Near real time inverse source modeling and stress filed assessment: the requirement of a volcano fast response system

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Volcanic unrest and eruptions are one of the major natural hazards next to earthquakes, floods, and storms. It has been shown that many of volcanic and tectonic unrests are triggered by changes in the stress field induced by nearby seismic and magmatic activities.

In this study, as part of a mobile volcano fast response system so-called "Exupery" (www.exupery-vfrs.de) we present an arrangement for semi real time assessing the stress field excited by volcanic activity. This system includes; (1) an approach called "WabInSAR" dedicated for advanced processing of the satellite data and providing an accurate time series of the surface deformation [1, 2], (2) a time dependent inverse source modeling method to investigate the source of volcanic unrest using observed surface deformation data [3, 4], (3) the assessment of the changes in stress field induced by magmatic activity at the nearby volcanic and tectonic systems. This system is implemented in a recursive manner that allows handling large 3D data sets in an efficient and robust way which is requirement of an early warning system.

We have applied and validated this arrangement on Mauna Loa volcano, Hawaii Island, to assess the influence of the time dependent activities of Mauna Loa on earthquake occurrence at the Kaoiki seismic zone.

References

[1] M. Shirzaei and T. R. Walter, "Wavelet based InSAR (WabInSAR): a new advanced time series approach for accurate spatiotemporal surface deformation monitoring," IEEE, pp. submitted, 2010.

[2] M. Shirzaei and R. T. Walter, "Deformation interplay at Hawaii Island through InSAR time series and modeling," J. Geophys Res., vol. submited, 2009.

[3] M. Shirzaei and T. R. Walter, "Randomly Iterated Search and Statistical Competency (RISC) as powerful inversion tools for deformation source modeling: application to volcano InSAR data," J. Geophys. Res., vol. 114, B10401, doi:10.1029/2008JB006071, 2009.

[4] M. Shirzaei and T. R. Walter, "Genetic algorithm combined with Kalman filter as powerful tool for nonlinear time dependent inverse modelling: Application to volcanic deformation time series," J. Geophys. Res., pp. submitted, 2010.