Ground deformation associated with the earthquake occurred in Solomon Islands on April 1, 2007 detected by ALOS/PALSAR

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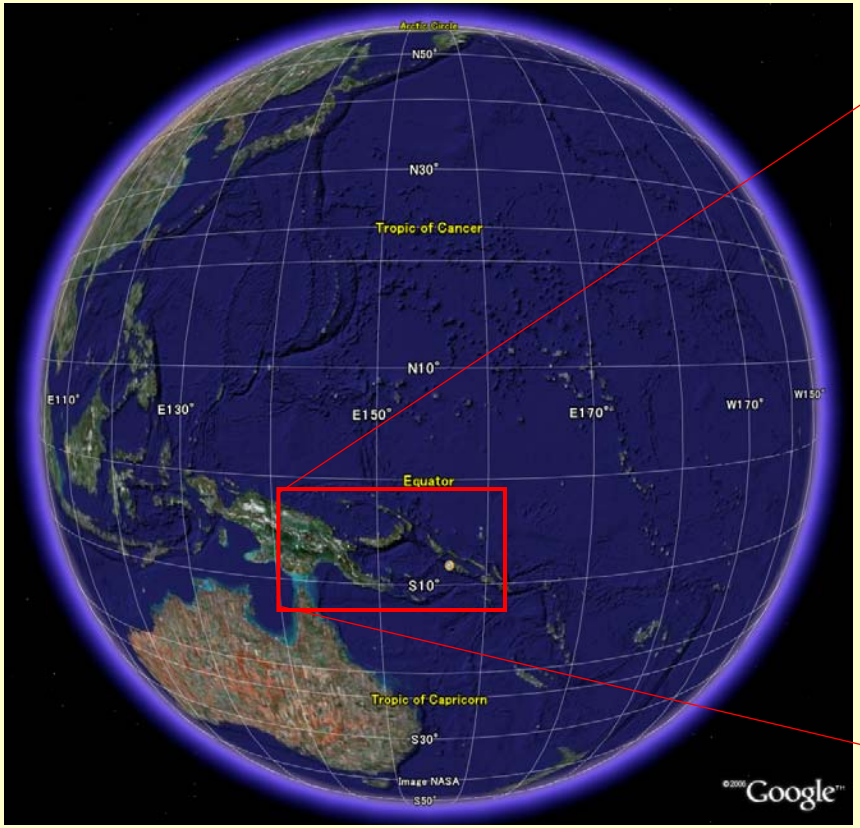
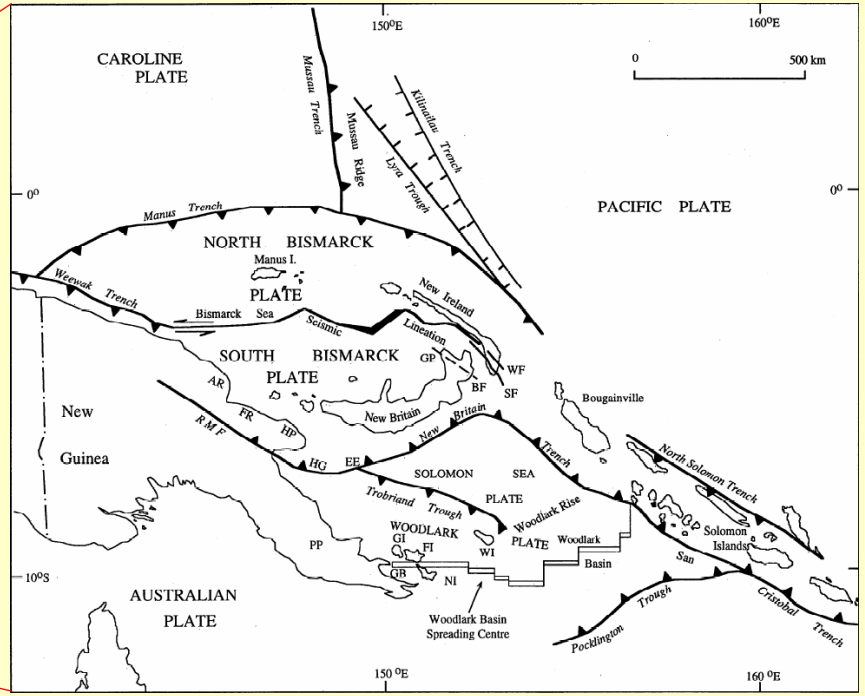
Outline of This Presentation

- M8.1 earthquake in Solomon Islands (April 1, 2007)
- Observation by ALOS/PALSAR
- Field investigation (Comparison with satellite data)
- Ground deformation from DInSAR processing
- Fault modeling
- Post-seismic deformation?
- Summary

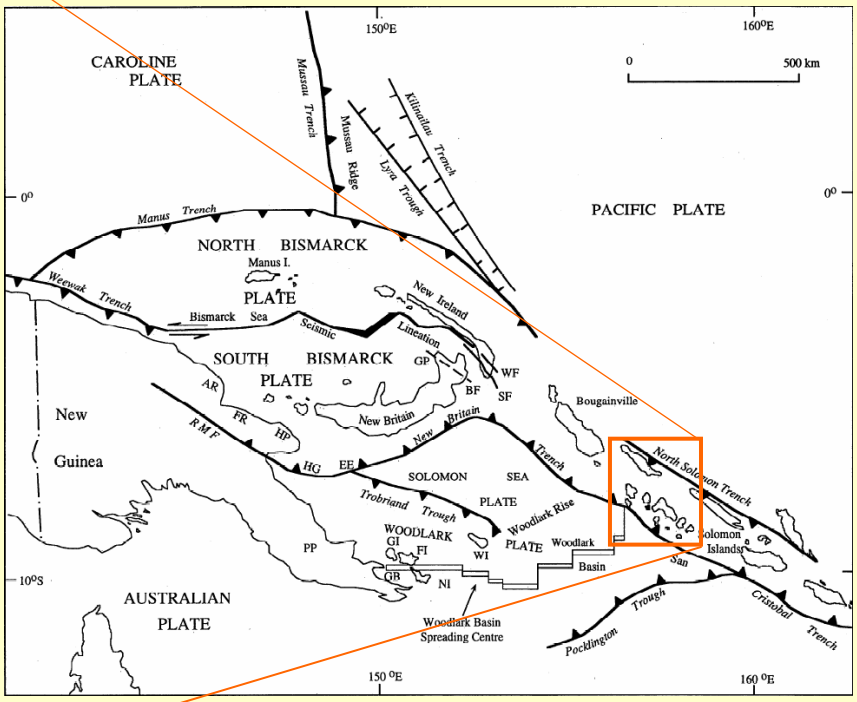
M8.1 Earthquake in Solomon Islands (April 1, 2007 (UTC))





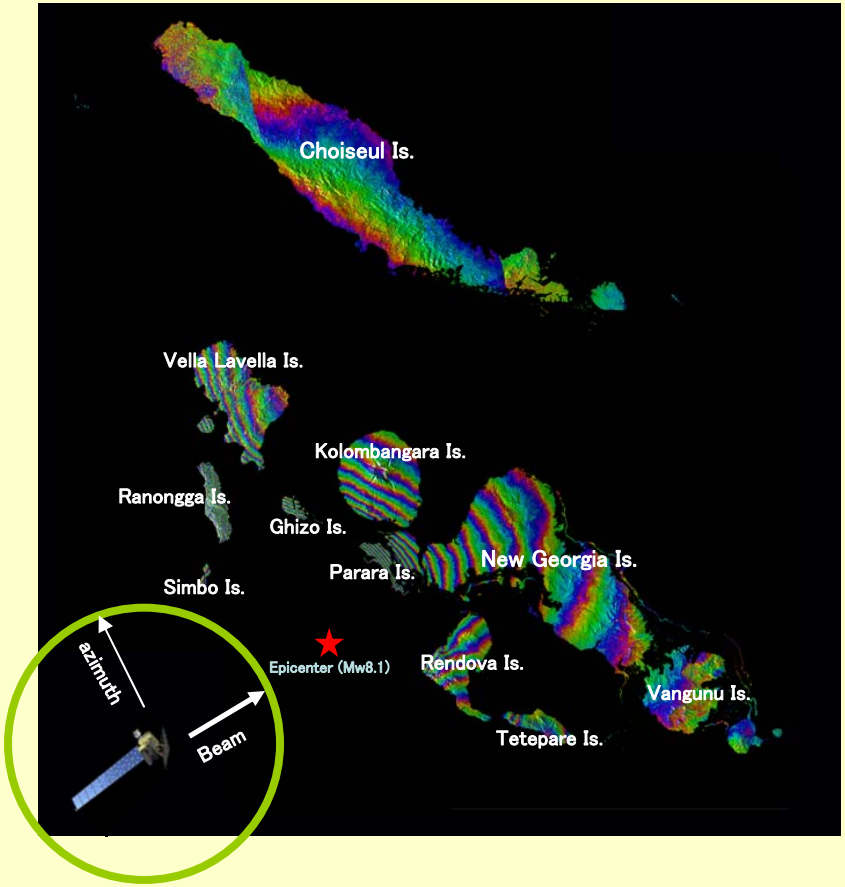
Tregoning et al., JGR, 1998

M8.1 Earthquake in Solomon Islands (April 1, 2007 (UTC))



Tregoning et al., JGR, 1998

Importance of remote sensing (PALSAR) data in remote locations



- A remote sensing technique has advantage to observe and monitor a disaster occurred in a remote location.
- PALSAR can acquire so many data, and the data can be applied to DInSAR technique.

Importance of ground truth for verification

- A remote sensing technique has advantage to observe and monitor a disaster occurred in a remote location.
- PALSAR can acquire so many data, and the data can be applied to DInSAR technique.
- Field investigation is helpful for verification (if it is possible).

(Field investigation during July 25-30, 2007)

*Parara Island **before** the earthquake*

(March 1, 2007: low tide ~0.1m)

*Parara Island **after** the earthquake*

(April 16, 2007: middle tide ~0.5m)

Slight increase of land area in spite of rising of tide level for the period.

*Parara Island **after** the earthquake*

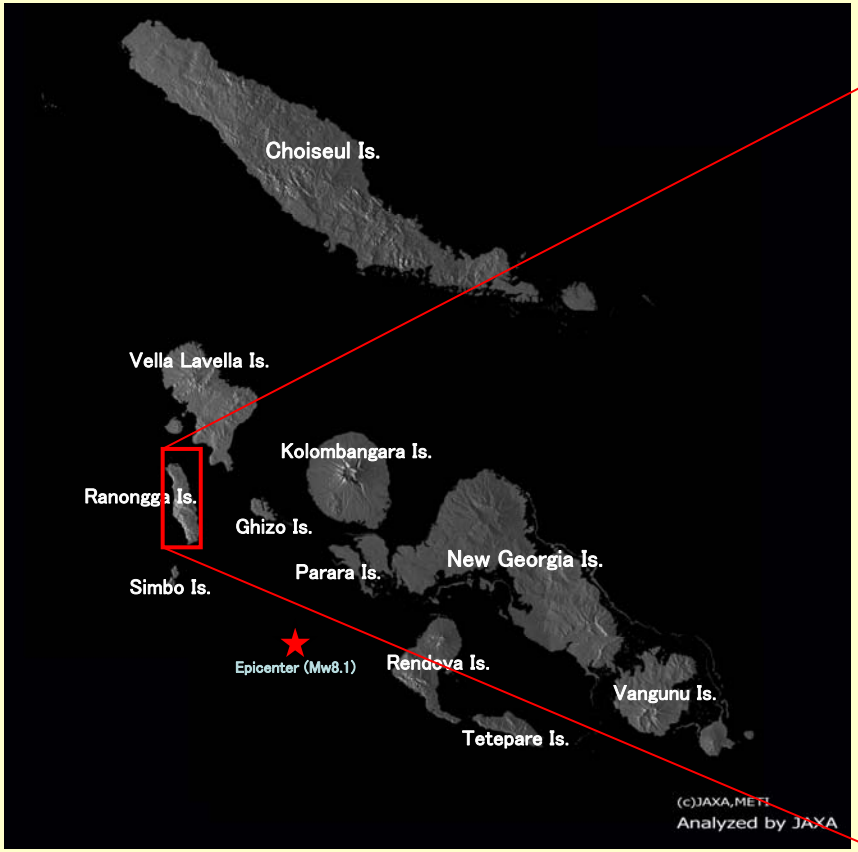
(July 25, 2007)

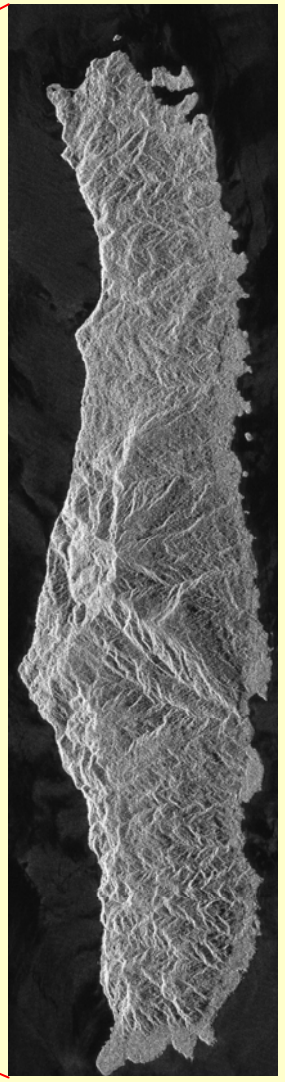
(April 16, 2007: middle tide ~0.5m)

From the field investigation, we could confirm that uplift of coral reef around Parara Island.

