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Sensitivity analysis of distributed volcanic source inversion

Flavio Cannavo' (1), Antonio G. Camacho (2), Pablo J. González (3), Giuseppe Puglisi (1), and José Fernández (2)

(1) INGV - Istituto Nazionale di Geofisica e Vulcanologia, Catania, Catania, Italy (flavio.cannavo@ingv.it), (2) Institute of Geosciences (CSIC-UCM), Madrid, Spain, (3) COMET. Institute of Geophysics and Tectonics, School of Earth and Environment, University of Leeds, Leeds, United Kingdom

A recently proposed algorithm (Camacho et al., 2011) claims to rapidly estimate magmatic sources from surface geodetic data without any a priori assumption about source geometry. The algorithm takes the advantages of fast calculation from the analytical models and adds the capability to model free-shape distributed sources. Assuming homogenous elastic conditions, the approach can determine general geometrical configurations of pressured and/or density source and/or sliding structures corresponding to prescribed values of anomalous density, pressure and slip. These source bodies are described as aggregation of elemental point sources for pressure, density and slip, and they fit the whole data (keeping some 3D regularity conditions). Although some examples and applications have been already presented to demonstrate the ability of the algorithm in reconstructing a magma pressure source (e.g. Camacho et al., 2011,Cannavò et al., 2015), a systematic analysis of sensitivity and reliability of the algorithm is still lacking. In this explorative work we present results from a large statistical test designed to evaluate the advantages and limitations of the methodology by assessing its sensitivity to the free and constrained parameters involved in inversions. In particular, besides the source parameters, we focused on the ground deformation network topology, and noise in measurements. The proposed analysis can be used for a better interpretation of the algorithm results in real-case applications.

Camacho, A. G., González, P. J., Fernández, J. & Berrino, G. (2011) Simultaneous inversion of surface deformation and gravity changes by means of extended bodies with a free geometry: Application to deforming calderas. J. Geophys. Res. 116.
Cannavò F., Camacho A.G., González P.J., Mattia M., Puglisi G., Fernández J. (2015) Real Time Tracking of Magmatic Intrusions by means of Ground Deformation Modeling during Volcanic Crises, Scientific Reports, 5 (10970) doi:10.1038/srep10970