

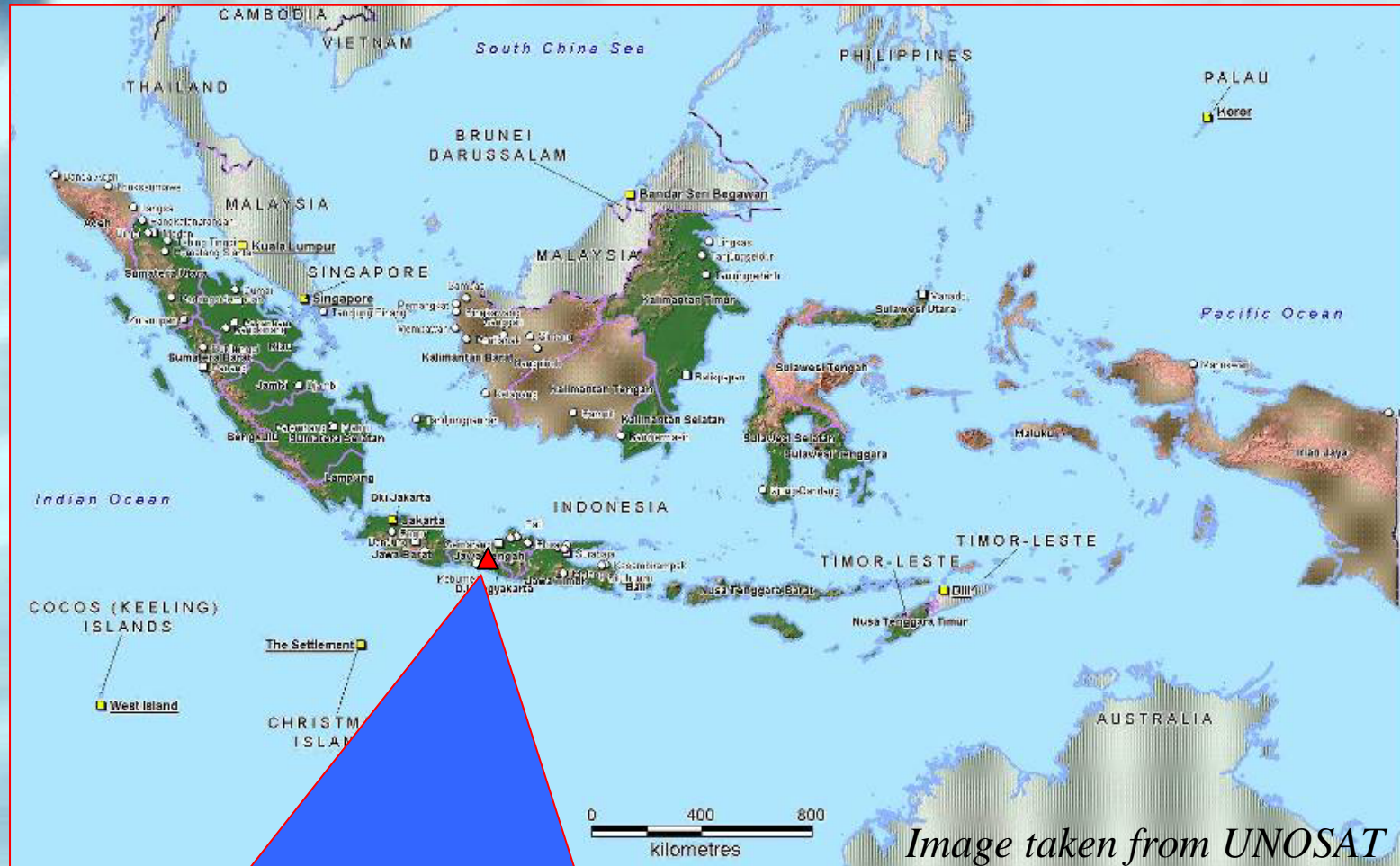
# **Extracting Topographic Change Pattern with the Mt. Merapi Eruption and the Yogyakarta Earthquake in Indonesia by RADARSAT D-InSAR**

Asep Saepuloh, Katsuaki Koike (Kumamoto University, Japan)  
Makoto Omura (Kochi Women's University, Japan)  
Masato Iguchi (DPRI Kyoto University, Japan)  
E-mail: [saepuloh@gmail.com](mailto:saepuloh@gmail.com)

# Content

- ❑ Mt. Merapi new volcanic product and Structure after the last eruption
- ❑ D-InSAR analysis after Earthquake for Yogyakarta City, Central Java

# Location of Mt. Merapi

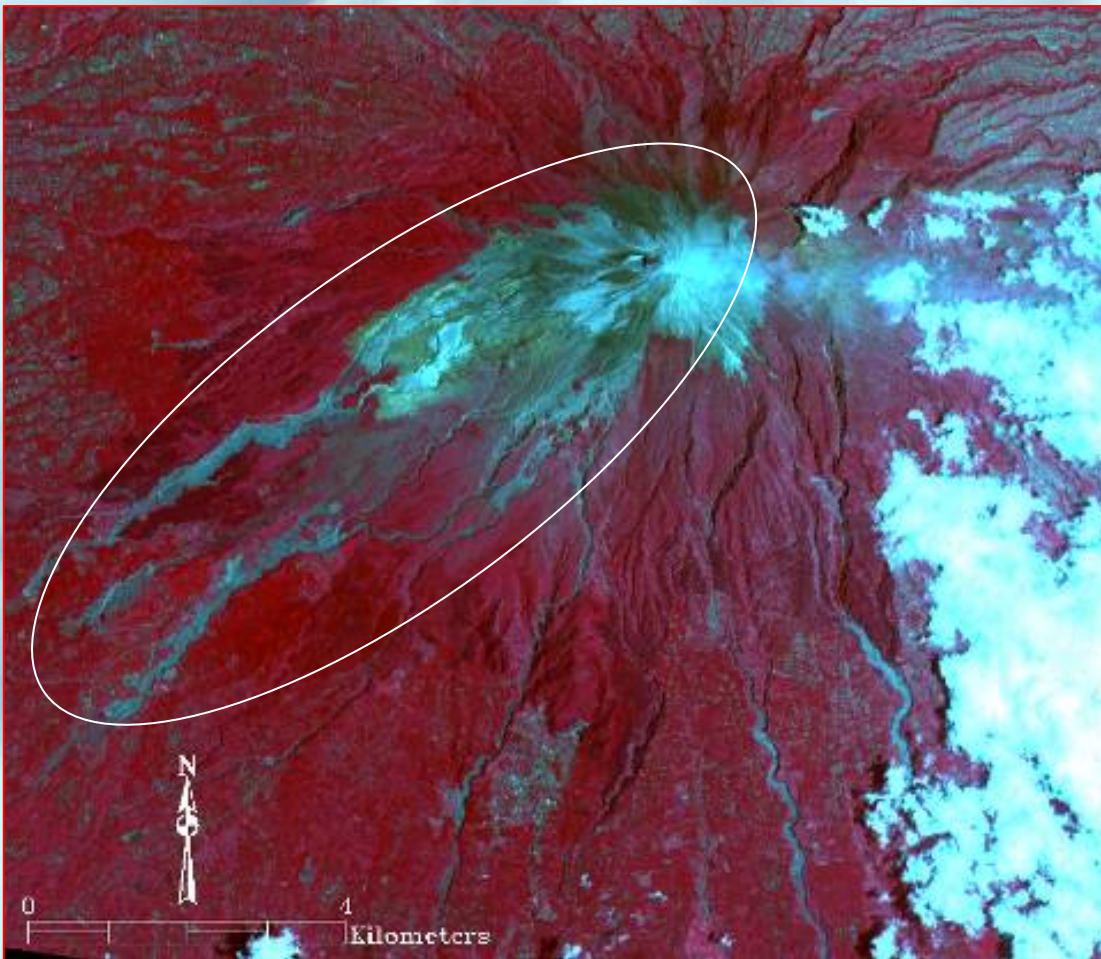


Mt. Merapi, the most dangerous volcano, located geographically  $-7^{\circ}32,5'$  latitude and  $110^{\circ}26,5'$  longitude which has stratovolcano type with lava dome at the peak typically