*Ranongga Island **before** the earthquake*

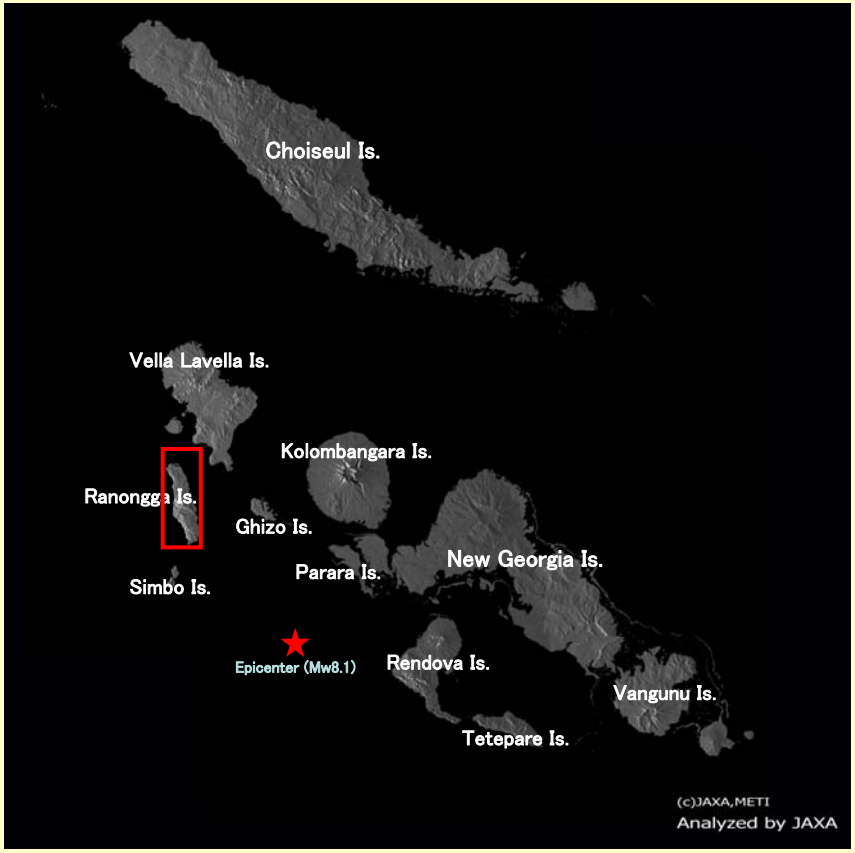
(January 31, 2007: low tide ~0.1m)

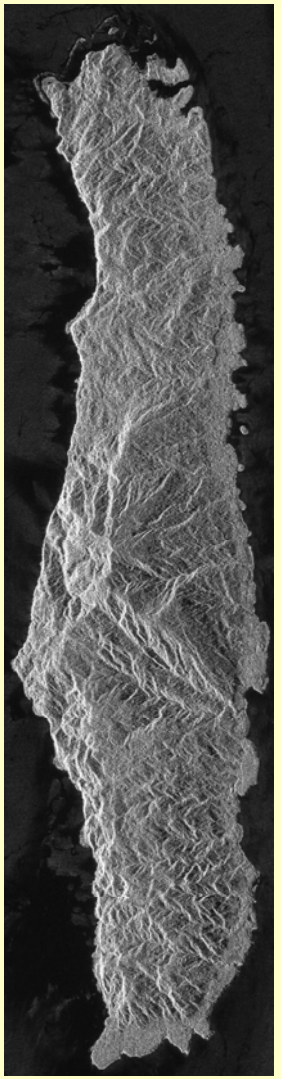




*Ranongga Island **after** the earthquake*

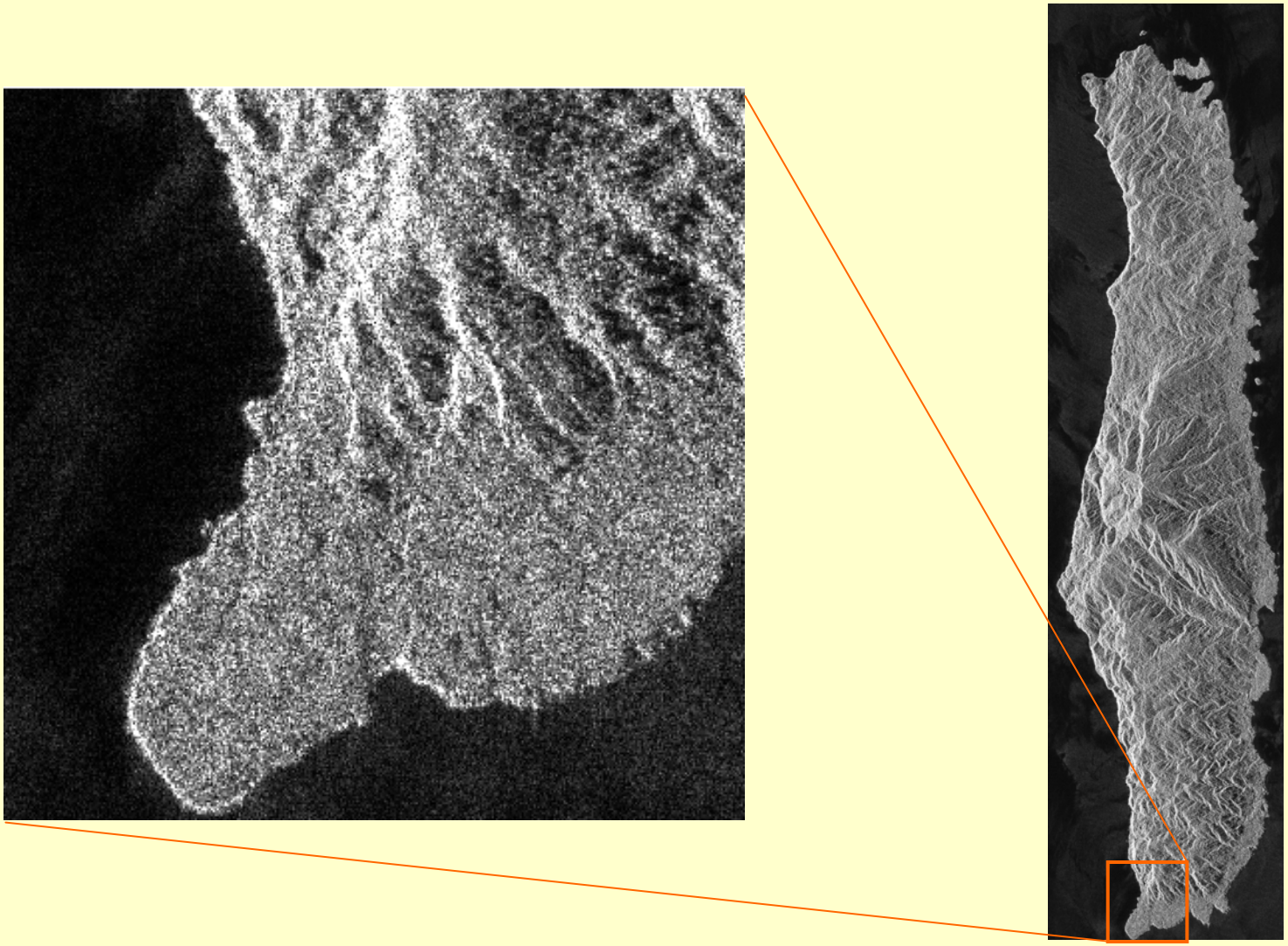
(May 3, 2007: high tide ~0.7m)





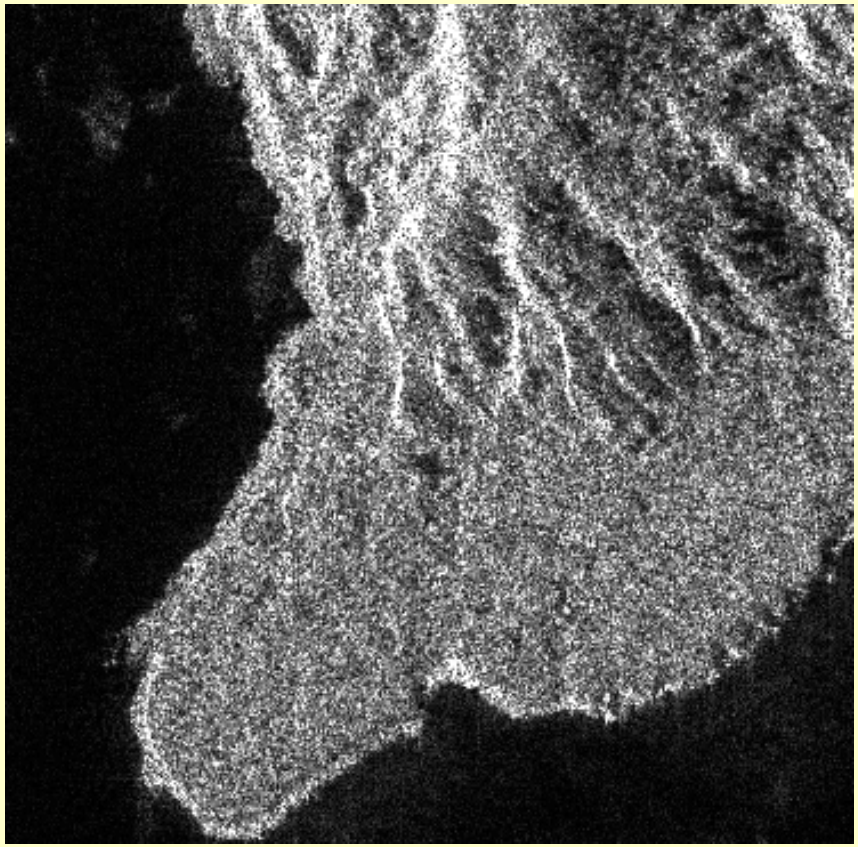
*Ranongga Island **before** the earthquake*

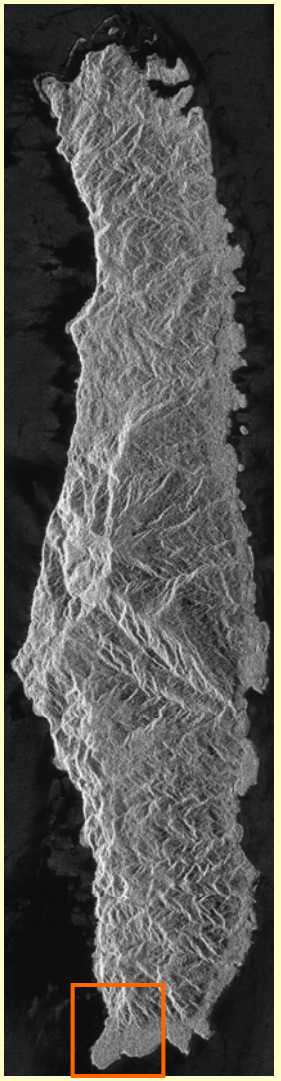
(January 31, 2007: low tide ~0.1m)



*Ranongga Island **after** the earthquake*

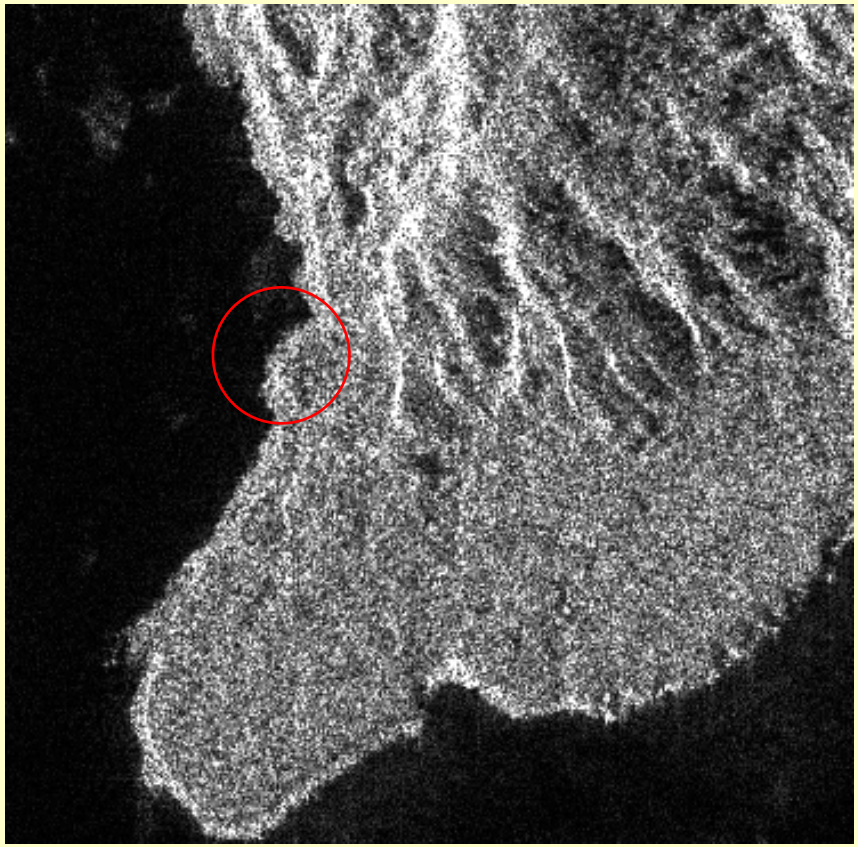
(May 3, 2007: high tide ~0.7m)





