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GPS application to the study of ground deformation in the volcano tectonic systems of the Terceira Island (Azores) – preliminary results

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The Azores Archipelago comprises nine volcanic islands, located where the Eurasian, American and African plates meet. Due to this complex tectonic setting seismic and volcanic activities are frequent in the archipelago. Since its settlement, in the 15th century, several volcanic eruptions and destructive earthquakes have been reported causing thousands of deaths and severe damages. Last eruption in the Azores occurred at sea, from 1998 until 2001, almost 10 km W of Serreta (Terceira Island). Ground deformation due to volcanic magma intrusion is recognised as an important precursor of eruptive activity at a volcano. The GPS is ideally suited for this application by being able to measure three-dimensional coordinate changes of the monitoring points over time. A comprehensive volcano-monitoring program should include techniques to measure surface deformations in order to contribute to a complete characterization of volcanic behaviour. Conventional modern geodetic techniques provide useful tools for the acquisition of discrete or continuous ground-deformation data. In the scope of the Azores seismovolcanic monitoring programme a geodetic network was implemented in Terceira Island. Forty geodetic benchmarks which include two permanent stations distributed according to the main volcanic and tectonic structures in the island. In the last six years five survey-mode campaigns have been performed, and the absolute velocities and internal deformations of the island have been evaluated from 2003 to 2009. Bernese 5.0 Software was used for GPS data processing and estimation of station coordinates and velocities for the periods.

Obtained velocity fields considering S. Miguel Island fixed shows subsidence over all of the island and oblique displacement along Terceira Rift. This supports the existence of the shear zone between S. Miguel and Terceira Islands. Regarding internal deformations in the island, the lower magnitude of horizontal velocities indicate apparently stable regime which corresponds to the absence of major seismic events during the periods in the island. However, comparing with its surroundings, more prominent subsidence can be recognized in the middle part of the island where the active volcanic systems exist, such as Pico Alto, the central caldera Guiherme Moniz, and the Fissural Zone which has the most recent eruptive centers on land in Terceira (1761 AD). The analysis of GPS data over 6 years revealed time-dependent process of ground subsidences in the volcano tectonic systems of Terceira Island.