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Analysis of coulomb stress changes during 1997-1998 intrusive period at Mt. Etna volcano

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At Mt. Etna, recent studies of the evolution of seismogenic stress and strain have evidenced that before an eruption accumulation of magma occurs beneath the edifice. Associated with this, a crustal volume located in the depth interval 2-10 km beneath the central part of the volcano was characterized by an anomalous orientation of stress with respect to the background regional tectonic stress, and an increase of seismicity at the south-western volcano flank. Here we investigate how the occurrence and distribution of seismic activity was controlled by magma accumulation, and investigate the changes in the Coulomb failure stress through numerical model simulations.
We investigate the 1997 – 1998 eruptive period, that was preceded by an increasing seismicity rate. The hypocentres were located in a highly fractured low - velocity zone located beneath the western slope of the volcano. By inversion of focal mechanisms we found the principal stress tensors rotated with respect to the regional North – South directed maximum compressive stress. By 3D hypocenter locations and focal plane analysis we found a vertical seismogenic structure located in the depth interval 3.5 –7.5 km having strike N50°E with a strike-slip movement.
We investigate the deformation pattern by utilizing GPS and InSAR data, in order to identify zones of dislocation and constrain the amount and type of displacement. Using the Boundary Element Method, through forward modelling of these dislocations we are able to compute the stress field within the volcano edifice in three dimensions. We calculate the Coulomb failure stress at receiver faults, locations and mechanisms of which were constrained by seismicity information. We find that large parts of the seismogenic receiver faults experienced Coulomb failure stress increases, which may provide an answer to the observed coupling of seismic and geodetic activity.