*Ranongga Island **after** the earthquake*

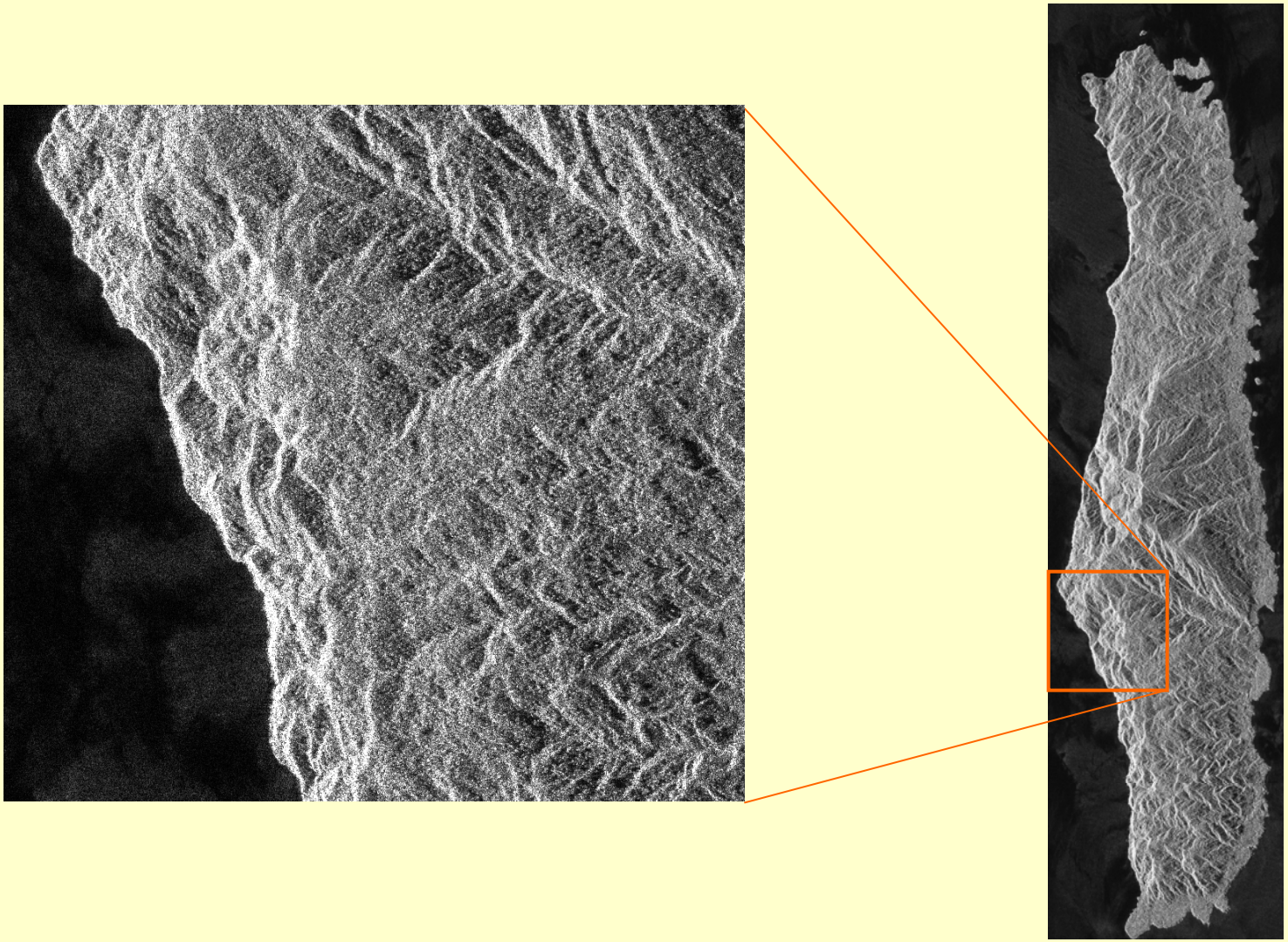
Significant uplift in the south part of Ranongga



(July 28, 2007)

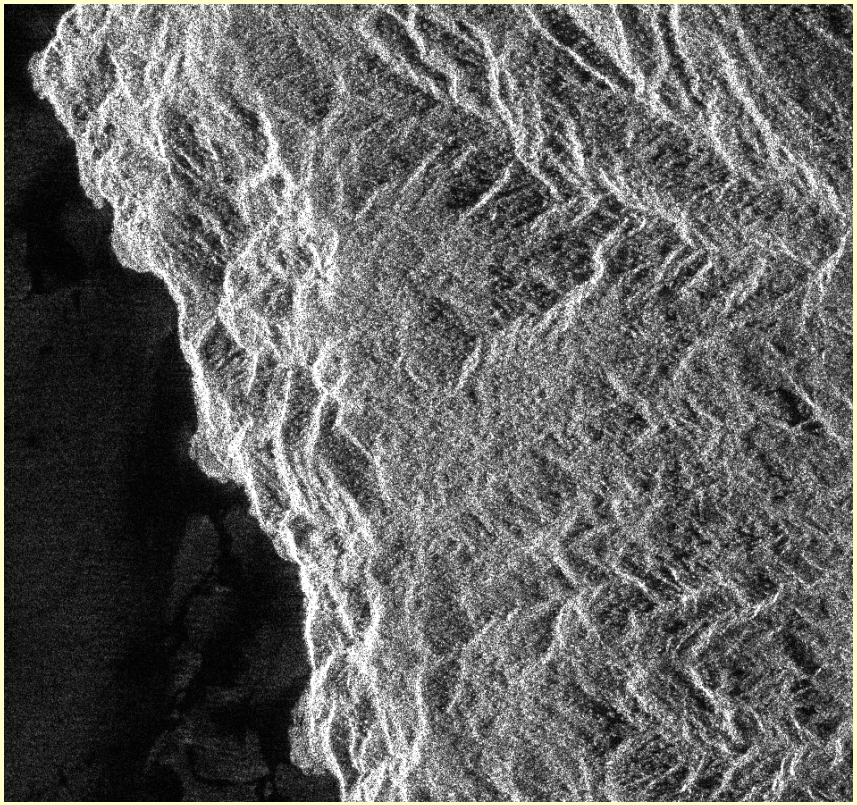
*Ranongga Island **before** the earthquake*

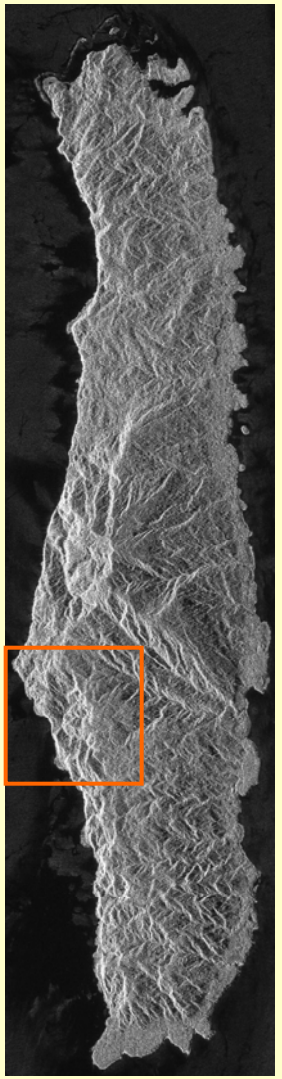
(January 31, 2007: low tide ~0.1m)



*Ranongga Island **after** the earthquake*

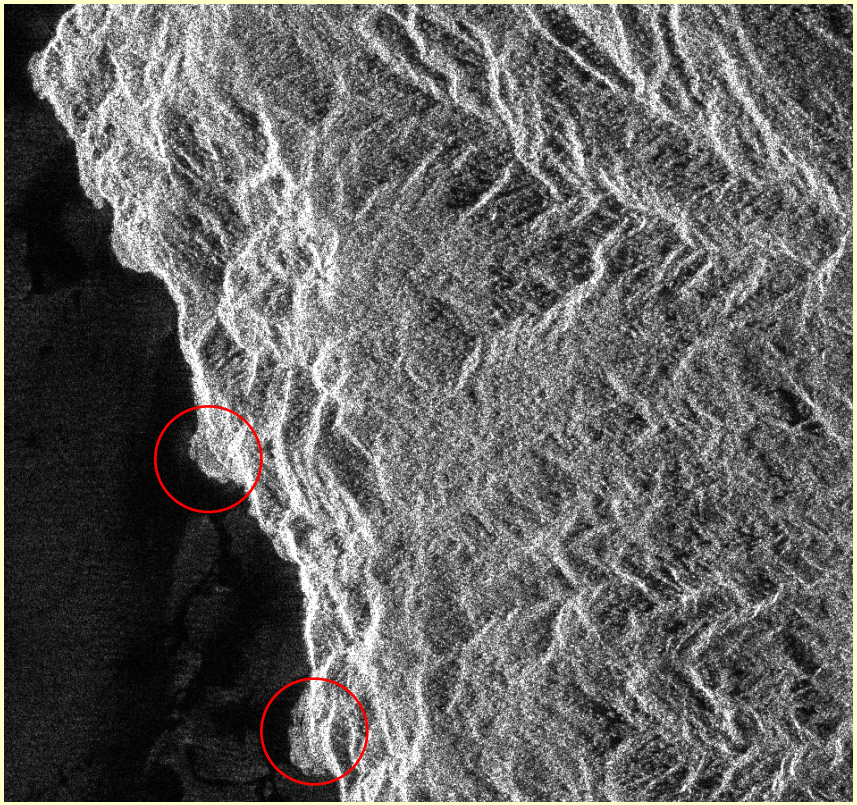
(May 3, 2007: high tide ~0.7m)





*Ranongga Island **after** the earthquake*

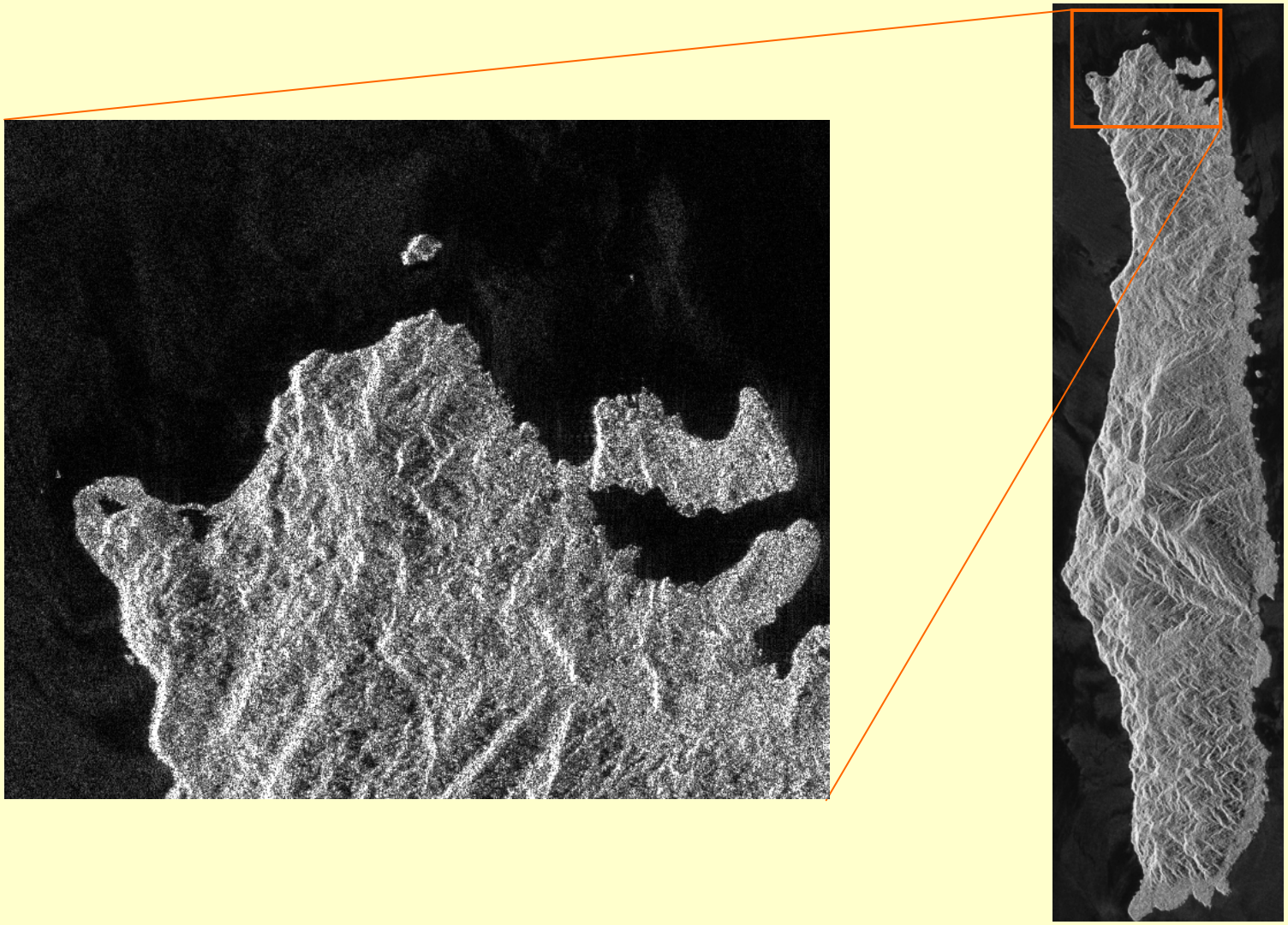
Many landslides or mudslides in the west coast of Ranongga.



