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Insights from and in-depth analysis of CGPS time series at Mt.Etna: evolution of magmatic sources between 2003 and 2012

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The detection and monitoring of crustal deformation on Mt. Etna is performed through the Etn@net continuous GPS network that is currently one of the largest worldwide in an active volcano, with its 40 stations.
Knowledge of the ground deformation of Mt. Etna with a good spatial and temporal resolution allows inferences to be made about the physics of the underlying deformation. In particular, we propose a modelling of the magmatic sources acting inside the volcano between 2003 and 2012 and their temporal evolution.
We performed an analysis of the CGPS long time series in order to investigate time spans characterized by coherent crustal deformation patterns. The analysed period has been divided into different coherent inflation/deflation phases and two phases characterized by a more complex deformation pattern. In particular, during the period 02 August 2008 - 14 June 2009 we observed the coexistence of a deflation of the summit area and an inflation at lower heights while the period 21 May 2010 - 31 December 2010 was characterized by an inflation at medium height without significant areal deformation changes at the summit.
Analytical models indicate a non-uniform deformation style revealing spaced sources acting at different time on different segments of a multi-level magma reservoir. The imaged Etnean plumbing system is depicted as an elongated magma reservoir that extends from the volcano body downwards to about 8.0 km below sea level (b.s.l.), sloping slightly towards the North-West, with storage volumes located at about 8.0, 4.0 and 2.0 km (b.s.l.).
The high quality of data collected on the dense configuration of the Etn@net CGPS network permits a detailed analysis of the mechanisms of magma migration from depth and, therefore, allows a fast and accurate evaluation of volcanic hazard. In particular, the analysis proposed here highlights some significant characteristics: 1) the inflation pressure sources are located between the eastern border of the low vp velocity zone and the western border of the high vp velocity zone, coherently with the path along which the magma rises; 2) the deflation pressure sources are located to the East with respect to the inflation sources, just below the Central Crater area; 3) the inflation sources are characterized by a more elongated shape with respect to the deflation sources showing an almost spherical shape; 4) the inflation sources undergo a progressive deepening in time; 5) during a generally non-homogeneous phase (either deflation and inflation recorded at different altitudes at the same time) it is possible to envisage different sources contemporaneously acting beneath the volcano, for the first time on Mt. Etna.