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Geodetic constraints to the source mechanism of the 2011–2013 unrest at Campi Flegrei (Italy) caldera

Elisa Trasatti (1), Marco Polcari (1), Maurizio Bonafede (2), and Salvatore Stramondo (1)
(1) INGV, Rome, Italy (elisa.trasatti@ingv.it), (2) University of Bologna, Bologna, Italy

Campi Flegrei (Italy) is a nested caldera and together with Vesuvius is one of the Italian GEO Geohazard Supersites (GSNL). The area is characterized by one of the highest volcanic hazard of the world, due to the very high density of inhabitants (1800/km^2), the persistent activity of the system and the explosive character of volcanism. A major unrest episode took place in 1982-84, when the town of Pozzuoli, located at the caldera center, was uplifted by 1.80 m. Minor uplifts of few centimeters, seismic swarms and degassing episodes took place in 1989, 2000 and 2004-06. Since 2005 Campi Flegrei is uplifting, reaching a ground velocity of 9 cm/yr in 2012, showing that the caldera is in a critical state on the verge of instability. In this work, we present results from SAR Interferometry and geodetic data modelling at Campi Flegrei in the framework of the EU's FP7 MED-SUV Project. We exploit two COSMO-SkyMed data sets to map the deformation field during 2011-2013. The spatial distributions of the cumulative displacement from COSMO-SkyMed ascending/descending orbits show similar behaviors, confirming the bell-shaped pattern of the deformation at least within the inner rim of the caldera. The resulting data, together with GPS data from the Neapolitan Volcanoes Continuous GPS network (NeVoCGPS) is fitted through a geophysical inversion process using finite element forward models to account for the 3D heterogeneous medium. The best fit model is a north dipping mixed-mode dislocation source lying at $\sim$5 km depth. The driving mechanism is ascribable to magma input into the source of the large 1982–1984 unrest (since similar source characteristics were inferred) that generates initial inflation followed by additional shear slip accompanying the extension of crack tips. The history and the current state of the system indicate that Campi Flegrei is able to erupt again. Constraining the defomation source may have important implications in terms of civil protection and the advanced techniques adopted provide useful information for short-term forecasting.