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Time dependent modeling at Mt. Etna volcano: an application to the 2005-2013 time interval

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Following the 2004-05 eruption, Mt. Etna activity has been characterized by the occurrence of a number of eruptive episodes (2006, 2008 and 2012) and more than 35 paroxysmal events (mainly during the 2011-2012 time interval). In addition, continuous downslope motion of its eastern flank has affected the volcano. This seaward motion has been characterized by some episodic phases combined with the occurrence of multiple slow slip events (SSEs). In order to obtain a comprehensive view of the time evolution of these observed features and thus provide new insight into the ground deformation pattern of Mt. Etna, here we use time-dependent modeling of the three-component daily time series of all GNSS continuous stations installed on the volcanic edifice.
All GNSS data spanning the 2005-2013 time interval were processed using the GAMIT/GLOBK software (Herring et al. 2010) following the strategy described in Gonzalez and Palano (2014). Estimated GNSS daily time series were referred to the "Etn@ref" reference frame (a local reference frame computed to isolate the Mt. Etna volcanic deformation from the background tectonic pattern; Palano et al. 2010).
Using these daily time series as input we performed a time-dependent, non-linear inversion using the TDEFNODE code (McCaffrey, 2009). We used TDEFNODE to invert the time series to model simultaneously the steady tectonic kinematics plus the transient volcanic and tectonic sources, thus obtaining a realistic model of the complex area.
Preliminary results allow us to track, over the considered time interval, the volume changes associated to the activity of a magmatic reservoir located at a depth of about 5 km b.s.l. beneath the upper western flank of the volcano, as well as the location and associated magnitude of four SSEs below the eastern flank. In addition, we attempted a preliminary subdivision of the southern and eastern flanks of Mt. Etna into four tectonic blocks which provide a reasonable representation of the observed seaward motion.

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