# Mt. Merapi on ASTER

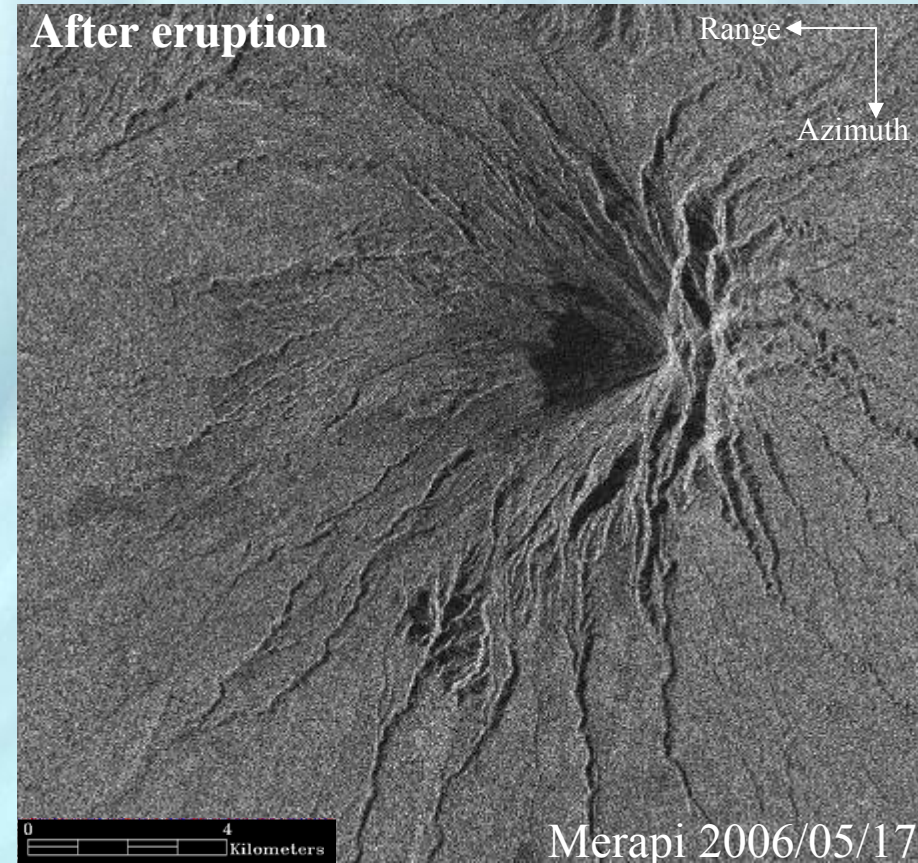
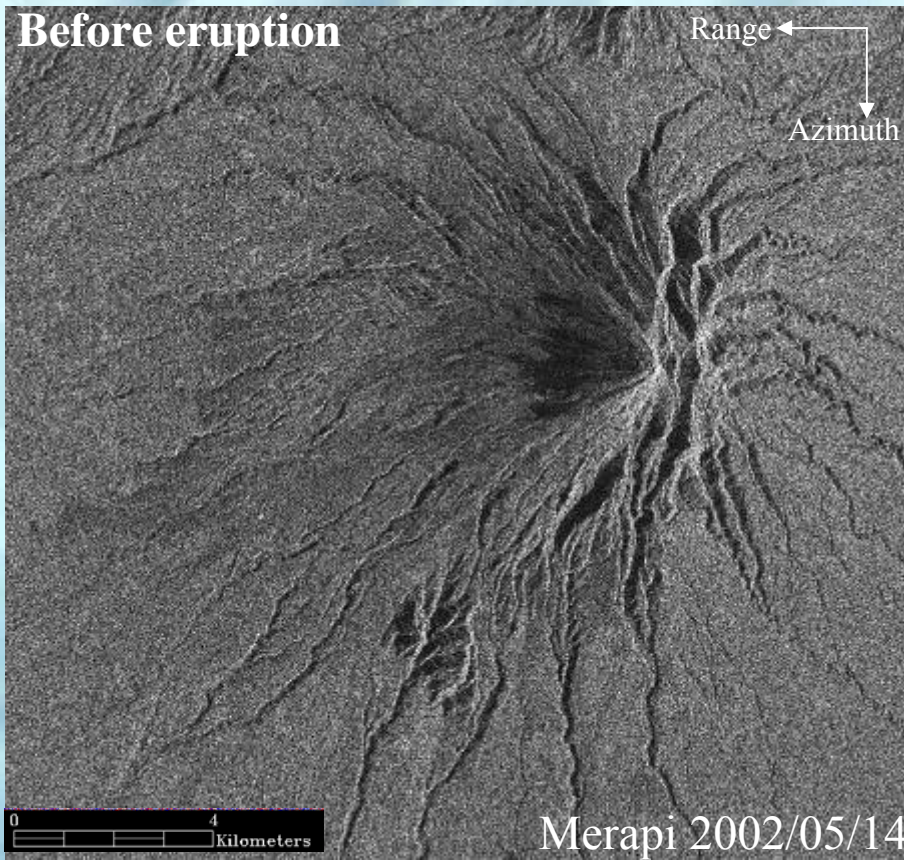
2002/12/11 R=3, G=2, B=1



- Initial volcanic product of Mt. Merapi showed the material elongated from the crater to the south-west.
- However, several days after the last eruption in May 2006, dense ashes covers over the mountain, made optical sensor difficult to asses the terrain.



# Radarsat Intensity Image



- ❑ We used the intensity image of RADARSAT data to obtain the volcanic product changed by the latest eruption in may 2006
- ❑ Based on the intensity image, we extracted the brightness value of the data by using betanought extraction method

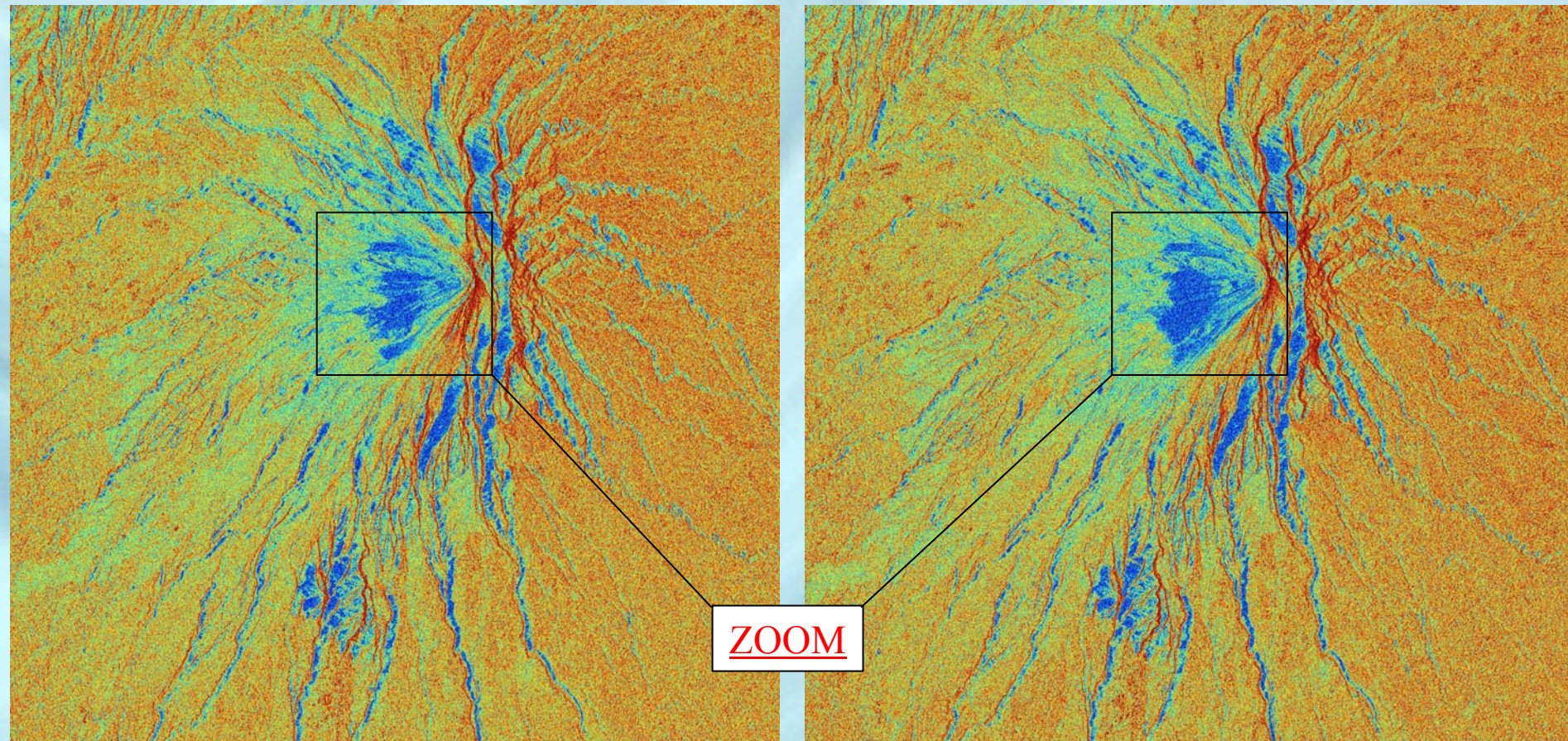


# Betanought ( $\beta^\circ$ ) for RADARSAT SLC Product

Extracting value of the radar brightness for pixels

$$\begin{aligned}\beta_j^\circ &= 10 \cdot \log_{10}[(DN_j/A2_j)^2 + (DNQ_j/A2_j)^2] \\ &= 20 \cdot \text{Log}_{10}(DN_j/A2_j) \text{ dB}\end{aligned}$$

Where:  $DN_j$ =Digital value of  $j^{\text{th}}$  pixel  
 $A2_j$ =scaling gain value for the  $j^{\text{th}}$ .

