Geophysical Research Abstracts
Vol. 20, EGU2018-3372, 2018
EGU General Assembly 2018

Finite element modeling of complex ground deformation sources in volcanoes and geothermal areas aided by Independent Component Analysis

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Ground deformation in volcanic and geothermal areas often show complex spatio-temporal patterns due to the presence of multiple sources having different geometries and behavior. Typical examples are the presence of multiple magmatic reservoirs or the coexistence of magmatic and hydrothermal reservoirs with slip along fault surfaces.
The retrieval of source models in these contexts requires complex modeling tools and/or cumbersome inverse methods to solve simultaneously for the parameters of different sources. An alternative solution can be separating the ground deformation related to the different sources before the inversion of the data. Independent Component Analysis (ICA) has shown to be an excellent mean to perform such a separation. On the other hand the inversion of individual sources, having a simpler spatio-temporal behavior, makes easier the use of advanced inversion techniques as well.
In this work we present some example application of the source separation using ICA, and the subsequent inversion of individual sources using a non-linear inverse method based on a finite-element forward modeling approach. We selected as case studies two SBAS DInSAR datasets acquired by ascending and descending orbits for Sakurajima and Teide volcanoes using Alos (L-Band) and Envisat (C-Band) sensors respectively.