

The 2009-2013 uplift at Campi Flegrei caldera, Italy: does continuous GPS monitoring demand a predominant source different from that of the major 1982-1984 unrest?

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Campi Flegrei (CF) is one of the most active volcanic systems of Southern Italy. It is a resurgent caldera located 15 km west of Naples inside the Campanian Plain, a graben-like structure at the eastern margin of the Tyrrhenian sea. Several eruptions have occurred during historical times, the last one in 1538.

CF periodically experiences notable unrest episodes which include seismic swarms, increases in the degassing activity and ground deformations. The 1970-1972 and 1982-1984 uplift episodes produced a cumulative vertical displacement of more than 2.5 m at the town of Pozzuoli. About 15000 shallow earthquakes (maximum magnitude 4) occurred during the 1982-1984 unrest. The ground has generally subsided between 1984 - 2000 at decreasing rate. During and after the subsidence phase, uplift episodes occurred in 1989, 1994, 2000, 2006. After partial recovery of the 2006 episode, the ground is generally uplifting at an increasing rate. From 2011 cumulative uplift is about 14 cm.

Osservatorio Vesuviano, department of Istituto Nazionale di Geofisica e Vulcanologia, is in charge of monitoring CF. Ground deformations are monitored by means of classical (e.g. leveling and tiltmetry) and satellite (e.g. GPS and SAR) techniques. Eleven GPS sites of the NeVoCGPS (Neapolitan Volcanoes Continuous CGPS) network are located inside CF. The oldest stations have been active since thirteen years and the newest since 4 years. Data processing is performed by the Bernese Processing Engine of the Bernese GPS software version 5.0.

Here we have used GPS data from 2009. At first, we have cross-compared the time series of the three displacement components (Eastward, Northward, vertical) of each station to search for possible time variations in the horizontal displacement direction and vertical-to-horizontal ratio. Then, the time series of the different stations have been compared with each other to search for local anomalies. Both tests have given negative results. In other words, the deformation pattern depicted by GPSs remains constant during the whole test period.

We have also compared the GPS time series with deformation data related to the 1982-1984 unrest. The latter data set originates from leveling and triangulation (EDM and angular) surveys; horizontal displacements are given with respect to a local coordinate system whose origin coincides with a reference triangulation monument and whose y-axis points toward a second one. Since GPS horizontal displacements radiate from a common center, we have searched for a roto-translation capable to make the 1982-1984 horizontal displacements radial. We have found that both (2009-2013 and 1982-1984) radiating centers and displacement (vertical and horizontal) patterns coincide within uncertainties, suggesting a common predominant source.