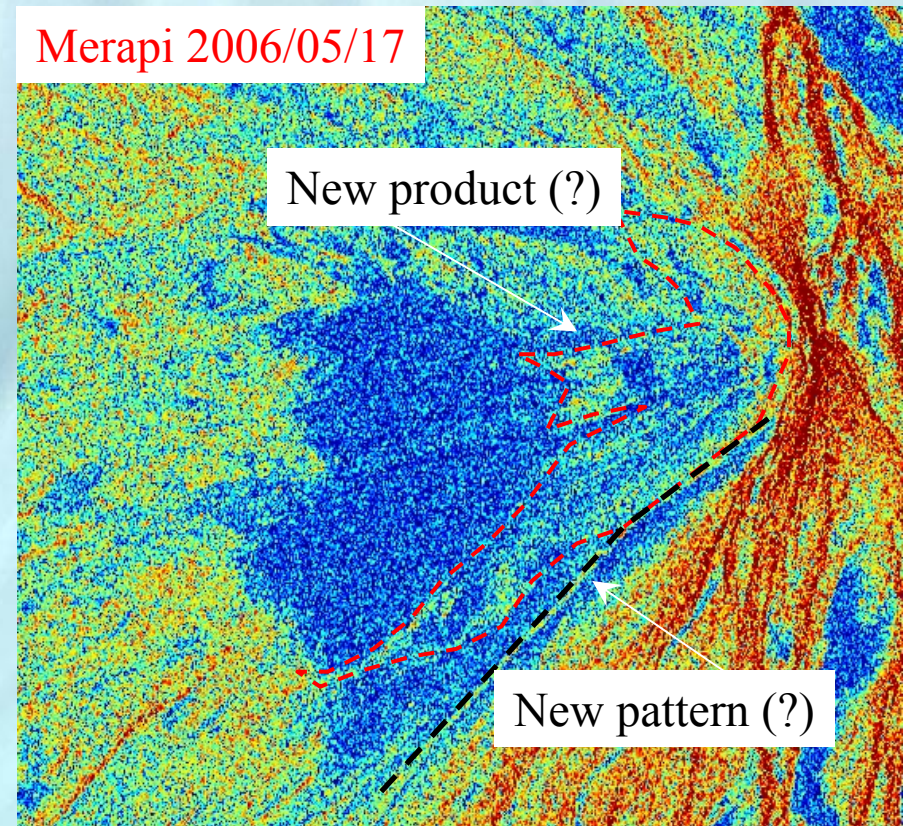
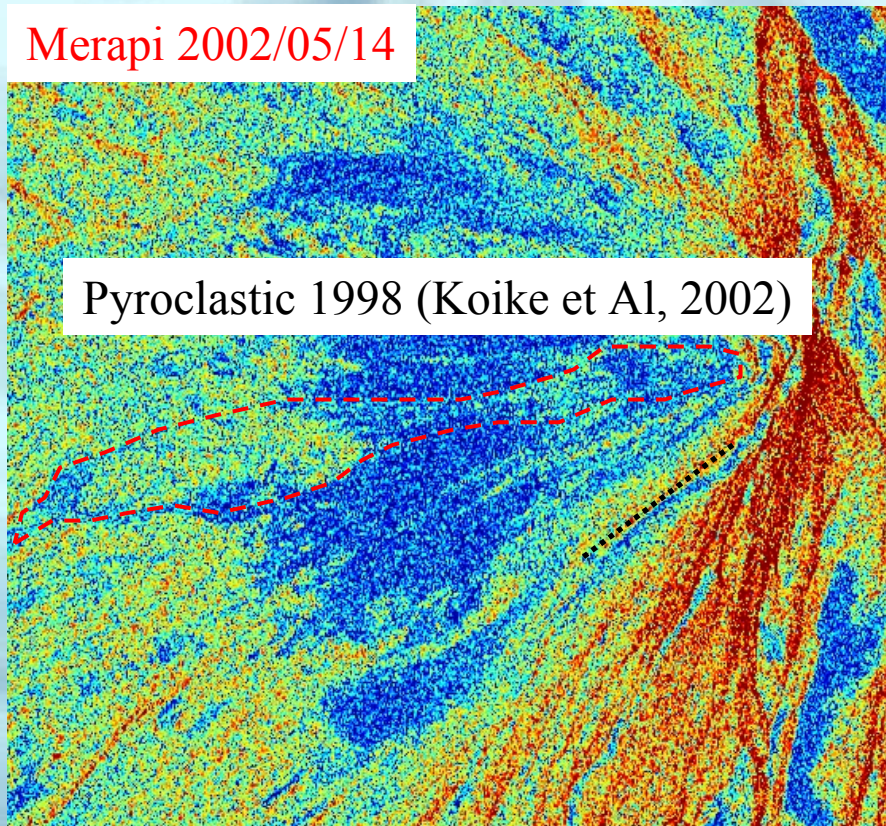


