Shallow dike injection at Mt. Etna in May 2008 imaged by dense GPS and DInSAR data: interaction between magma and flank dynamics

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Global Positioning System (GPS) and Differetial Interferometric Synthetic Aperture Radar (DInSAR) data collected from July 2007 to July 2008 on Mt. Etna, are analyzed in order to define the dynamics preceding and accompanying the onset of the eruption, on 13 May 2008. Short and long-term comparisons have been made on both GPS and radar data, covering similar time windows. Thanks to the availability of three GPS surveys in the year preceding the eruption onset, an increase in the seawards movement of the NE flank of the volcano has been detected in the few months before the dike intrusion.

The GPS ground deformation pattern also shows a slight inflation centred on the western side of the volcano in the pre-eruptive long-term comparison (from July 2007 to May 2008). The GPS has been integrated with DInSAR data by the SISTEM approach, in order to take advantage of the different methodologies, providing high spatial sampling of the 3D ground displacement pattern. We inverted the SISTEM results in order to model the pressure source causing the observed pre-eruptive inflation.

The subsequent emplacement of the eruptive dike was imaged by two GPS surveys carried out on a dense network on the uppermost part of the volcano on May 6 and 13, i.e. a few days before and a few hours after the beginning of the eruption. We inverted this comparison to define the position, geometry and kinematics of the dike. The dike intrusion was imaged also by DInSAR data with temporal baselines of 2-3 months, which confirm strong displacements localized on the summit area, quickly decreasing towards the middle flanks of the volcano, as detected by very short term GPS data; furthermore, the comparison between DInSAR and GPS data highlighted the presence of a depressurizing source localized beneath the upper south-western area, acting just after the dike intrusion.

Finally, the long period (one year) GPS and DInSAR data were integrated by SISTEM in order to finely depict the 3D ground deformation pattern with the highest spatial resolution (taking advantage of the more complete GPS network surveyed). The long period data allowed the complex kinematics of the volcano to be finely imaged and highlighting the interaction between flank dynamics and magma injection.