(July 28, 2007)

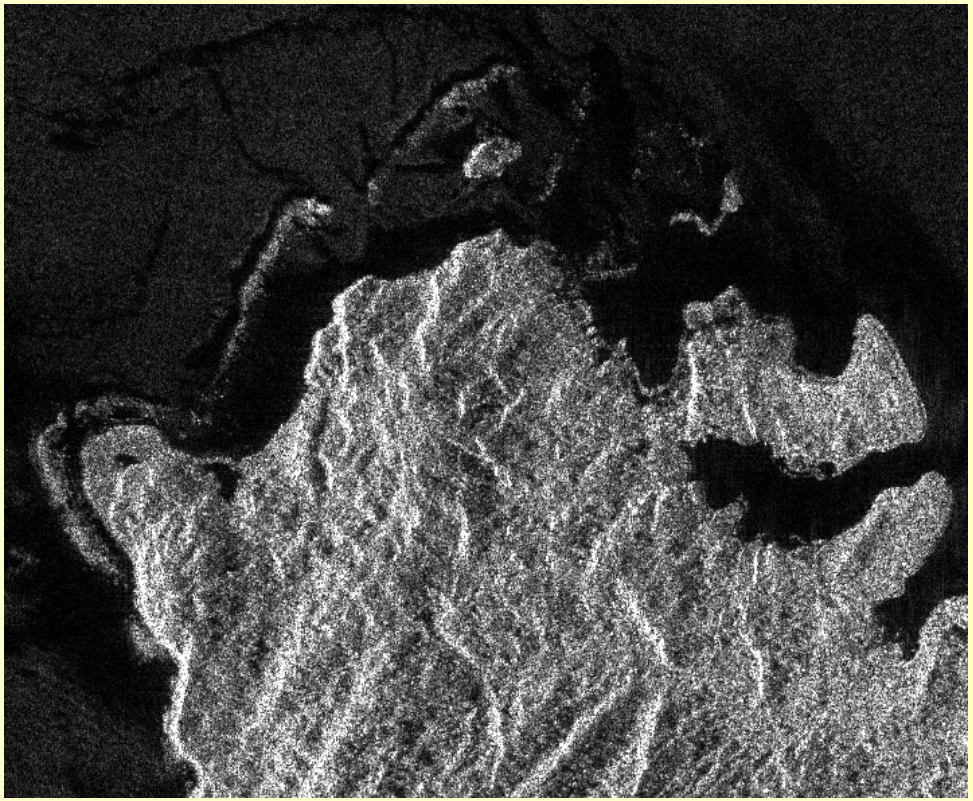
*Ranongga Island **before** the earthquake*

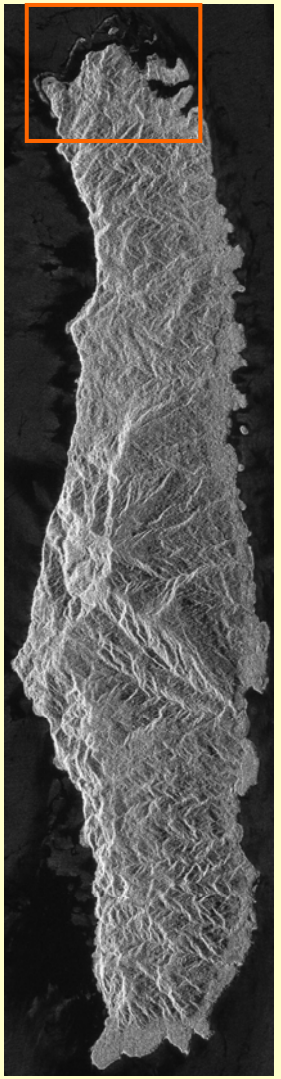
(January 31, 2007: low tide ~0.1m)



*Ranongga Island **after** the earthquake*

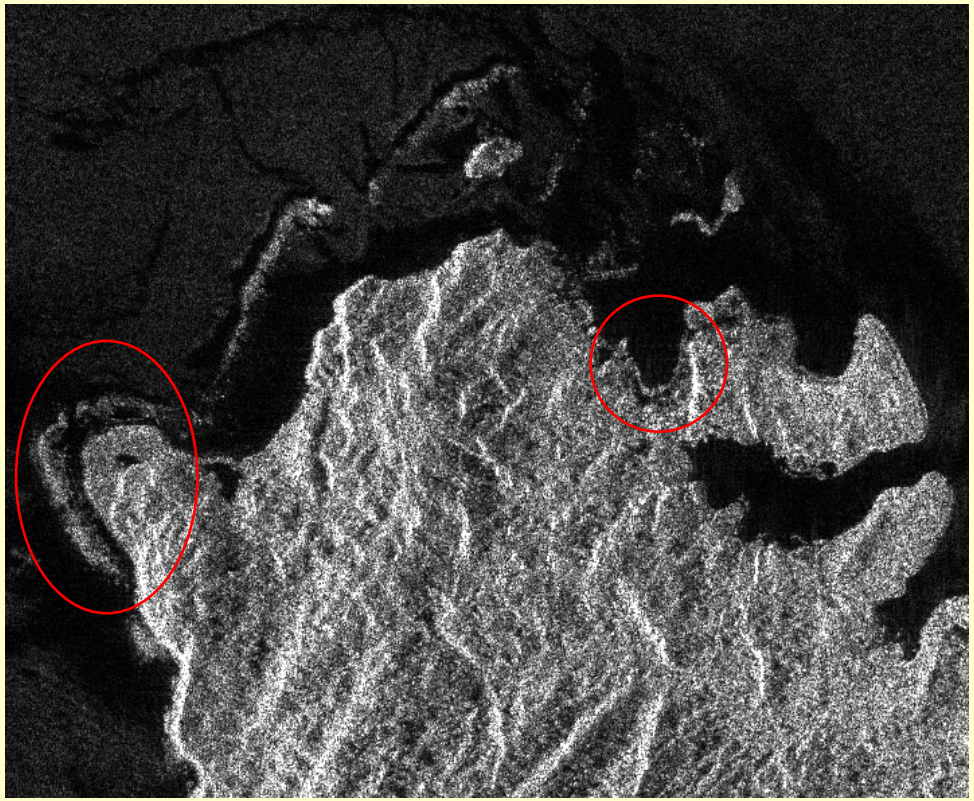
(May 3, 2007: high tide ~0.7m)





*Ranongga Island **after** the earthquake*

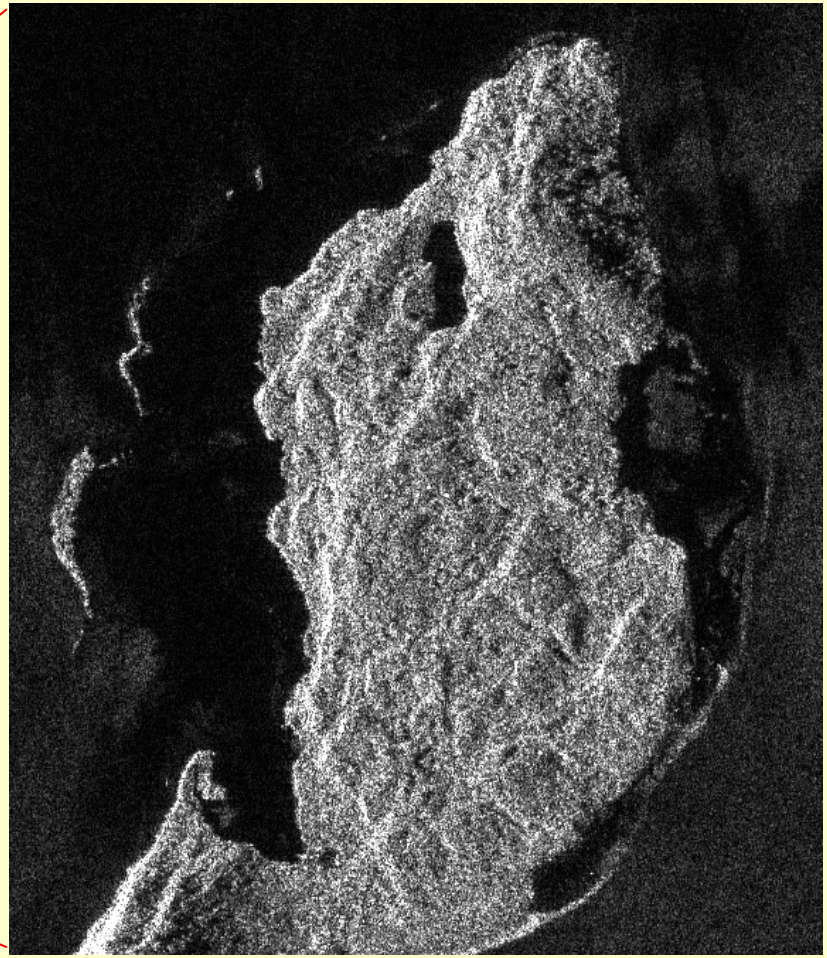
Significant uplifts in the north part of Ranongga



(July 28, 2007)

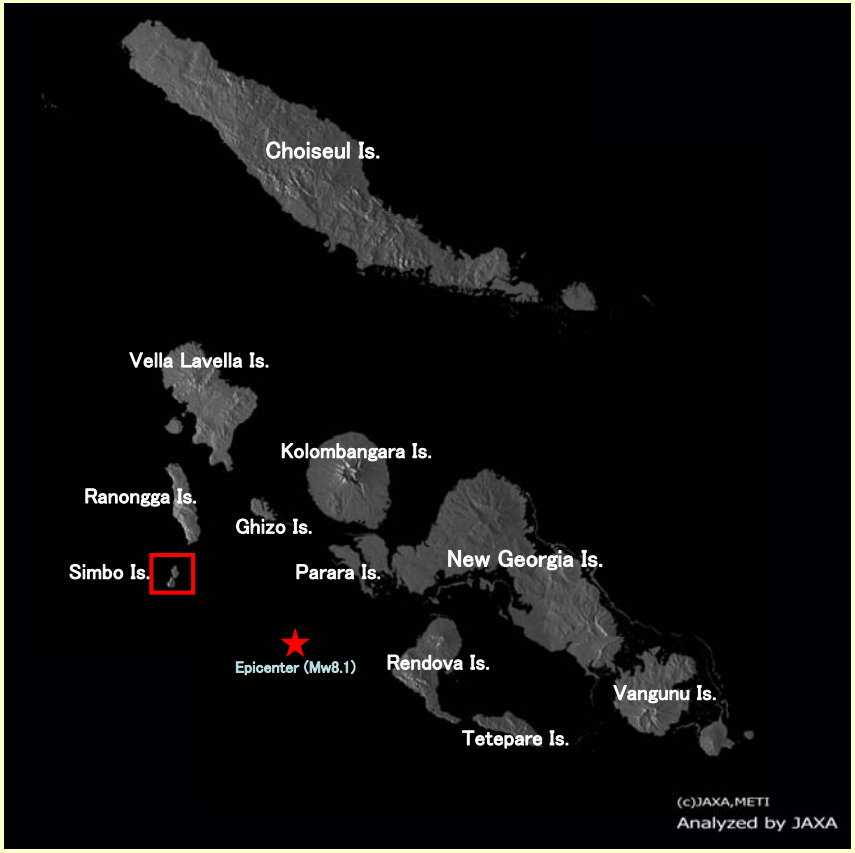
*Simbo Island **before** the earthquake*

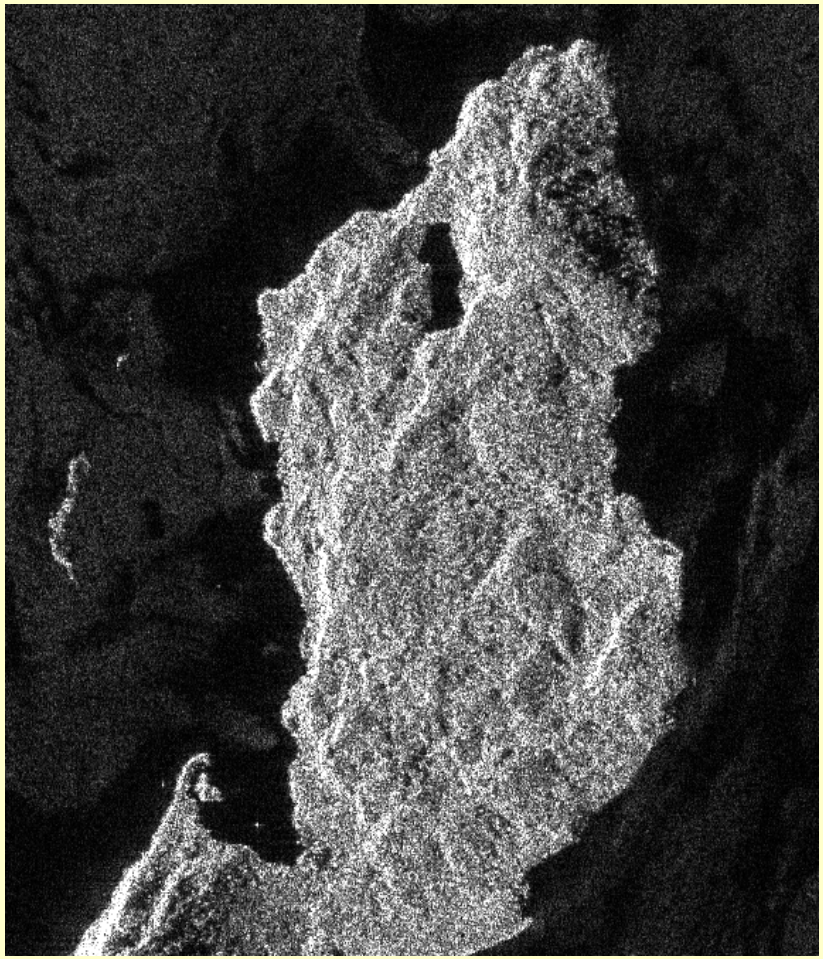
(January 31, 2007: low tide ~0.1m)



