ALOS PALSAR interferometry of Taupo Volcanic Zone, New Zealand

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Outline

1. Introduction to Taupo Volcanic Zone (TVZ), New Zealand
   • Previous studies using ERS and ENVISAT C-band data

2. Current studies using ALOS PALSAR interferometry
   • Some examples

3. Difficulties in processing and interpretation of ALOS PALSAR InSAR data

4. Conclusions
Deformations occurring in Auckland, New Zealand from ENVISAT interferometry.
M 6.7 George Sounds earthquake, October 16
ALOS interferometry

20070906-20071207
Post seismic slip
20071022-20071207
New Zealand and Taupo Volcanic Zone

- New Zealand tectonic is driven by the subduction of the Pacific plate beneath the Australian plate.

- Taupo Volcanic Zone (TVZ) is a highly active volcanic region (350x50 km) located in the central North Island.

Geothermal fields

Ruapehu, the largest active volcano in the region.
Previous studies using 1996-2004 ERS and ENVISAT SAR by J.K. Hole et al., 2007

- Revealed subsidence at geothermal fields
- Only interferograms with short perpendicular baseline less than 250 m and time span less than one year were coherent
- We also tried JERS-1 data but because of orbital errors stopped using it.
Current studies using ALOS PALSAR

Objective: Evaluate capability of ALOS PALSAR for mapping ground deformation and ground changes in New Zealand

- 56 PALSAR images spanning 12/2006 - 07/2008 were used in this study
- Data was processed with GAMMA from RAW format
- For interferometric processing FBD images were resampled to FBS
- Only HH polarized images were used
- 90 m SRTM and 40 m LINZ (NZ local) DEM were used to remove topography

Descending, path 628

Ascending, paths 324-327

Large New Zealand Earthquakes

Notable shallow (generally less than 30 km deep) earthquakes since 1848

5 March 1934 Palahina Magnitude 7.6
23 January 1935 Wairarapa Magnitude 8.2
19 October 1888 Cape Farewell Magnitude 7.5
17 June 1929 Maruia Magnitude 7.8
24 May 1968 Inangahua Magnitude 7.1
22 August 2003 Foxland Magnitude 7.1
22 November 2004 Puysegur Trench Magnitude 7.1
30 September 2007 Auckland Islands Magnitude 7.3
20070113-20070228, Bp= 829 m  
20080116-20080302, Bp= -464 m
Subsidence at Ohaaki geothermal field

Subsidence at Tauhara geothermal fields
Interpretation, descending path 628, 2007-2008

Path 628, stack 2007-2008

Interpolated 2007-2008 GPS velocities converted to descending line-of-sight
Interpretation, ascending path 324, 2007-2008

Matata earthquake swarm

Observed uplift

Any relation?
Difficulties I, Baselines

Perpendicular baselines are too big and keep increasing with time
Difficulties II, Soil moisture, penetration depth, topographic errors or vegetation

Observed signal often correlates with structures on the ground and mimics deformations
Difficulties III, Orbital, processing or ionospheric errors

Non linear signal is observed on a few interferograms
InSAR results from M 6.6 Gisborne earthquake
20 Dec 2007

We believe that this signal is mostly due to atmospheric noise.
Difficulties IV, Tropospheric noise

Clouds?
Mapping lahars at Mt Ruapehu, March 2007
ALOS SAR data from 1/2007-1/2008

Backscatter intensity

Differential interferometry

Coherence

Differential coherence
Conclusions

1. 56 ALOS PALSAR images spanning 12/2006 - 07/2008 were used in this study of Taupo Volcanic Zone, New Zealand

2. We confirm that L-band interferometry can be successfully used for mapping ground deformations in densely vegetated regions such as TVZ, New Zealand

3. We could identified ground subsidence at a few geothermal fields (Wairakei, Tauhara, Ohaaki) and possibly uplift around Taupo

4. Created stacks are noisy because images with short time span were used (magnitude of noise is similar to magnitude of signal)

5. Orbital (processing, ionospheric) errors, atmospheric noise, soil water content (topographic errors) are significant limiting factors and more work needs to be done to eliminate them

6. We found that it is very hard, if possible at all, to map slow deformations with large wave-length

7. Perpendicular baselines are too big and continue increasing with time, they have to be controlled better (if possible)
Acknowledgement

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