Merapi 2002/05/14

Merapi 2006/05/17



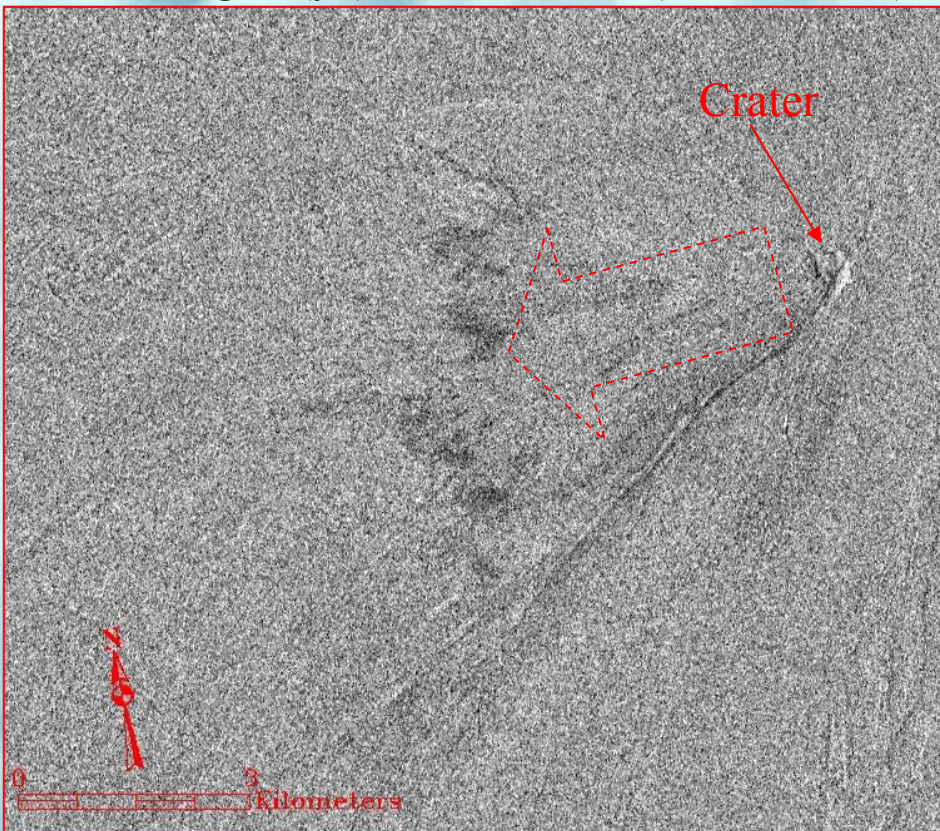
# Pre-Interpretation



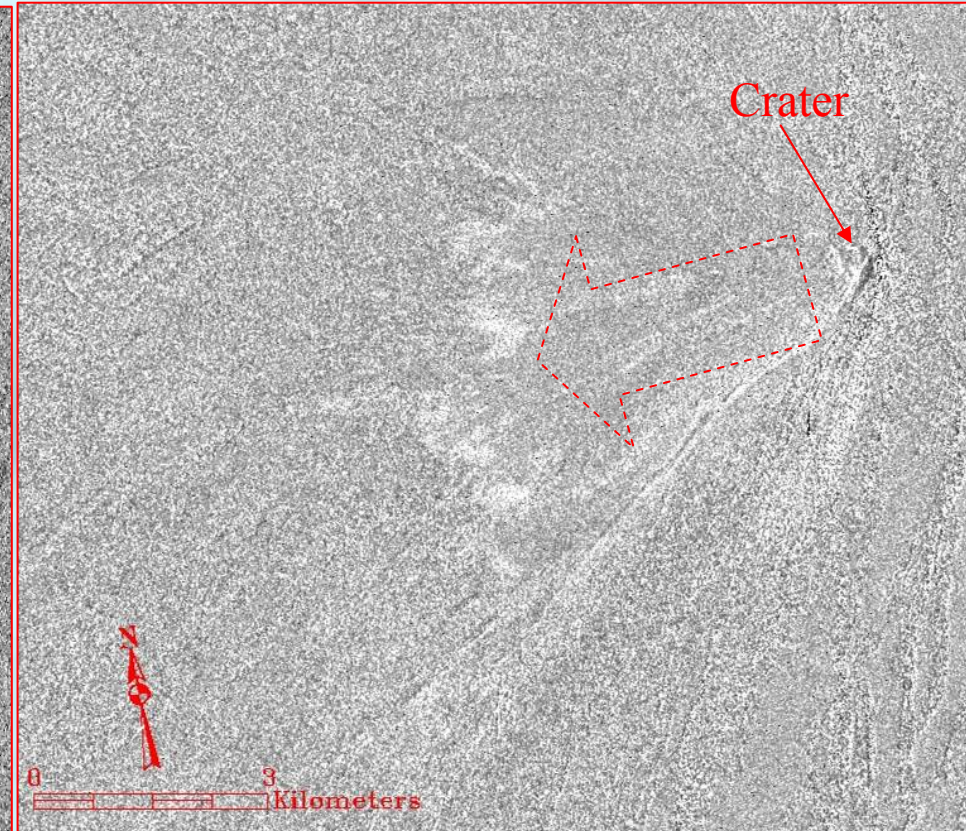
- ❑ Changed volcanic product, 2002 to 2006 data, shows some new features clearly
- ❑ Temporal math calculation of Betanought made the new features appear well



Betanought ( $\beta^\circ$ ) Subtraction (2006-2002)

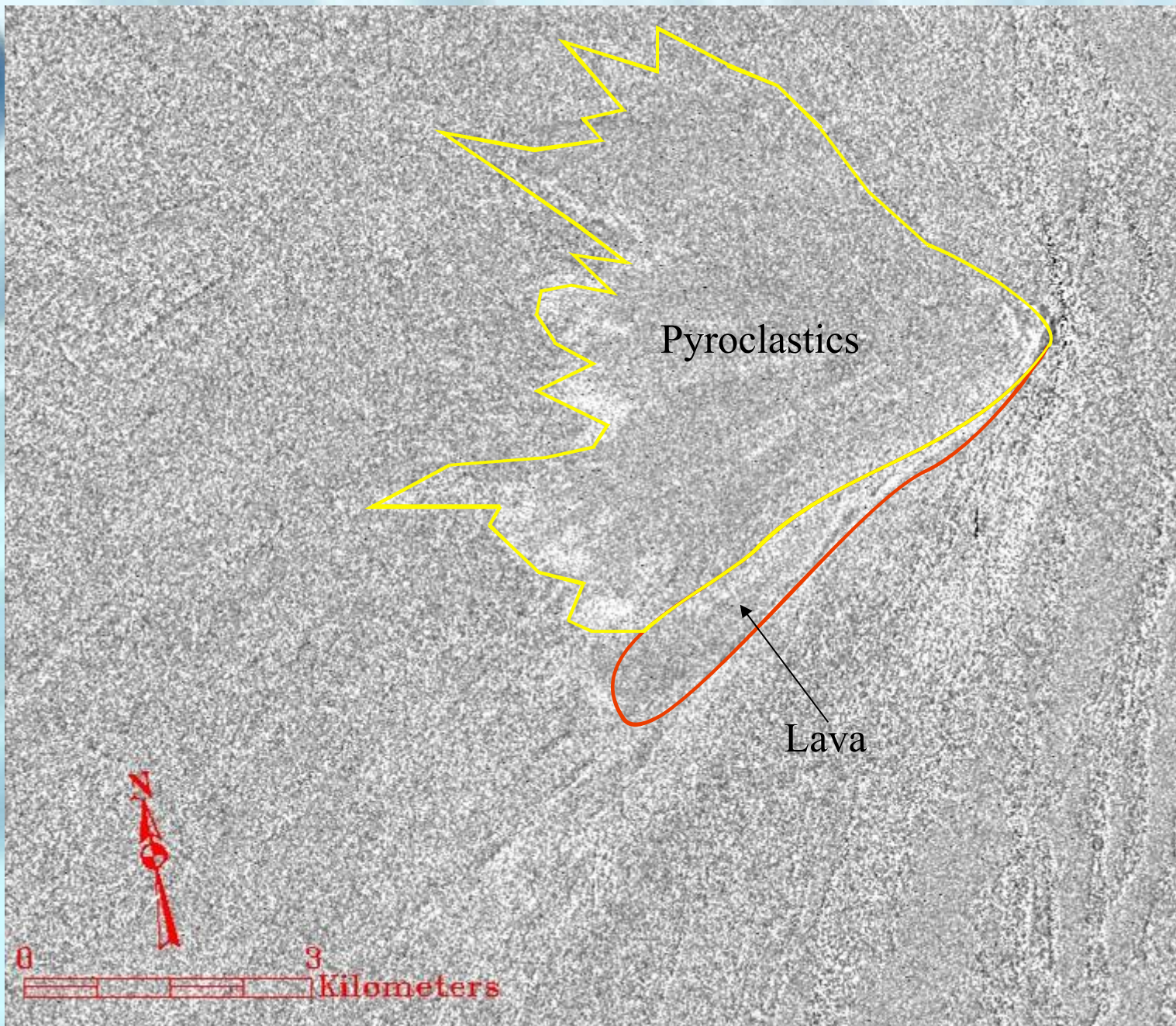


Betanought ( $\beta^\circ$ ) Ratio (2006:2002)



Calculation of RADARSAT SAR intensity image shows the newest volcanic product, spread out from the peak of Mt. Merapi to the west side relatively

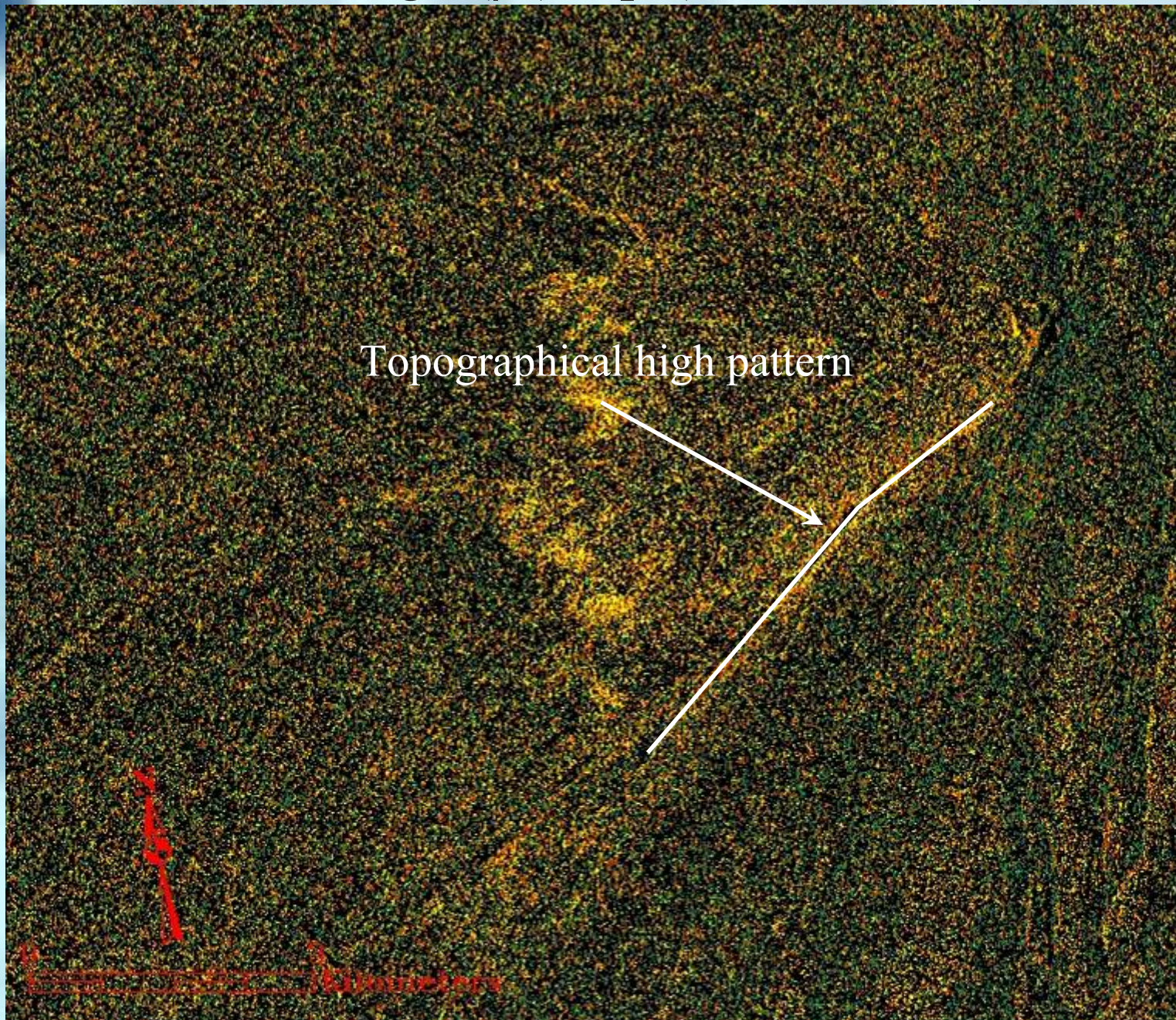




The newest volcanic product consist of lava and pyroclatics



# Betanought( $\beta^\circ$ ) Sqrt( $2006^2 - 2002^2$ )





# Validation result

Thermal Infrared image of probable  
lava flows (surface length  
approximated from SRTM).