*Simbo Island **after** the earthquake*

(May 3, 2007: high tide ~0.7m)

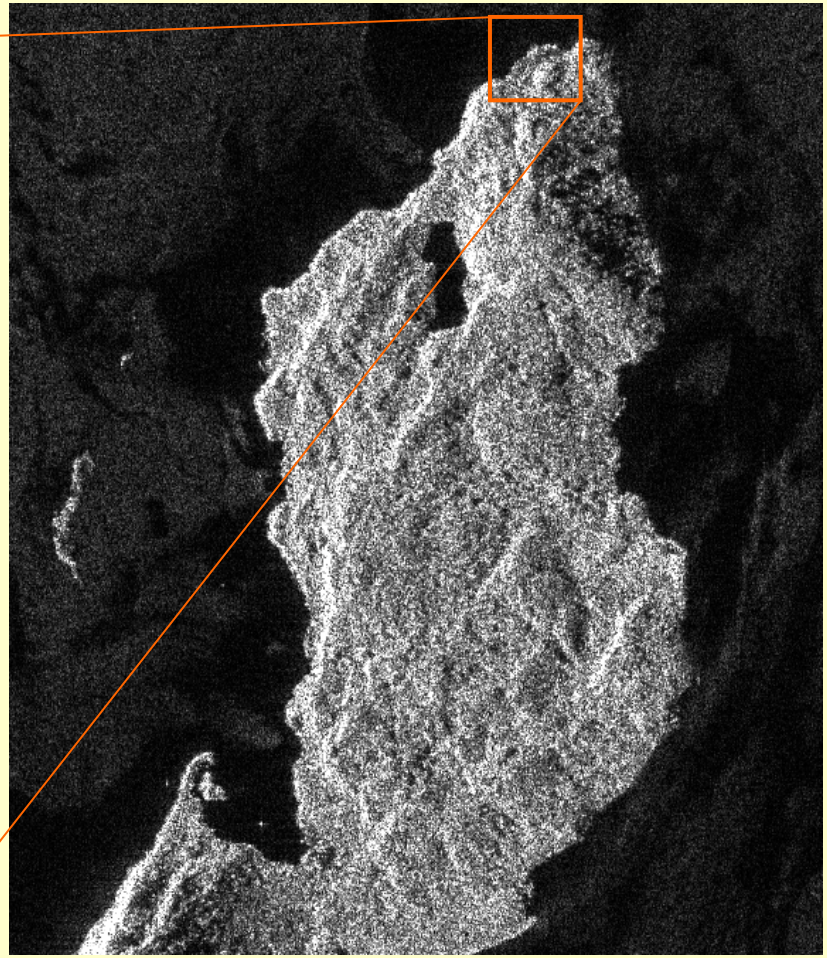




Tsunami damages at Tapurai

(north part of Simbo Island)

Tapurai



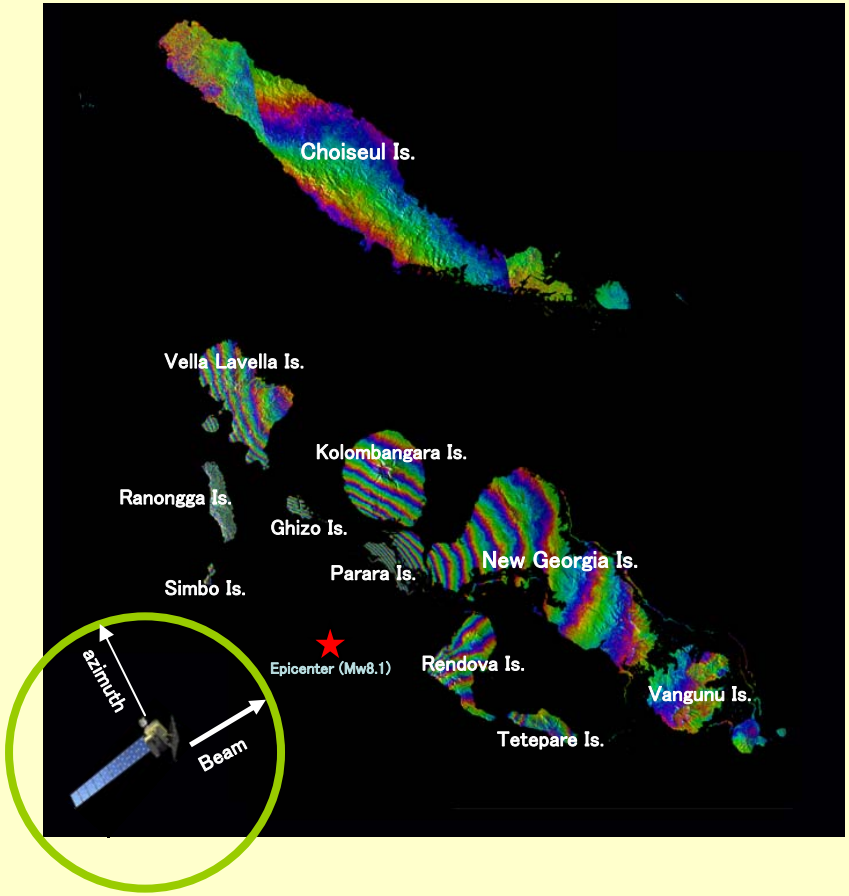
Tsunami damages at Tapurai

(north part of Simbo Island)

Tapurai

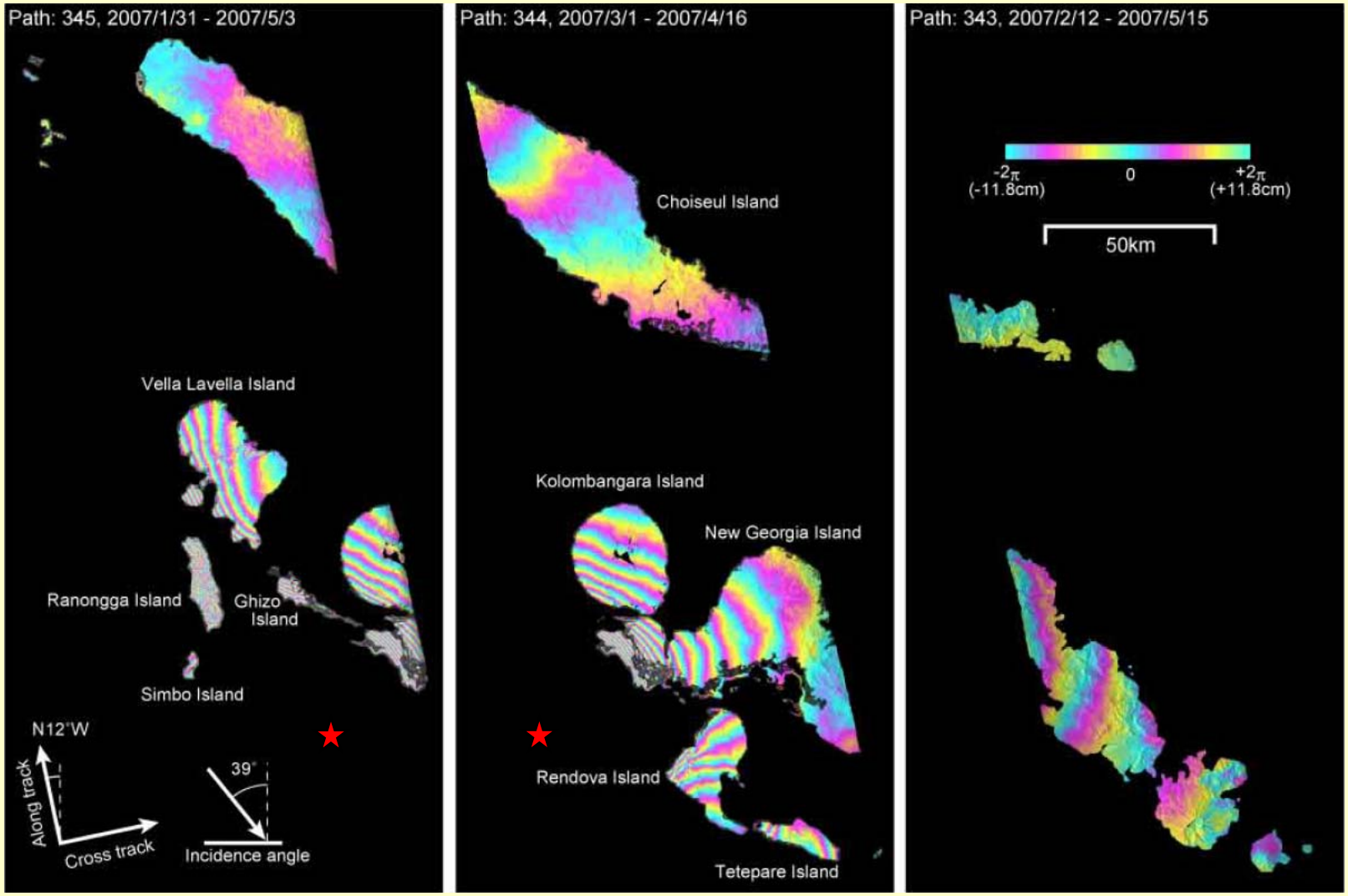
(July 28, 2007)

Importance of remote sensing (PALSAR) data in remote locations

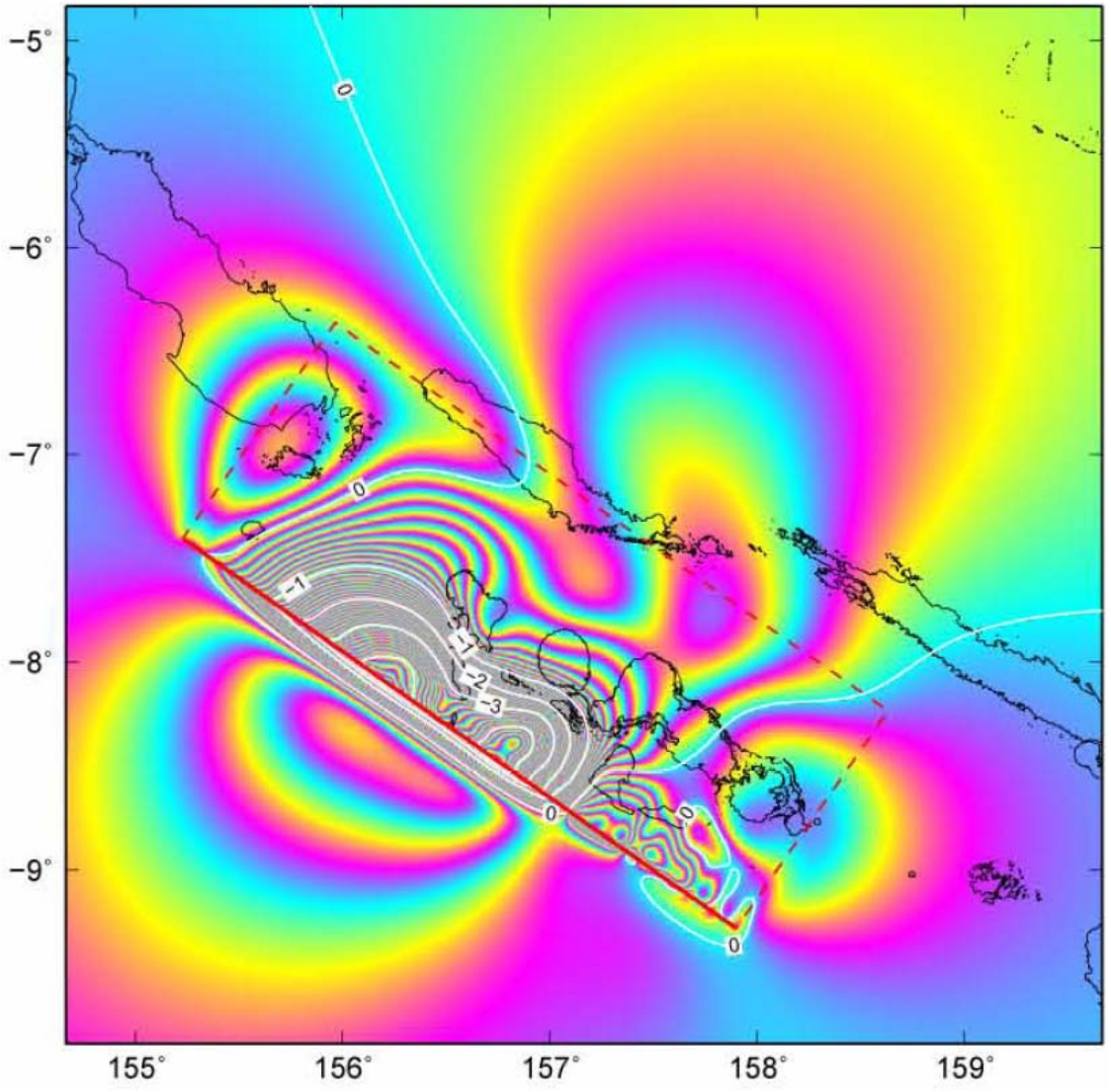


- Big uplift in Ranongga, and no uplift or subsidence and significant damage from tsunami in Simbo. There may be boundary of uplift and subsidence between them.
- From just comparison of amplitude images, we can see that something occurred or the pattern of phenomena. However we can't understand what it is or how it is.
- Ground movements resulted from DInSAR technique are quite precise, and can be used for quantitative discussion.

