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Structural setting of Mt. Etna revealed by integrating PS and GPS measurements

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Mt. Etna has been exploited as a very favorable volcanic test site for the application of the recently developed Permanent Scatterer SAR technique (PS), thanks to the fruitful cooperation between the INGV of Catania, the Politecnico of Milano and Tele-Rilevamento Europa (T.R.E.). The PS technique provides a very detailed map of the ground deformation allowing the kinematics of the active faults on Mt. Etna and ground compaction phenomena to be detected and analyzed. More recently, the PS technique has been applied to repeated ERS images taken from ascending and descending satellite passes from 1995 to 2000. By appropriately combining the ascending and descending PS data, the horizontal (E-W) and vertical components of ground velocities are discriminated. The comparisons of the three-dimensional GPS data with PS horizontal and vertical ground deformation data show a good agreement.

Thanks to the absence of flank eruptions from 1993 to 2001, the studies of Mt. Etna through this period focus on the long-living phenomena, as the movements produced by the activity of either the deep volcanic sources or the tectonic and volcano-tectonic features The preliminary results confirm that the Eastwards motion component of the eastern flank of Mt. Etna is by far the dominating measured deformation. The ground deformation pattern is strongly influenced by the structural setting of Mt. Etna and the kinematics of the different faults dissecting the volcano can be defined by PS data. Gradient on E-W motion is detected only on some faults (e.g. on the Fasano-S. Gregorio fault, on the lower southern flank of the volcano). On the NE sector of the volcano, on the Giarre wedge (at the easternmost corner of the volcano) and on the central part of the SE block there is no gradient on the E-W motion evidencing an uniform horizontal velocity of this part of the volcano. The main N-S component resulting form the right lateral strike-slip of “Timpe” faults produces secondary effects on PS measurements, thus the NS component is measurable only using GPS networks. Gradients of the vertical motion show important dip-slip components along many faults on the southern and south-eastern side. An evident eastward decrease of the vertical velocity also affects each block on the SE flank evidencing a westwards tilt of each block. On the southern part of the eastern flank, the dip of GPS vectors and the pattern of the PS vertical velocities indicate a global tilt, suggesting the rotational sliding of this flank; this hypothesis agrees with a “decollement” along listric surfaces (at least in SE flank) already identified by analyzing GPS data.

This work provided essential information about the geometry and dynamics of the mobile sector of the volcano, in the framework of the INGV-DPC V4 “Flank” Project.