2.6 km  
0.9 km

30 May 06 ASTER TIR  
(Night 3AM local time approx.)

1:80,000



1:80,000

2.3 km  
2.6 km

6 June 06 ASTER TIR  
(Day 3PM local time approx.)



1:80,000

3.2 km  
2.6 km

7 June 06 ASTER TIR  
(Night 3AM local time approx.)





# Validation result

False-color image of ash cloud and ejected pyroclastic material on 6 June 2006 (Aster VNIR bands).

Ash cloud drifting SW

Ejection of  
pyroclastic material

Scale: 1:60,000

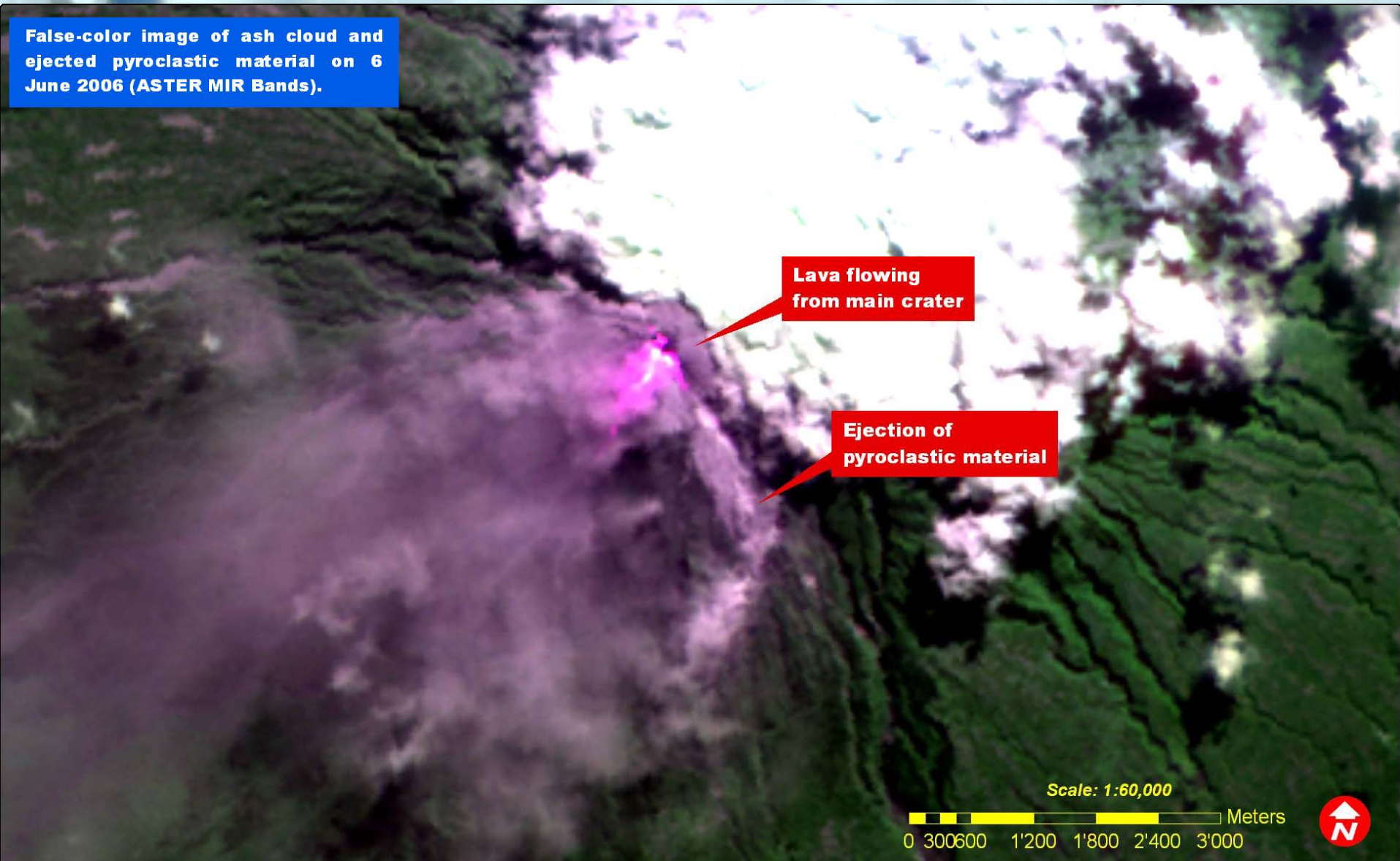
0 300 600 1'200 1'800 2'400 3'000 Meters





# Validation result

False-color image of ash cloud and ejected pyroclastic material on 6 June 2006 (ASTER MIR Bands).





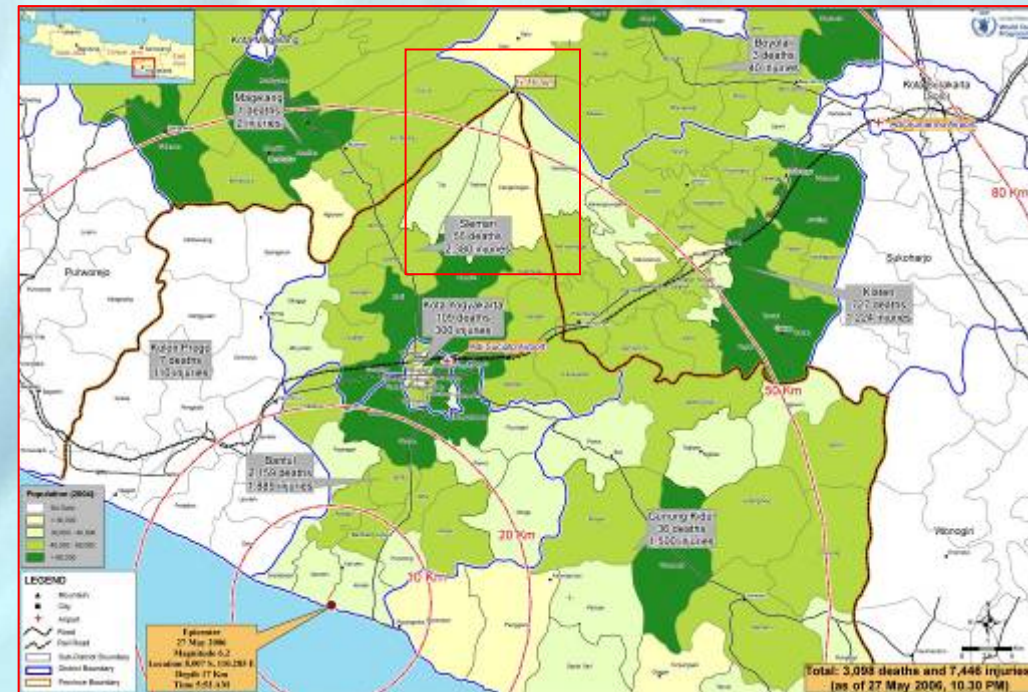
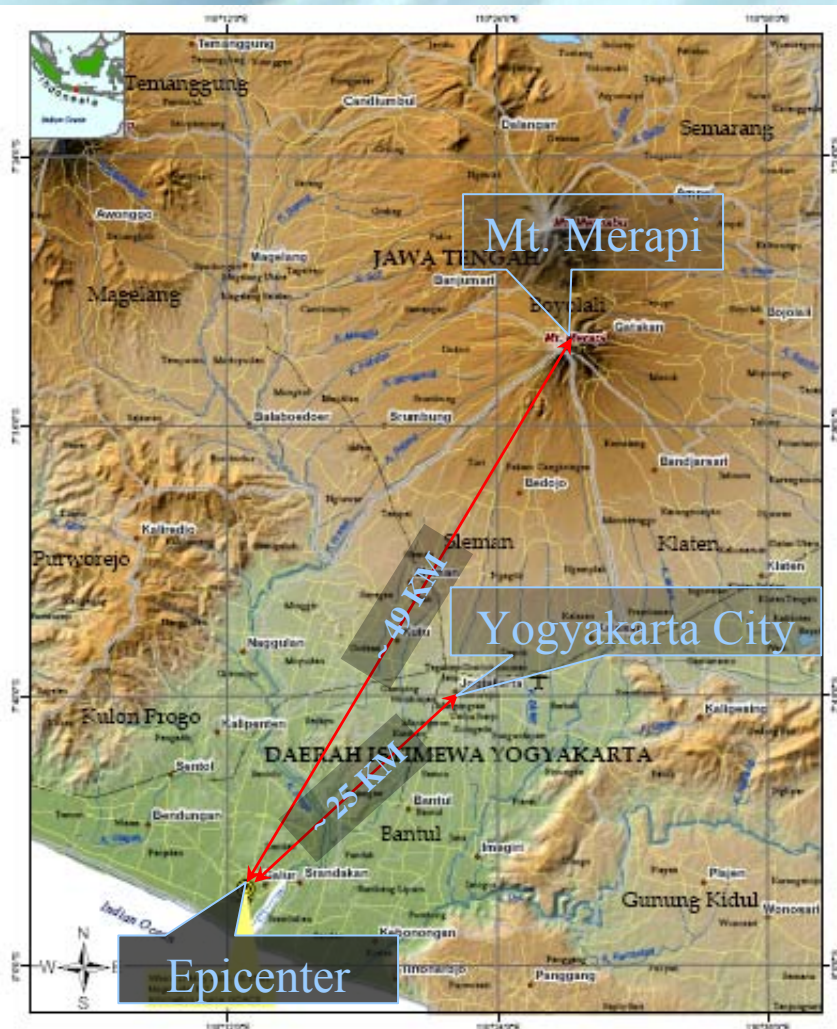
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# Yogyakarta earthquake may 27, 2006

