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The 2011 volcanic crisis at El Hierro (Canary Islands): monitoring ground deformation through tiltmeter and gravimetric observations

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El Hierro is an ocean island located at the western end of the Canary Islands, and along with Tenerife and La Palma islands have been the most geologically active in the recent past. The island has a triple armed rift and, presently, is at the stage of growth, representing the summit of a volcanic shield elevating from the seafloor at depth of 4000 m up to 1501 m above the sea level (Münn et al., 2006; Carracedo et al., 1999).
Since July 19th, 2011 seismic activity has produced more than 11950 events up to date. The seismic crisis resulted in a volcanic eruption that began on October 10th, being still currently active. The new volcano is located 2 km off the coast and about 300 m depth, in the submarine flank of the southern rift of the island, which is extended some 40 km length.
Since September 2004 until November 2010 two continuous tilt stations were installed at the north, Balneario site (BA), and at the center of the island, Aula de la Naturaleza (AU) site. Both stations were used to assess the pattern of local ground movements in the island. When seismic swarm started on past July 2011, we have reinstalled both tilt stations (BA and AU) and 2 new ones located at the south of the island, namely Montaña Quemada (MQ) and Restinga (RE) sites. We have used short base platform tiltmeters that measure ground tilts with resolutions varying from 0.1 up to 0.01 microradians (μrad).
On October 8th, a 4.4 magnitude earthquake took place and is supposed that fractured the ocean crust at some 8-10 km off the south coast of the island and about 1000 m depth. Typical spike signals were observed at the tilt stations. Two days after, the eruption onset was recorded also at tilt stations through a remarkable increase of the high frequency signal, being of large amplitude the components (radial) orientated towards the new volcano edifice. When compared with previous tiltmeter records in the island, tilt pattern were clearly modified several times at the stations when strong and shallow earthquakes happened, producing in some cases large tilt variations of tens of μrad.
By other side, in 2003 we established a control gravity network that was measured again in 2004 and 2008. After the beginning of the eruption on October 2011, we have carried out gravity measurements in various points of the network as well as other new points to attain more accurate control of the possible variations of gravity or/and altitude. Gravity data are still under study although some results about observed gravity changes could reflect the ground deformations pattern according to tiltmeter records and GPS measurements, or a change in the subsurface mass distribution as consequence of the new emplacement the magmatic material in the area with volcanic and seismic activity.