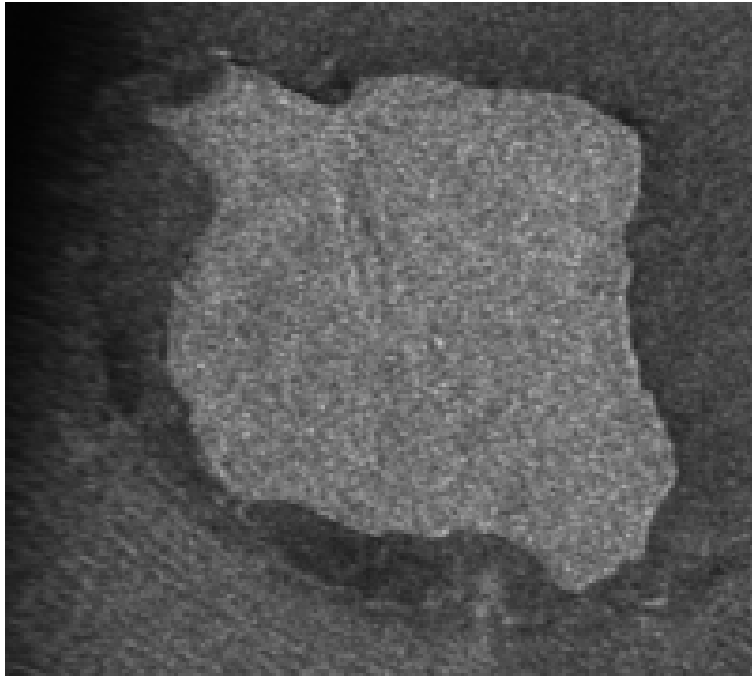


Table et al., Change of vertical displacement of the 2002 and 2005 Sumatra earthquakes revealed by satellite radar imagery, Earth Planets Space, Vol. 58 (No. 1), pp. 61-64, 2006.

更新日：平成18年2月21日  
国土交通省 国土院 地質院

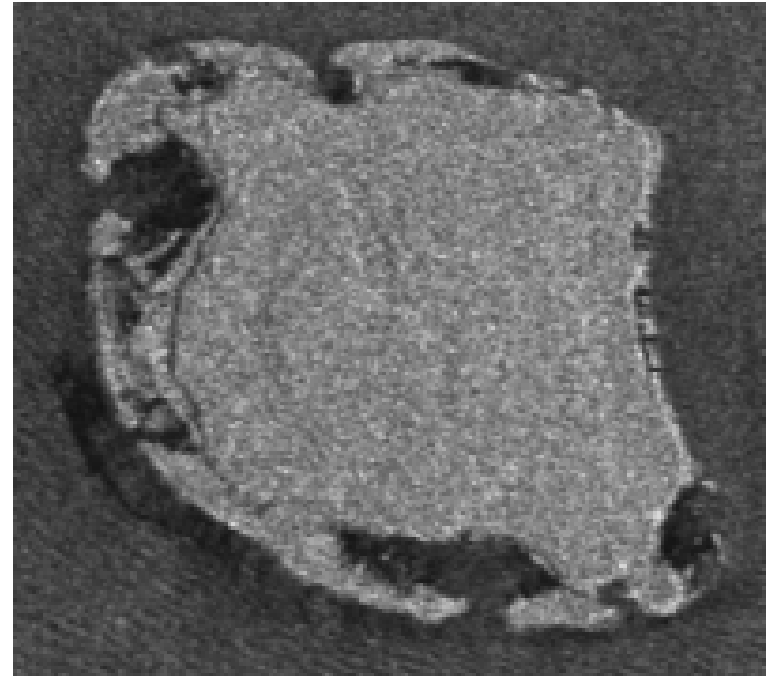
分析に使用した人工衛星データ：RADARSAT-1, ENVISAT, ERS/2, ASAR

Before



2004/06/03

After



2004/12/30

**North Sentinel island  
Uplift**