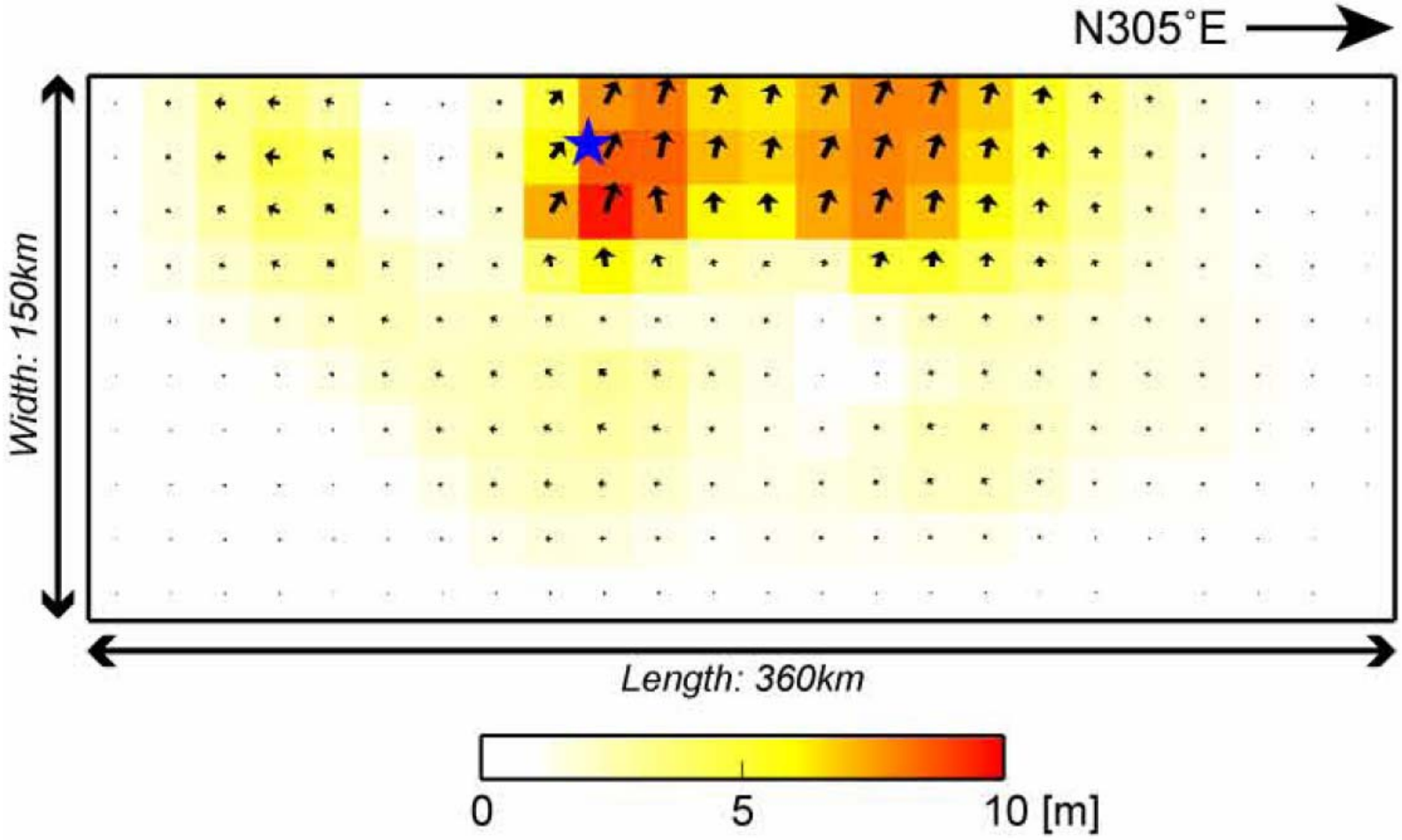
PALSAR Interferometric Images



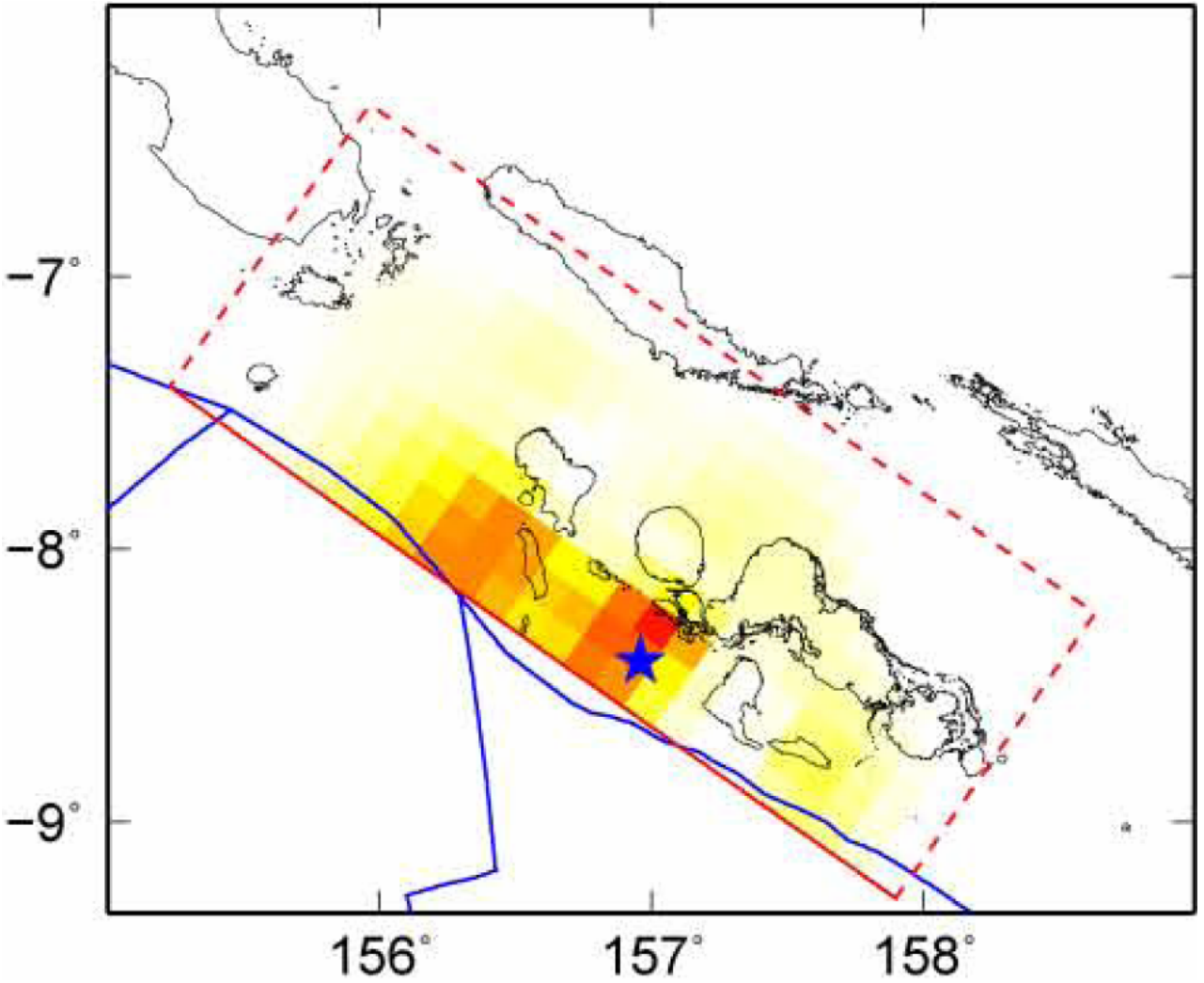
Fault modeling (Preliminary)



Slip Distribution

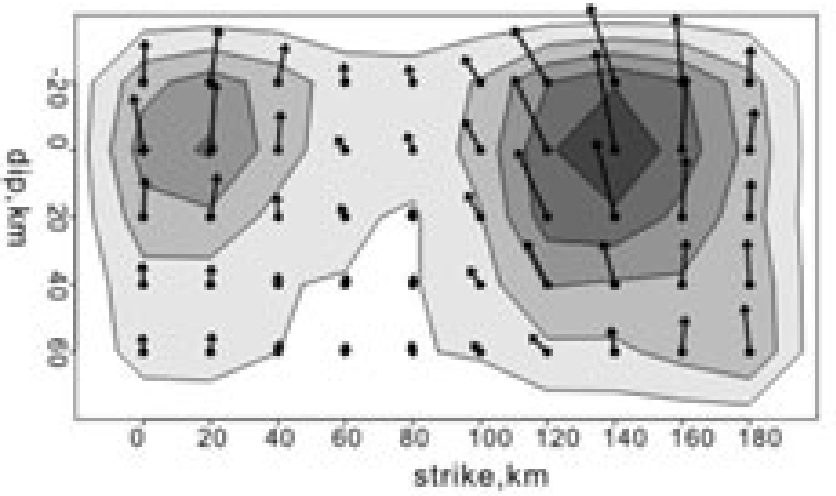


Slip Distribution



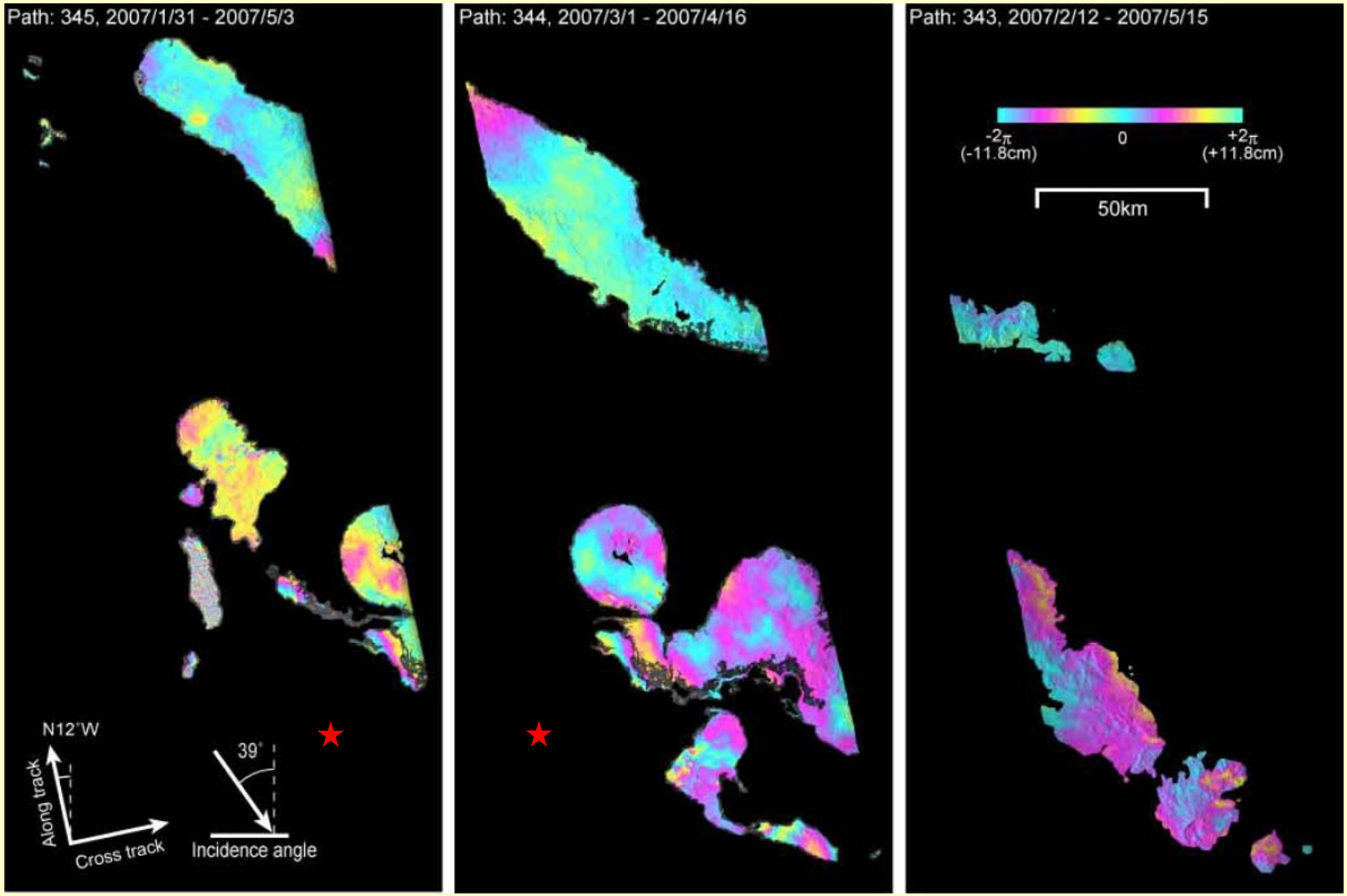
Fault modeling using seismic data

http://www.seis.nagoya-u.ac.jp/sanchu/Seismo_Note/2007/RSVD1.html



Yamanaka (2007) also inferred slip distribution using teleseismic body wave data. The pattern that there are two eyed large slip area around the hypocenter and the northwest of it, is consistent with those induced from just DInSAR data.