## Mt. Merapi, Yogyakarta, and Epicenter Map

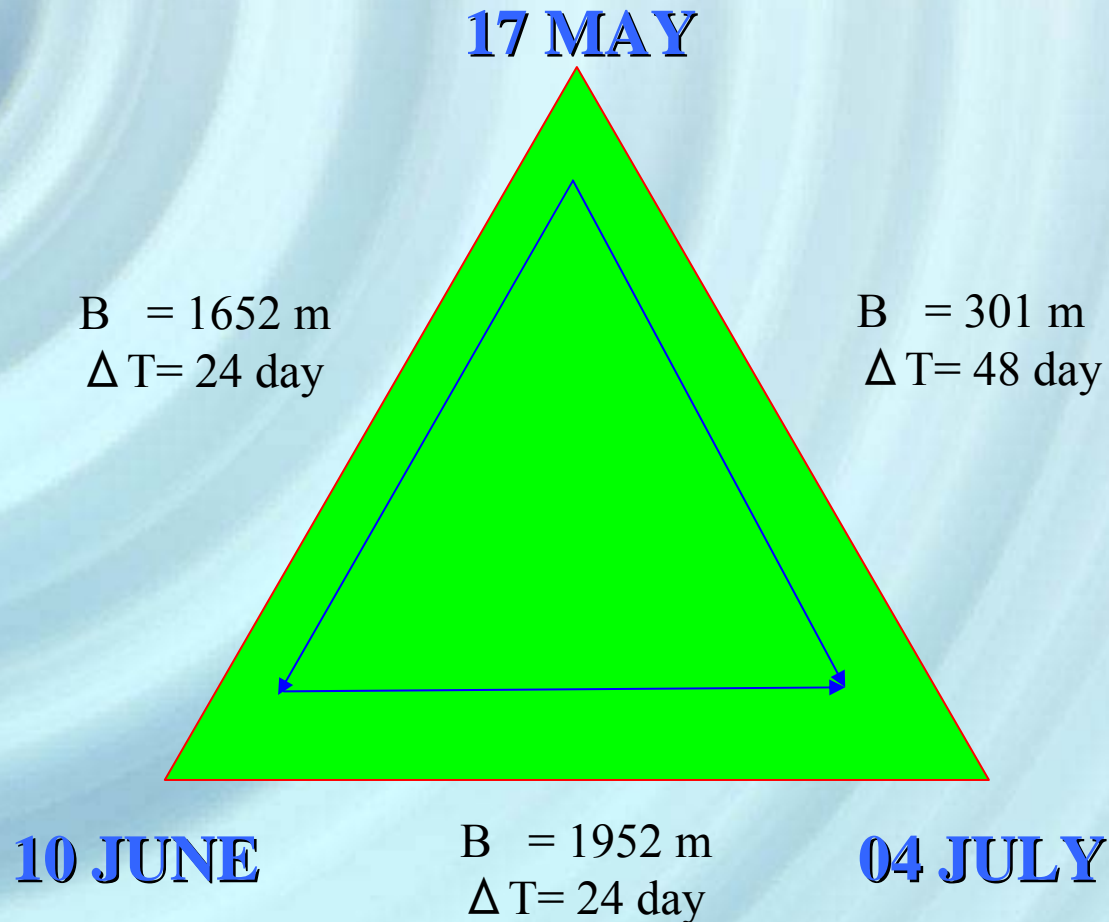


## Map of Earthquake Affected Areas of Yogyakarta and Central Java

Source data: United Nations in Indonesia, available at <http://un.or.id/yogya/index.asp>



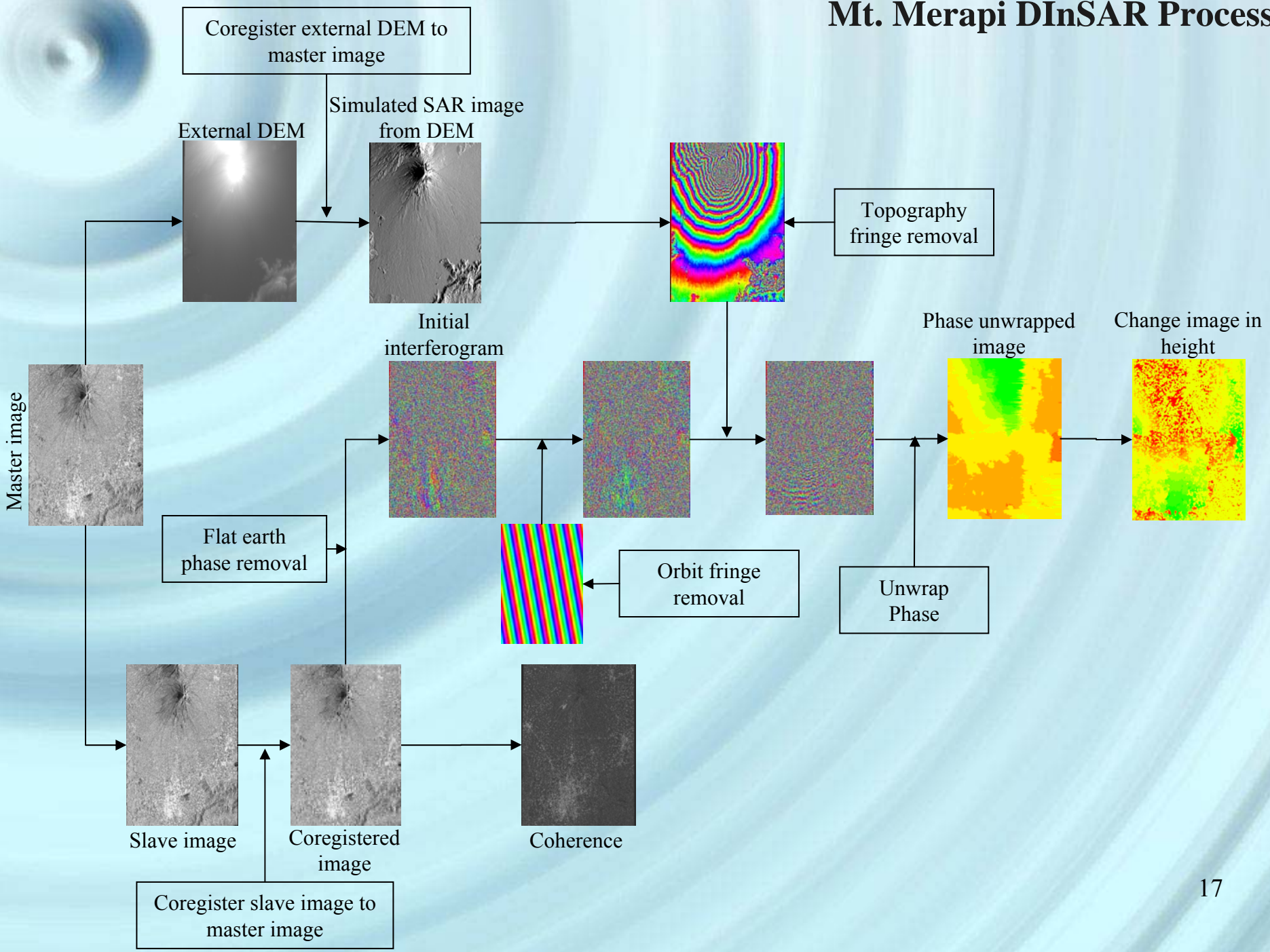
# Evaluation of three phase of RADARSAT SAR images



