

The Ground Deformations: tools, methods and application to some Italian volcanic regions

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Abstract

The objective of this thesis is the study of slow deformation of the soil as a result of intrusion of magma inside the magmatic chambers of some volcanoes located in Southern Italy. In particular, the Mt. Vesuvius and Campi Flegrei caldera have been monitored over the last 7 years. The research has been accomplished through the use of geodetic instrumentation (long baseline tiltmeters, Sacks-Evertson dilatometers) that has been installed during the entire period of the research near the aforementioned volcanoes. The data were recorded with the aid of data-logger, some of which are specifically designed for the current research.

Campi Flegrei and Mt. Vesuvius are two volcanoes located near Naples, already monitored by Osservatorio Vesuviano, the local office of INGV (Istituto Nazionale di Geofisica e Vulcanologia). In the last 40 years systematic recordings of seismic data, of changes in distance of milestones, of leveling lines, of local gravimetric anomalies and of GPS-InSAR data have been carried out. Starting from 2004, the monitoring network maintained by Osservatorio Vesuviano has been enriched by the DINEV project: this is intended as a complementary network of geodetic stations and consists in the installation of a small array of 6 borehole stations (with an average depth of 120 m), each of which is constituted by a three components borehole broadband seismometer Teledyne Geotech KS2000BH and a Sacks-Evertson areal strainmeter (dilatometer). In addition, two three components surface broadband seismometers Guralp CMG 3-ESP have been installed to control the anthropogenic surface noise.

In Campi Flegrei caldera, then, another array of instruments has been installed: two long baseline water tiltmeters have been installed in Italian Army abandoned tunnels. The total length of tiltmeters is about 350 m for the northernmost tunnel, and of about 150 m for the southernmost tunnel. Tiltmeters were installed, respectively, in axial and tangential direction in respect with the position of the Campi Flegrei magmatic chamber.

The use of the instruments described in the current report allows to model the strain field in the range of low frequencies, monitoring the deformation tensor for its non-diagonal components (pure tilt) by using the tiltmeters, and the diagonal components (pure deformation) by using the dilatometers.

The monitoring is occurred for a time range of some years in length, needed to remove the seasonal drifts due to changes in rainfalls, while the deformation due to changes in barometric pressure have been deleted using linear regression techniques.