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0.1 Spatiotemporal modeling of the dike propagation forerunning the Etna July 2001 eruption

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0.1.1 Abstract

Late on the night of July 17, 2001, a lateral eruption started from the slopes of Mt. Etna. A 7 km long field of ground fractures opened between 13 and 20 July. The eruption ended on August 9, 2001 after emitting a lava volume of approximately 48 $\cdot 10^6$ m^3. A strong seismic swarm earthquake was recorded between July 12 and 17. The evolution leading up to the July crisis was monitored through continuous geodetic measurements, which constrained the intrusion preceding the eruption in time, and inferred the position and geometry of the uprising dike. Previously, ground deformation from GPS and tilt data was modeled by inverting changes in ground positions and tilts recorded between 11 and 16 July, before the eruption onset [Bonaccorso et al., 2002]. The deformation pattern indicated the response to a tensile mechanism that evidenced an intrusion in the volcano edifice along a ca. N-S direction. The tensile crack, with an opening dislocation of ca. 3 m, crossed the volcano edifice slightly southeast of the crater area. The location of the modeled source fits the zone of the seismic swarm occurring during the magma uprising.

In this study, we modeled the temporal evolution of the continuously geodetic data recorded during the dike propagation on the southeast flank, using a random search approach of a purely elastic earth model [Gottsmann et al., 2006]. The reproduction of the recorded signals allowed us to describe the geometry and characteristics of the

intrusion in greater detail than the previous static inversion. The ground deformation pattern associated with the final uprising and its modeling suggest a very fast dike emplacement which appears different, both in terms of rapidity (only a few days) and source position, with respect to the sources modeled for the other lateral eruptions in the last twenty years. We show that geodetic data and its temporal modeling represent a powerful tool to verify and constrain spatiotemporal dike intrusions in detail.

References

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