- ❑ Two problem faced when generate interferogram for analyzing the deformation caused by the earthquake, baseline and time scene between two data
- ❑ Time is the most problem because in the tropical area when rainfall is high makes the change is high too

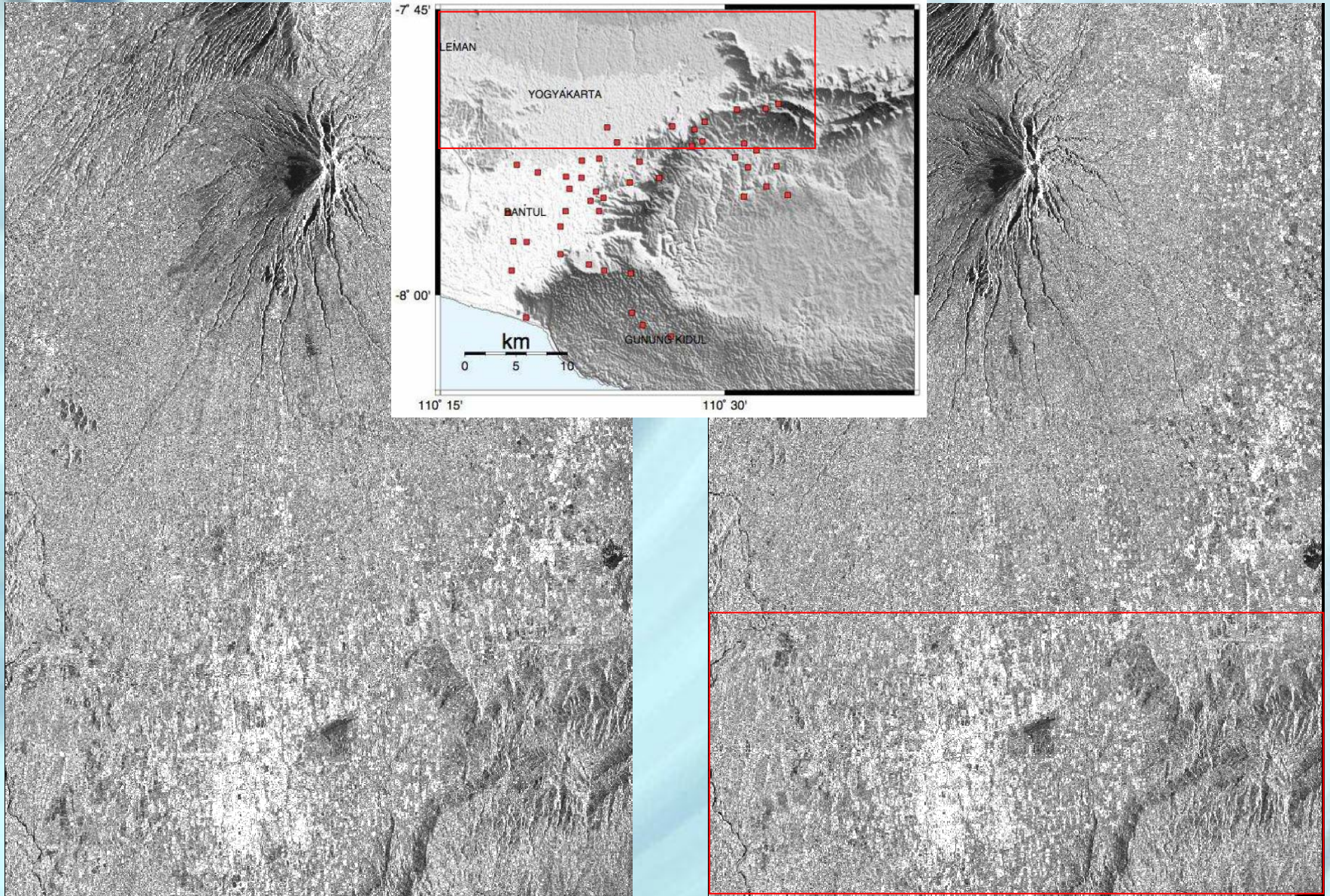


# Mt. Merapi DInSAR Process





# Image pair selection considering temporal time and distance of baseline

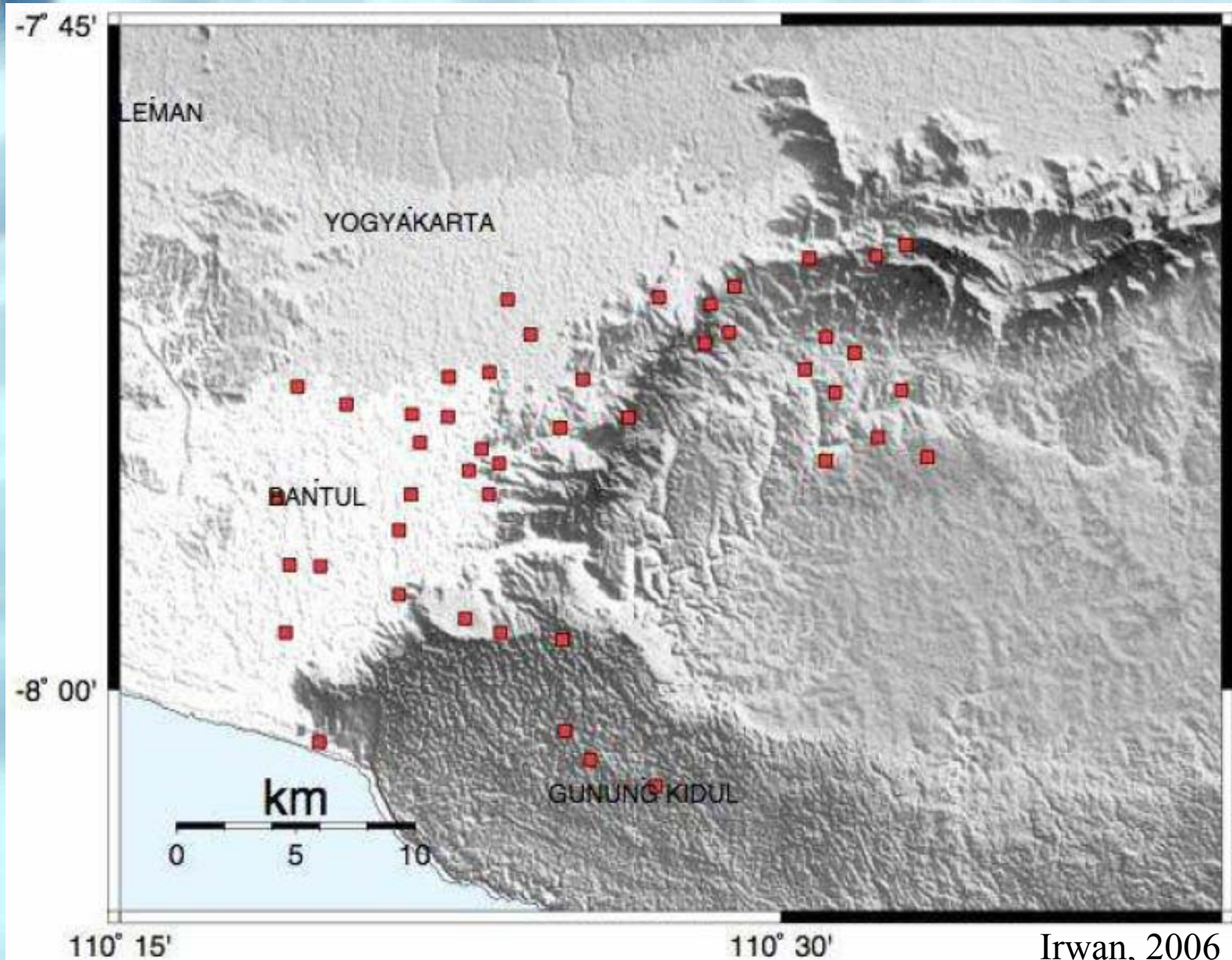


