

MODELING OF COULOMB STRESS CHANGES DURING THE 2002-2003 ETNA ERUPTION

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A fully 3D finite element simulation is performed to study the interaction between the magmatic intrusions and the fault systems that were reactivated during the 2002-2003 Etna eruption. We investigated how the topography and the complex medium heterogeneity can affect the ground deformation and the stress field solutions. The modeling is conducted using the CIG finite element code PyLith [Aagaard *et al.*, 2008]. The computational domain was generated using a digital elevation model of Mt Etna from the 90 m Shuttle Radar Topography Mission (SRTM) data and a bathymetry model from the GEBCO database (<http://www.gebco.net/>) using LaGriT (<http://lagrit.lanl.gov>). To simulate the magmatic intrusions we assigned tensile dislocation boundary conditions to the nodes lying on the dike surfaces. The elastic parameters were estimated using seismic velocity tomography.

Based on the Coulomb failure criterion, we resolved the stress changes, generated by the magmatic intrusions, onto the mapped structural trends of the Pernicana Fault (PFS, a local volcanic edifice feature on Etna), which was reactivated soon after the eruption onset. The presence of medium heterogeneity and topography strongly alter the amplitudes of the Coulomb stress changes with respect to homogeneous elastic half-space solutions (see Figure). Seismicity matches well the areas of positive increase in the static stress changes caused by the intrusive events along the southern and northeastern flanks [Currenti *et al.*, 2008].

References

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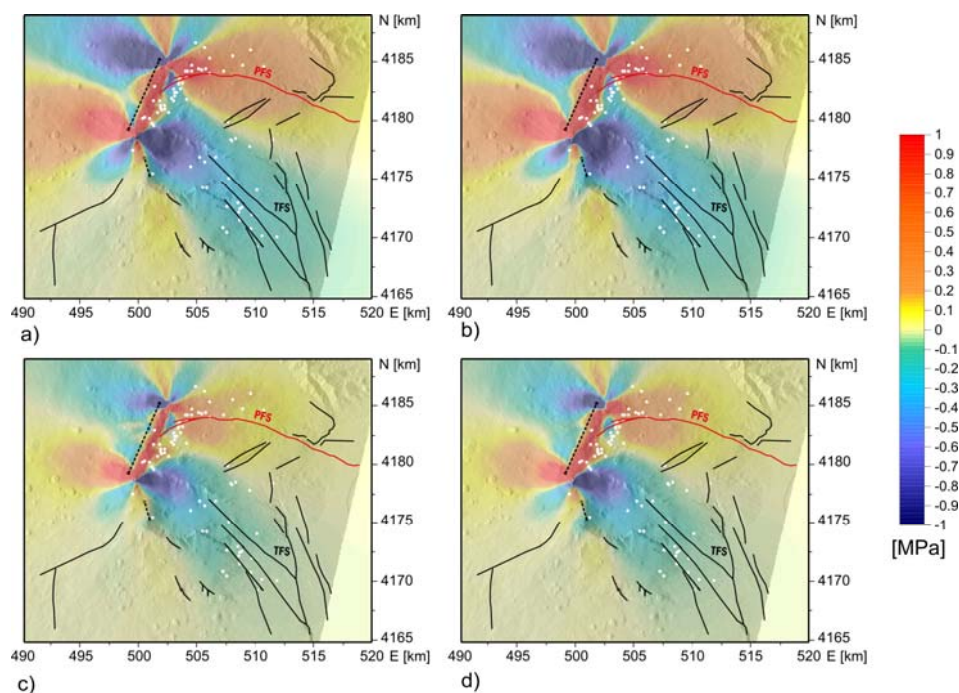


Figure – Map view of Coulomb stress changes generated by the magmatic intrusions (black dashed lines) resolved onto Pernicana Fault (red line). The fault is mapped by a vertical plane oriented 100°N with left lateral motion. For all the models HomFlat (a), HomTopo (b), HetFlat (c), HetTopo (d) a positive stress change area surrounds the Pernicana Fault and well matches the seismicity recorded from 27th to 29th October (white circles, from Barberi *et al.*, 2004).