Preliminary results of ESA Category-1 Project 5834 "Application of DInSAR technique to areas of active ground deformations"

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We have established a processing chain of Synthetic Aperture Radar (SAR) data for identification and parametrisation of deformation sources in areas of active ground deformation (e.g. seismogenic areas, volcanic districts). SAR data from European Space Agency (ESA) satellites ERS-2 and ENVISAT are used.

SAR and InSAR data processing

LEVEL 0 SAR data are focussed to Single Look Complex (SLC) through ROI_PAC (Copyright 2002-2008, Caltech/Jet Propulsion Laboratory). We perform an advanced data processing using Doris (Kampes and Usai, 1999) a single program that can do most common steps of the interferometric radar processing starting from SLC data to generation of interferometric products and geocoding. Unwrapping of interferometric phase is performed using the public domain software snaphu (Chen and Zebker, 2001).

Modeling of deformation sources

We propose a novel inversion approach base on non-linear inversion. The forward modeling is provided by the semi-analytic deformation model for point sources and finite faults. The parameters of the fault (center position, width, height, rake and seismic moment) are inverted using a combination of non-linear optimization algorithms (as Monte-Carlo, Nelder&Mead Simplex and Simulated Annealing). The misfit function defined for the optimization is based on the L2 norm of the error weighted by the coherence of the considered spatial point.

Test datasets

To test our modeling procedure we chose three different study areas, refer to mainly strike-slip seismogenic sources with different orientation to respect satellite Line Of Sight (LOS):

December 26 2003 Iranian earthquake (Bam e.), data from both ascending and descending passes of ENVISAT ASAR narrow swath IS2 (RAW and SLCs); August 17 1999 Turkey earthquake (Izmit e.), data from both ascending and descending passes of ERS-2 AMI SAR (SLCs); June 17-21 2000 Iceland earthquakes, data from both ascending and descending passes of ERS-2 AMI SAR (SLCs).

Tests carried over real deformation unwrapped interferograms have shown encouraging results. Preliminary modeling of deformation sources is presented.

References
Chen W., H. Zebker A. (2001) -Two-dimensional phase unwrapping with use of statistical models for cost functions in nonlinear optimization- Journal of the Optical Society of America, 18, 338-351.
Kampes B., Usai S. (1999) -Doris: The Delft object-oriented Radar Interferometric software.- In: proceedings ITC 2nd ORS symposium, August 1999 (CD-ROM).