Geophysical Research Abstracts
Vol. 12, EGU2010-6395-1, 2010
EGU General Assembly 2010

Numerical modeling of magnetic, gravity and deformation fields at Etna volcano: a case study from the 2008 eruption

Gilda Currenti, Ciro Del Negro, Agnese Di Stefano, Filippo Greco, Rosalba Napoli, and Danila Scandura

Elastic finite element models (FEM) are applied to jointly model magnetic, gravity and deformation fields produced by volcanic pressure sources and magmatic intrusions at Etna volcano. Before an eruption, the magma accumulation in intermediate storages beneath the volcano and its ascent toward the surface induce ground deformation and local disturbances in the magnetic and gravity fields. Simple analytical models, which are useful as a first approximations for localizing the source position and inferring its geometry, have been widely used to interpret the anomalies observed in the monitored parameters. However, since analytical solutions are based on the simple assumption of homogeneous elastic half-space models, they could provide an inaccurate estimate of the expected variations in the geophysical parameters. Our numerical results highlight that the presence of steepest relief and complex distributions of rock properties at Etna strongly affect the estimate of geophysical variations produced by pressure or dislocation sources. Therefore, the FEM approach, which allows for considering complex 3D models, could advance the reliability of model-based assessments of ground deformation, gravity and magnetic changes associated with volcanic activity. Although, remarkable changes in these monitored parameters have been reported in association with the renewal of the eruptive activity in many volcanic areas, very few volcanoes worldwide are continuously monitored by multiparametric arrays which allow for integrated modeling. Among others, the multi-disciplinary monitoring networks at Mt Etna have reached a high quality level and enabled collecting important data during the onset of the 2008 eruption. Geophysical data constrained the emplacement of a dyke and its northward propagation, suggesting a possible evolution of the ongoing activity. Using FEM, we modeled the magmatic intrusion with a dyke crossing the volcano edifice along a ca. NNW-SSE direction in the northern flank and calculated the expected deformation, magnetic and gravity fields. A good match between the computed and observed variations is obtained. The FEM integrated approach provides constraints to define the volcanic activity and consequently to propose suitable scenario for hazard assessment.