Residuals between obs. and calc.

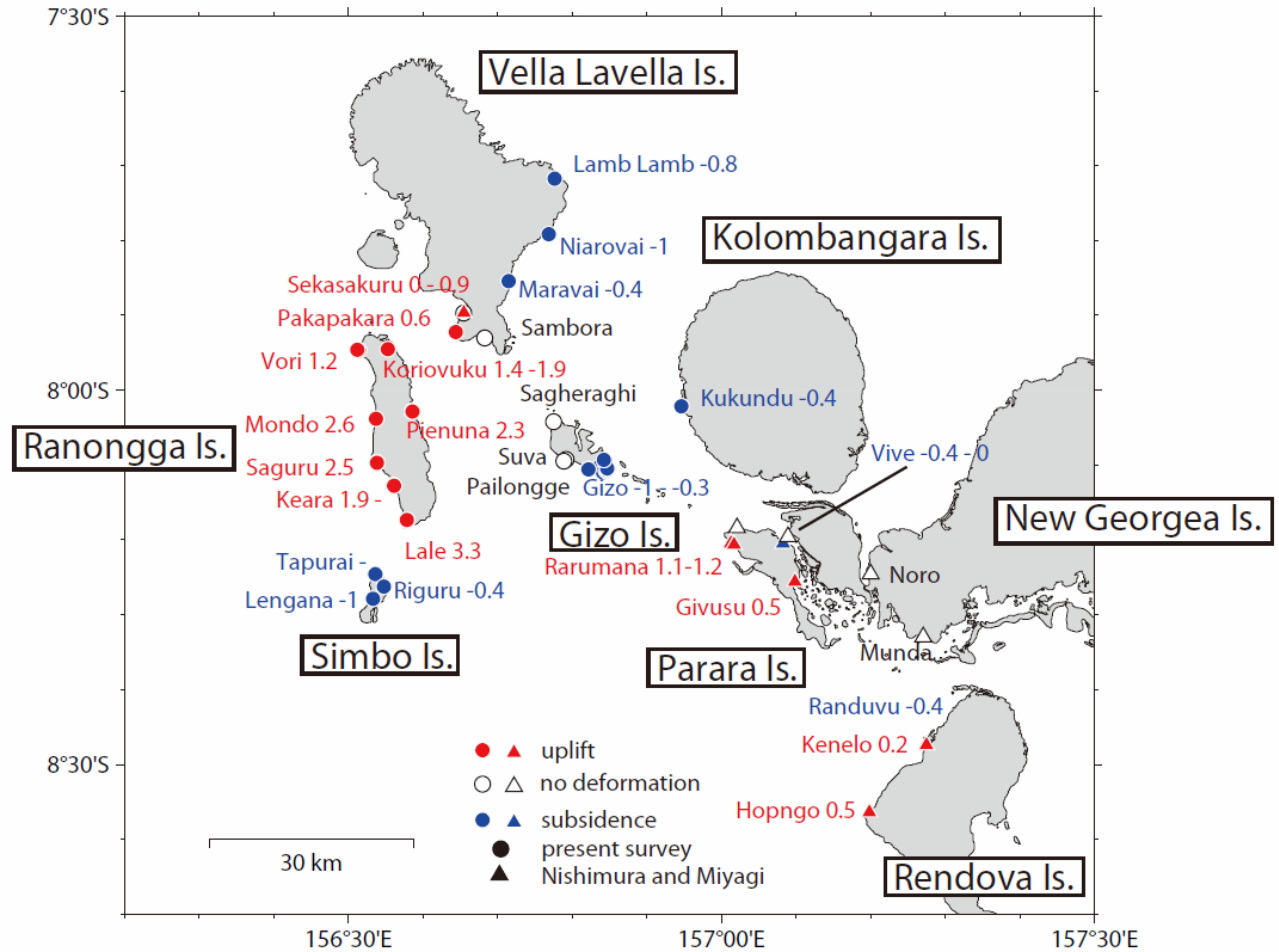


Summary

- ALOS/PALSAR could acquire favorable data to understand phenomena associated with the large earthquake in Solomon Islands.
- Comparison of amplitude images between before and after the earthquake, it was revealed that something has occurred and it was confirmed by field investigation.
- Huge uplift occurred in Ranongga Island, on the other hand, subsidence or no uplift occurred in Simbo Island, so differently-damaged by tsunami.
- Significant ground deformation over the wide area was represented using DInSAR technique. From these geodetic data, we inferred fault model and slip distribution for the earthquake. Although it is a preliminary results, it shows good agreement with observed deformation.

Post-seismic deformation?

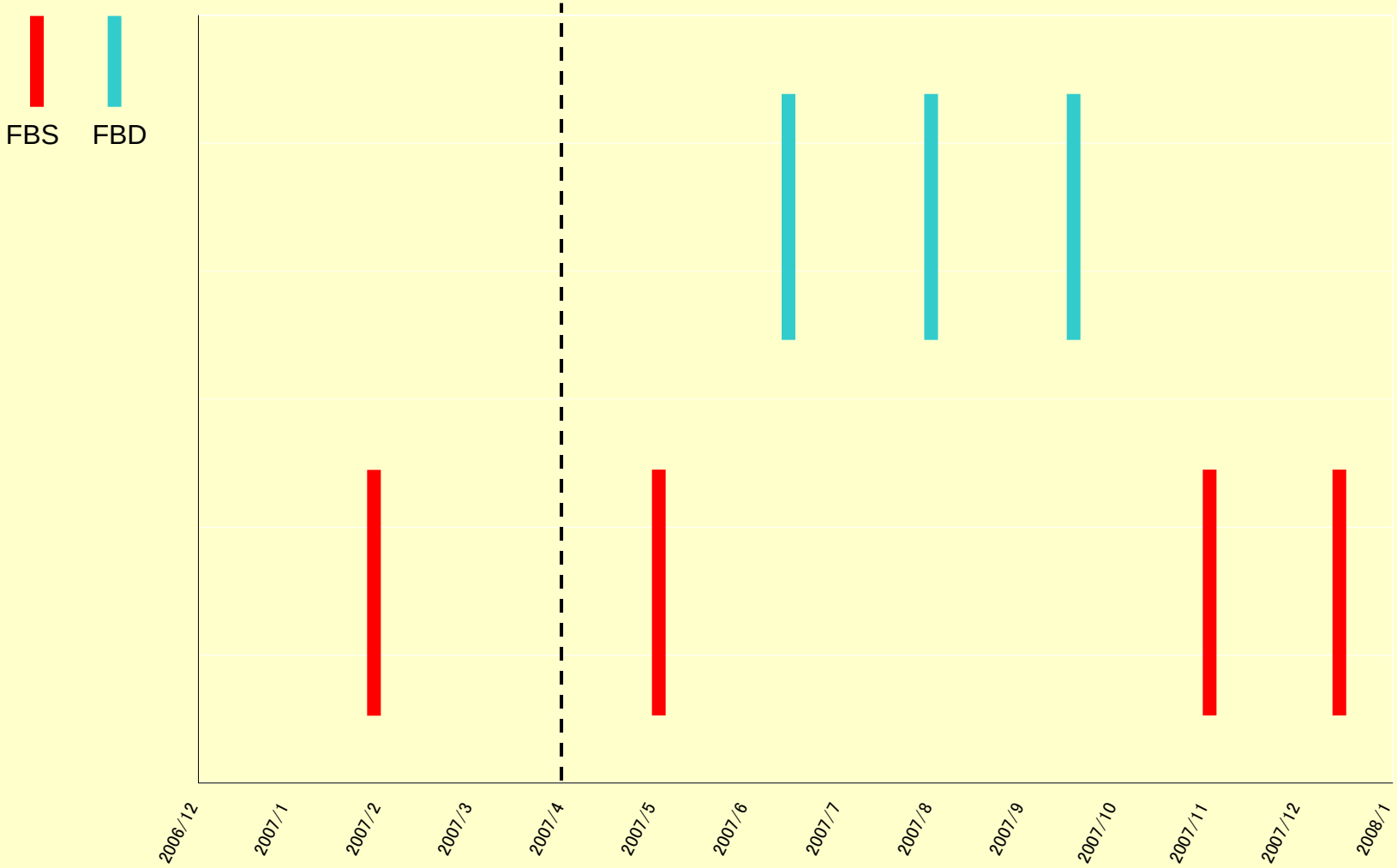
- In interviews with inhabitants who lives in Ghizo Island or its surroundings, we obtained witnesses that a sea level rose compared to it before earthquake in April, and witnesses that the sea level lowered in July. We wondered whether these witnesses are induced from their ambiguities, or these mean co-seismic subsidence and post-seismic rebound.



Nishimura et al., [2007]

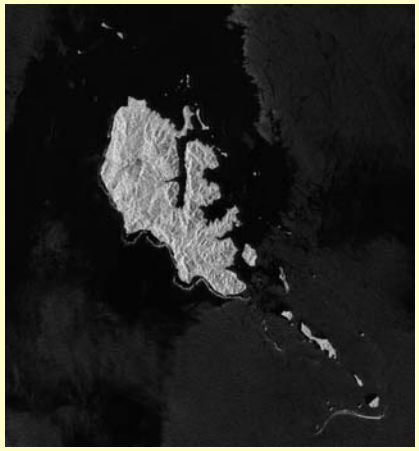
PALSAR Data for Solomon Islands

Path-345 *(2007/1/31 (FBS), 2007/5/3 (FBS), 2007/6/18 (FBD), 2007/8/3 (FBD), 2007/9/18 (FBD) , 2007/11/3 (FBS), 2007/12/19 (FBS))*



Ghizo Island

2007/1/31 low tide (~0.1m)



2007/5/3 high tide (~0.7m)

2007/6/18 high tide (~0.8m)

2007/8/3 middle tide (~0.6m)

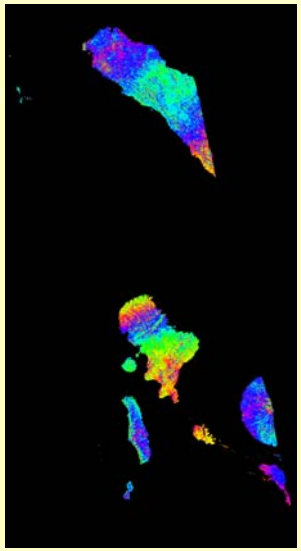
2007/9/18 middle tide (~0.5m)

2007/11/3 middle tide (~0.4m)

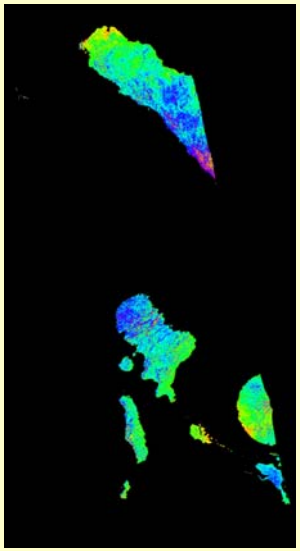
2007/12/19 low tide (~0.2m)

Path-345

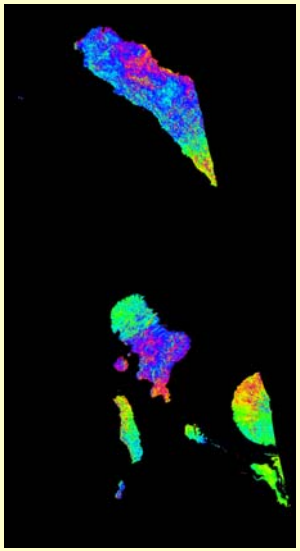
2007/5/3-2007/6/18



2007/6/18-2007/8/3



2007/8/3-2007/9/18



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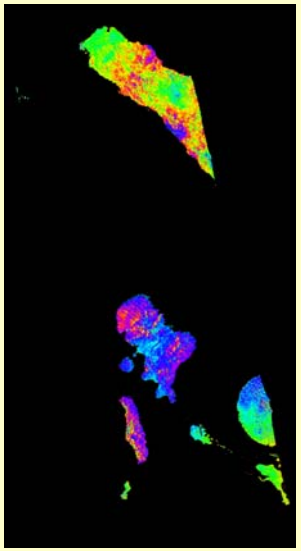

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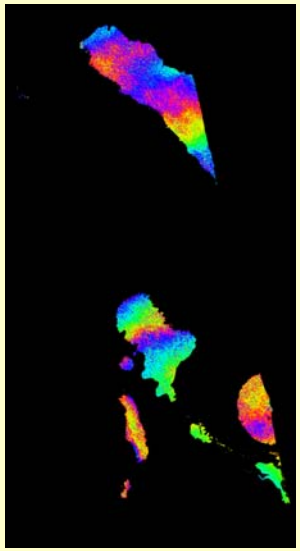