**Master Image,  
17 May 2006**

**Slave Image,  
10 June 2006**

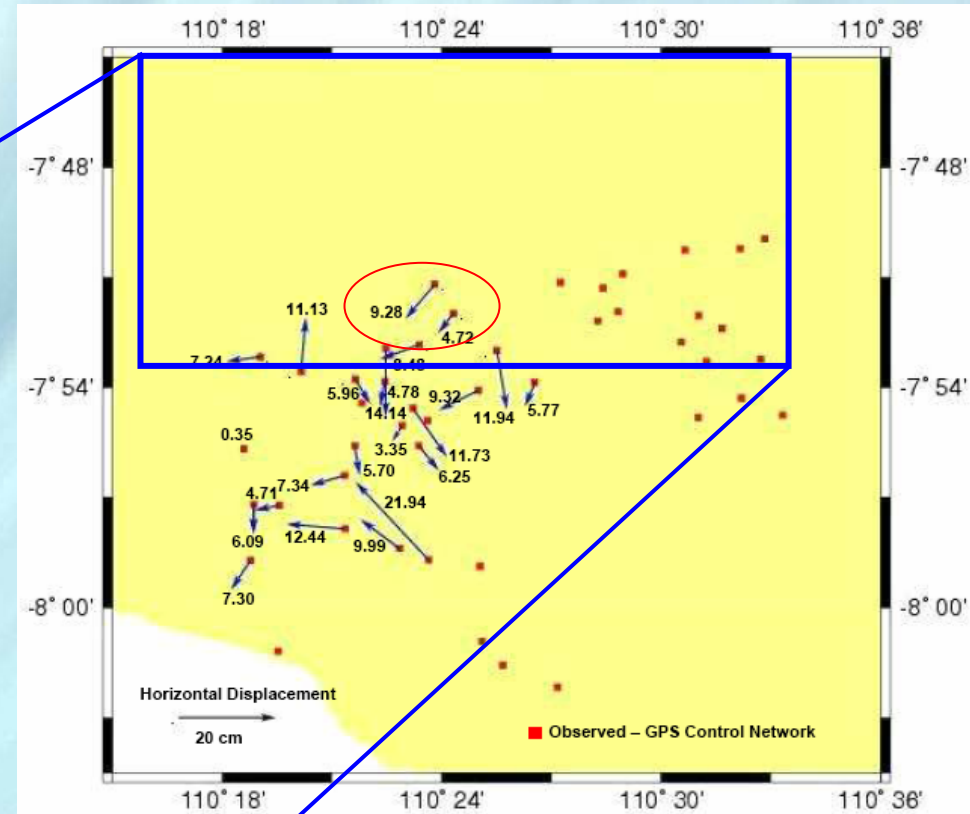


# GPS survey for Yogyakarta networking





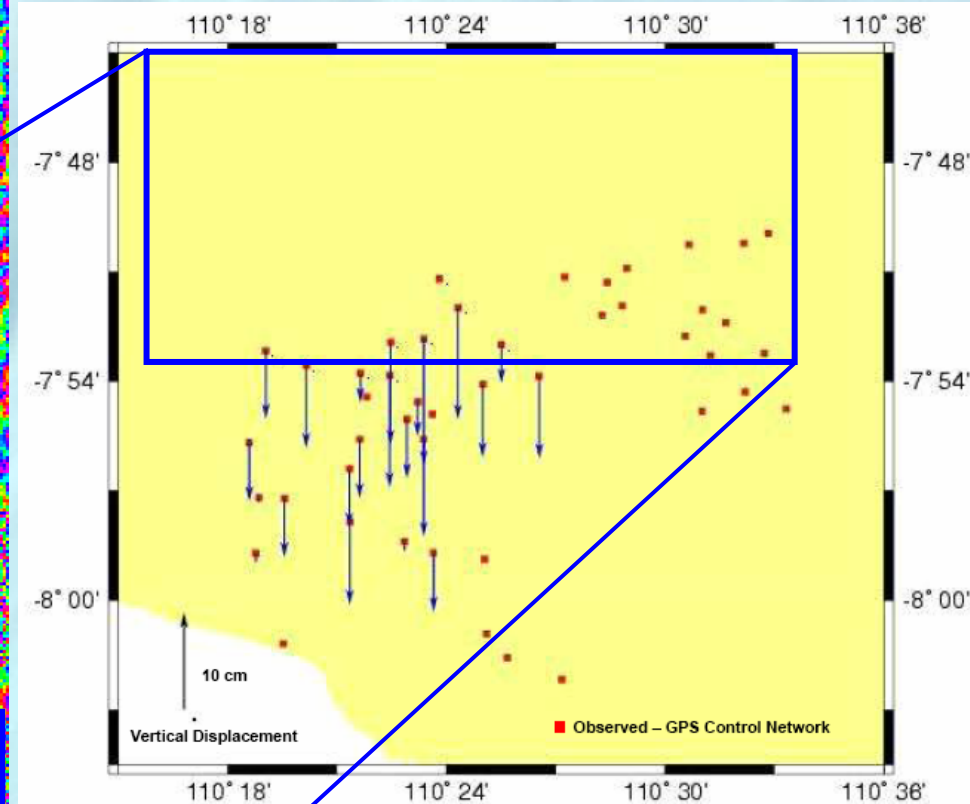
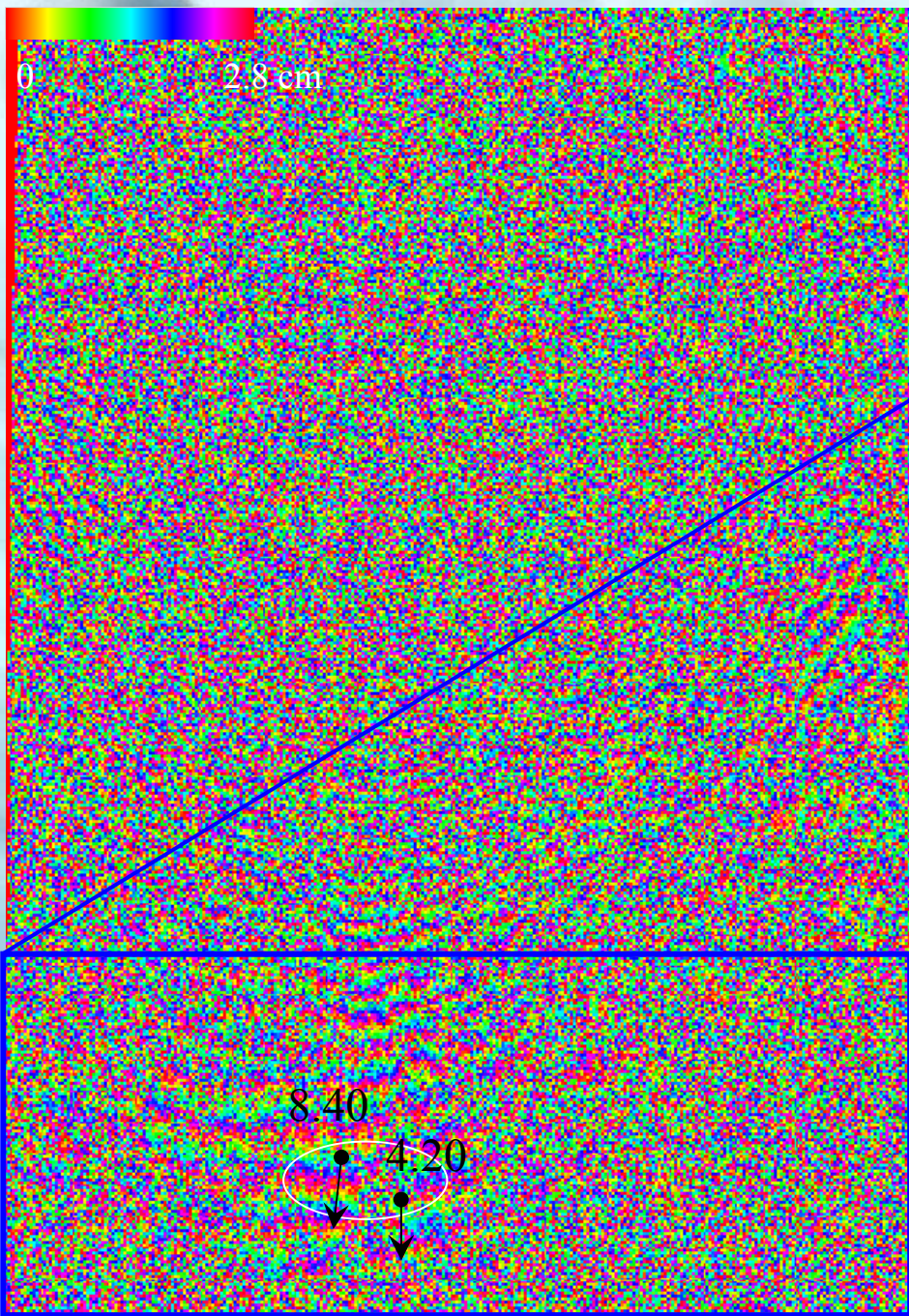
# Horizontal displacement



Irwan, 2006



# Vertical displacement



Irwan, 2006





That's all Thank you...

