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Shallow dike intrusion at Mt. Etna in May 2008 imaged by GPS and Radarsat-2 data integration

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GPS and DInSAR data collected from May to June 2008 on Mt. Etna are analyzed in order to define the dynamics accompanying the onset of the 2008-2009 eruption on 13 May 2008. The dike intrusion was accompanied by a strong seismic release and marked ground deformation; furthermore violent lava fountains took place along the eruptive fracture during the first hours of the eruption. On the same day, lava fountains erupted from a N140°E fissure (3050-2950 m asl) that propagated down-slope southeastward, curving toward N120°E and reaching a minimum elevation of 2620 m asl, where lava flows erupted and rapidly expanded in the Valle del Bove. The seismicity affected the upper portion of the NE Rift, where a dry, extensive ∼N-S fracture field began to form.
The emplacement of the eruptive dike has been imaged by two GPS surveys carried out on a dense network on the uppermost part of the volcano on early May and June 2008, i.e. a few days before the dike intrusion and about one month after. The dike intrusion also was imaged by DInSAR descending Radarsat-2 data acquired in "fine mode" (about 5 m ground resolution), which confirm strong displacements localized on the summit area, quickly decreasing towards the middle flanks of the volcano, as detected by the GPS data covering the same period.
In order to finely depict the 3D ground deformation pattern with the highest spatial resolution, GPS and DInSAR data were integrated by using two approaches: the Samsonov and Tiampo, 2006, and the SISTEM (Guglielmino et al., 2011) methods. The results from the two methodology integrations were also compared. The resulting 3D displacement maps show the deformation related to the dike intrusion are confined on the upper part of the volcano. In addition, the very high detail of the displacement pattern constrains the position of the dike, in perfect agreement with the position of the eruptive and dry fractures detected by geological surveys. We inverted the results of the integration between GPS surveys and DInSAR analysis in order to define the geometry and kinematics of the eruptive dike.