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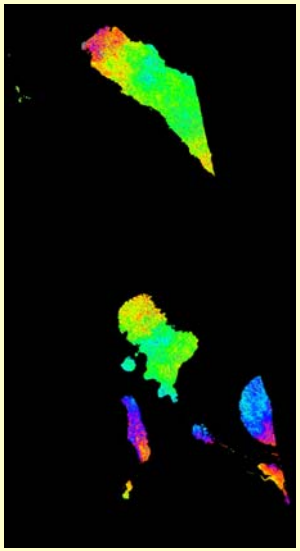

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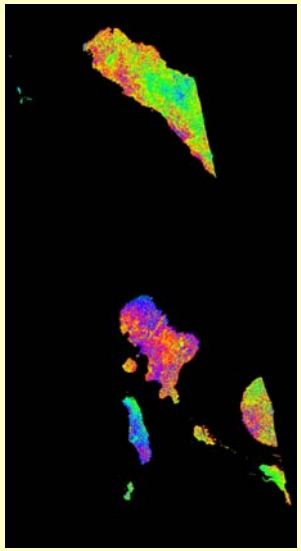
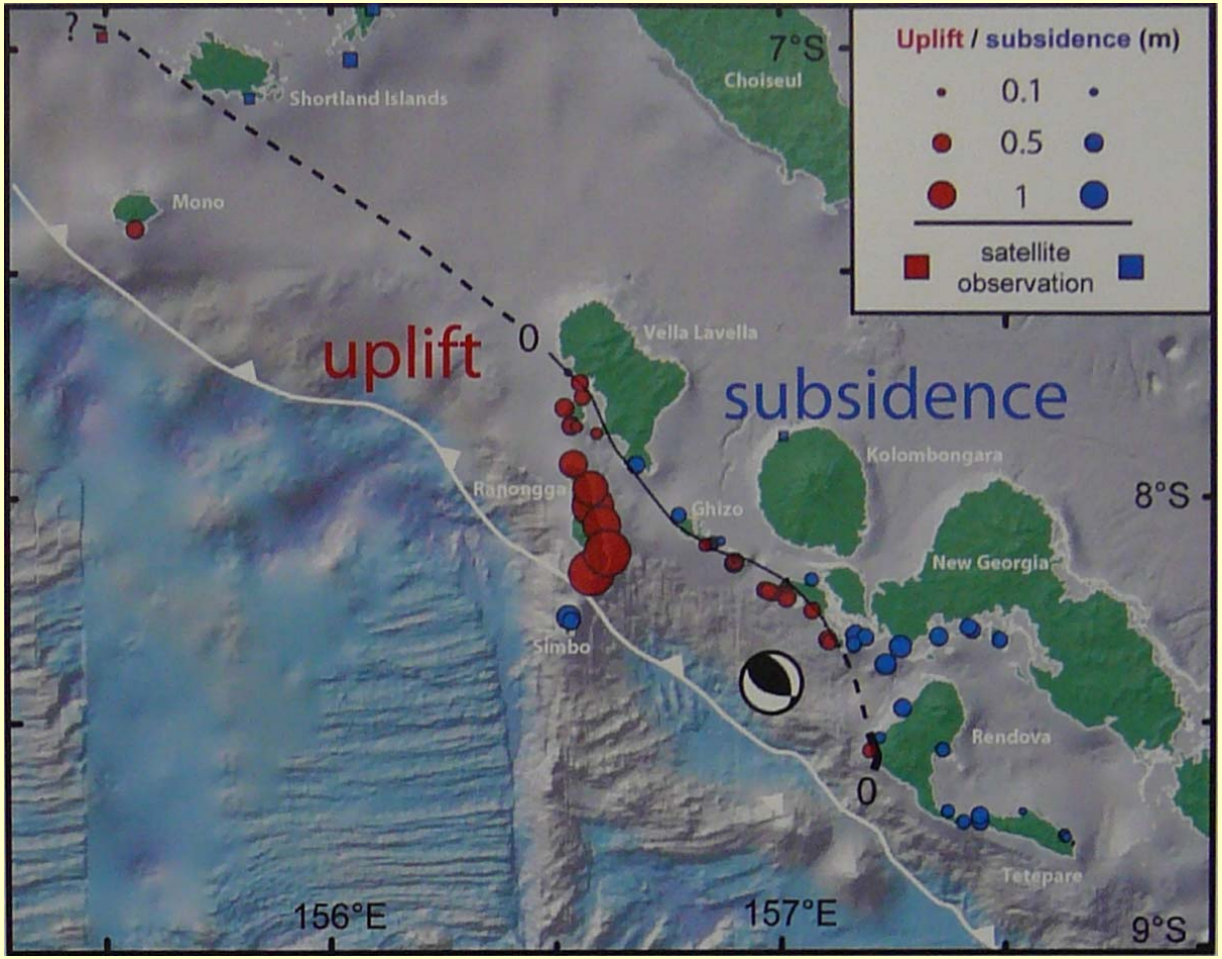


Just on the boundary



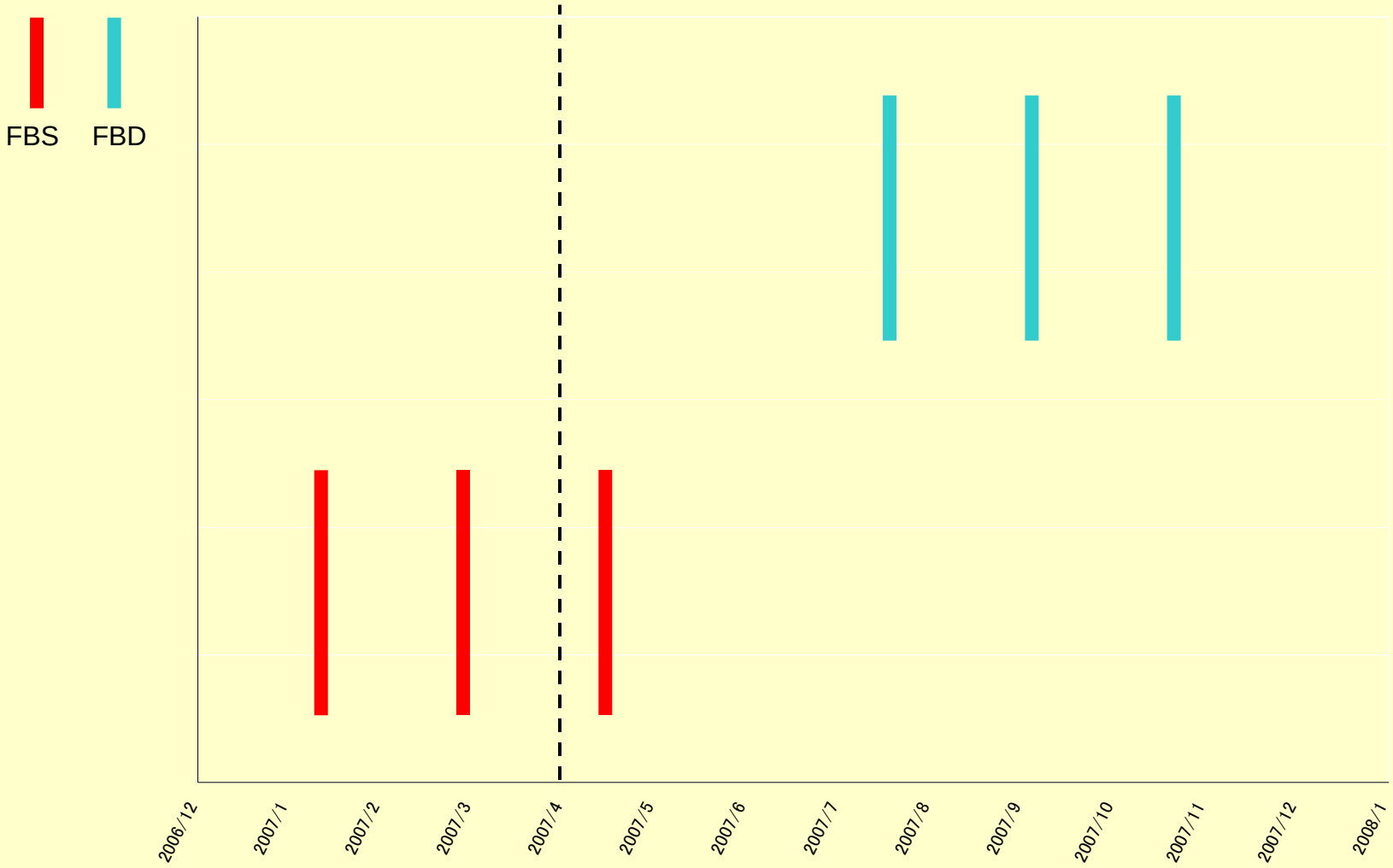
Briggs et al., [2007]

PALSAR Data for Solomon Islands

Path-343 *(2006/12/28 (FBS), 2007/2/12 (FBS), 2007/5/15 (FBS), 2007/6/30 (FBD), 2007/8/15 (FBD), 2007/9/30 (FBD), 2007/12/31 (FBS))*

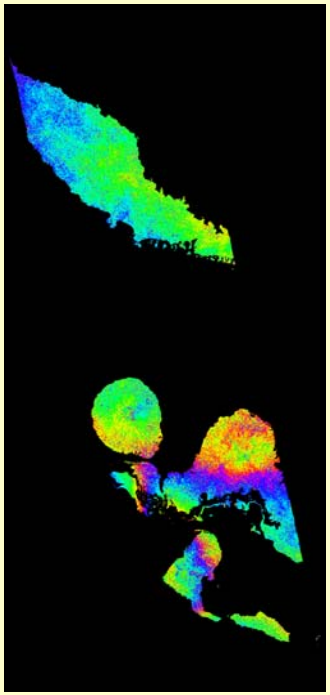
PALSAR Data for Solomon Islands

Path-344 *(2007/1/14 (FBS), 2007/3/1 (FBS), 2007/4/16 (FBS), 2007/7/17 (FBD), 2007/9/1 (FBD), 2007/10/17 (FBD))*

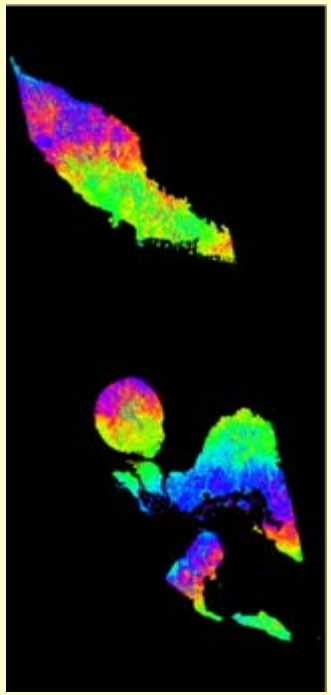


Path-344

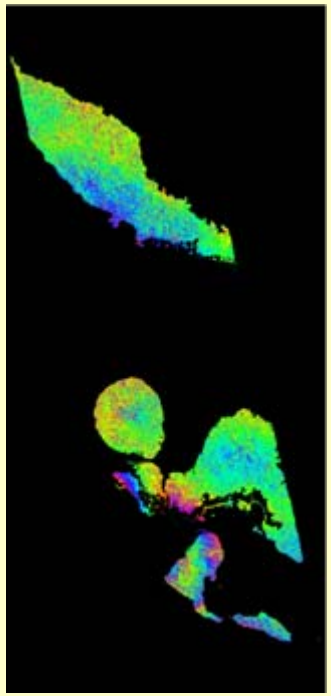
2007/4/16-2007/9/1



2007/9/1-2007/10/17

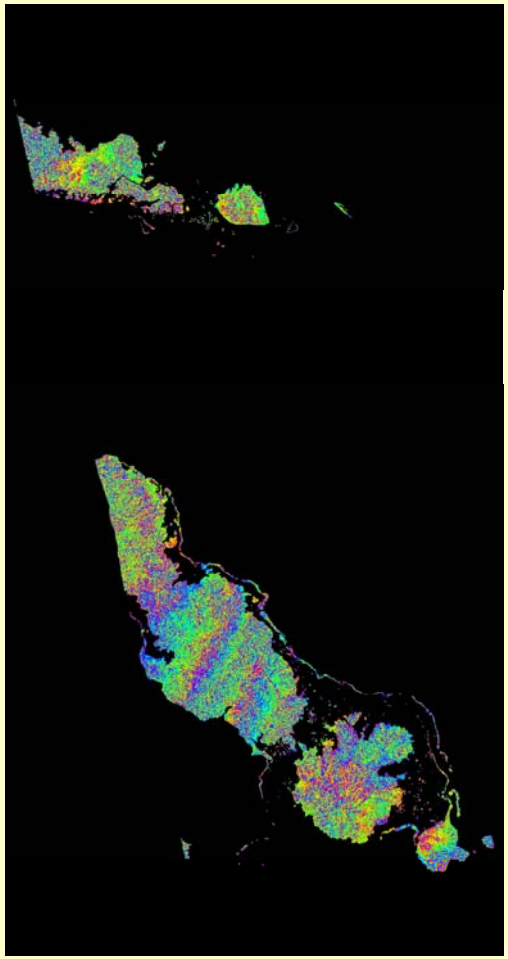


2007/4/16-2007/10/17



Path-343 Post-seismic

2007/5/15-2007/12/31



Path-343 Co-seismic

2007/2/12-2007/5/15