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New data from borehole strainmeters to detect and infer lava fountains source mechanisms at Etna volcano

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In January 2011 the eruptive activity resumed at Mt Etna producing several paroxysmal events from the summit South-East crater. On 24 April 2012 the last 25th lava fountain event occurred. Almost all lava fountains had the same characteristics with a strombolian phase increasing very slowly for few hours and preceeding the paroxistic event. During the fountain events small changes ($\sim$ 0.2–0.5 microradians) were detected in the tiltmeters installed on the volcano flanks. From November 2011 the first two borehole strainmeters were installed at Etna and during the paroxysmal events detected negative strain changes ($\sim$ 0.15 - 0.8 microstrain), pointing out a clear deformation response to a depressurizing source within the volcano. Due to the topography and the medium heterogeneity of the volcano, the half-space homogenous assumption introduces oversimplification into the source modelling, which could lead to inaccurate estimates in volumetric strain and tilt. Therefore, a 3D axial-symmetric Finite Element Model (FEM) was set up to accurately estimate the expected tilt and volumetric strain changes at the stations. A profile of the real Etna topography derived from a DEM and the elastic medium heterogeneity estimated from seismic tomography were considered. In this framework, we numerically computed the elastic deformation and strain field caused by an ellipsoidal depressurizing source and explored the ranges of its depth, aspect ratio and volume change in order to match the observed changes. The numerical computations pointed out a source located at 0 km bsl, which undergoes a volume change of ca. 2 millions of cubic meters. The ellipsoid aspect ratio of 0.5 is consistent with the hypothesis of an elongated source simulating the shallow conduit processes. The volume change is in agreement on average with the estimates of the emitted volumes during the several fountain events.