Multidisciplinary study of the Trecastagni fault (Mt. Etna volcano, Sicily)

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The complex interaction between regional stress, gravity forces and dike-induced rifting of Mount Etna, seems to have a role in the eastward movement of the Mt. Etna eastern flank. In this context, the Trecastagni-Tremestieri Fault system identifies the southern boundary of the unstable sector.

The Trecastagni fault is a NNW-SSE tectonic structure developing on the lower southern flank, characterized by evident morphological scarps and normal and right-lateral movements that directly affect roads and buildings. Continuous creep affects this fault, with episodic accelerations accompanied with shallow seismicity.

The dynamics of these faults has been analysed by a multi-disciplinary approach with terrestrial and satellite deformation data. Terrestrial data consist in levelling across both faults and extensometers record on the Trecastagni fault. Satellite data consist in InSAR data and GPS surveys on wide and local networks.

The levelling route on Mt Etna is 150 km long and consists of 200 benchmarks. The portion of the levelling network, crossing the Trecastagni fault, has been installed on 2009; the surveys show a long-term mean vertical slip rate of about 10 mm/y and episodic acceleration on short segments of the fault, with displacements of almost 30 mm.

The in-situ monitoring of the Trecastagni fault is also performed by two continuous wire extensometers. Each extensometer is equipped with a data-logger programmed for 48 data/day sampling, storing displacement and ground temperature. The two stations measure the relative displacements perpendicular to the fracture. Data recorded by extensometers highlight an opening trend of about 2-3 mm/year with some acceleration leading up to more than 2 mm in 15 days at the end of 2009.

The fault shows clear traces on SAR interferograms and Persistent Scatterers (PS) time series. InSAR data allows tracking the path of fault down to the coastline. The Trecastagni fault shows a
main vertical kinematics, with an evident downthrow of the eastern side at a rate of about 4 mm/y. Subsidence increase eastwards away from the structure, reaching a maximum rate of almost 10 mm/y. The fault produces a minor increase in the eastwards velocity on its eastern side evidencing also a minor extension of the structure. Episodic accelerations affect the fault and are visible on some interferograms from different sensors.

The dense GPS network is measured periodically and has more than seventy benchmarks. The time series of this network began in 1988 and from then on its configuration has been continuously improved. Integration of this wide spectrum of geodetic data allows strongly constrained ground deformation pattern to be defined and modeled. Furthermore, the very long time series available for the different datasets on the fault, allows its behavior to be investigated in time and its role and relationships in the framework of flank instability and eruptive activity to better understood.