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# Deformation Monitoring of the Wider Area of Kaparelli - Plataies with the Contribution of Multitemporal SAR Interferometry and Copernicus Earth Observation Images

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Characterizing active faults and quantifying their activity are major concerns in Greece. Geodetic measurements including GPS and leveling have provided valuable observations of crustal deformation. The GPS network, with stations generally spaced less than 10 km apart, could highlight mainly regional and in some cases local displacements. However, these measurements do not provide the high spatial resolution needed to detect in detail surface creep on individual faults.

Monitoring of active faults in areas of high exposure both building store and population is of great importance, providing useful information to assess seismic hazards and risks.

Our study area is located in the Beotian geographic department of Greece (Kaparelli – Plataies area) and ends up in the eastern Gulf of Corinth (Kalamaki bay). Surface topography and geomorphology of the Corinth Gulf are clearly associated with seismic activity along large normal faults. The 1981 earthquake sequence, which was characterized by shallow earthquakes (<10km) and magnitudes greater than 6 (Abercrombie et al., 1995), and especially the third shock, ruptured the Kaparelli fault which was activated during that period and produced extensive ground deformation. The fault is characterized as a complex fault zone due to its numerous fault segments. It is a south dipping normal fault with an active fault plane dipping at about 45o. This fault is a segment of a greater normal fault zone that is situated to the north of Parnitha Mountain in Central Greece. Recent geological data (Drakatos et al., 2005) showed that the Kaparelli area forms the boundary between fast-slipping normal faults in Corinth-Perachora regions and slow-slipping faults in Viotia, Attica.

Spaceborne Synthetic Aperture Radar (SAR) interferometry is a technique that produces 3D topographic data of Earth's surface directly from two SAR images (Bamler and Hartl, 1998). An extension of the basic technique, called differential SAR interferometry (DInSAR), allows measurements of land deformation and it has various applications in the fields of volcanology, cartography, crustal dynamics, slope instabilities and land subsidence. Using large stacks of SAR images acquired over the same area, long deformation time series can be analyzed using multi-temporal differential SAR interferometry techniques like Permanent Scatterers Interferometry (PSI) (Ferretti et al., 2001), Small Baseline Subset (SBAS) (Berardino et al., 2002), Interferometric Point Target Analysis (IPTA) (Werner et al., 2003), Stanford Method for Persistent Scatterers (StaMPS) (Hooper et al., 2004), Coherent Pixel technique (CPT) (Blanco-Sanchez et al., 2008). Multi-temporal DInSAR is nowadays a well-documented technique for the characterization of ground motions over large spatial areas and is capable of detecting movements with metric resolution and millimetric accuracy.

The area of interest is a part of the Corinthian Gulf characterized by active tectonism and seismic activity.

The main purpose of this paper is to detect potential displacement along the Kaparelli fault and its strands by the synergy of MTInSAR and geological field observations. Concerning MTInSAR a rich dataset of 92 ascending and 55 descending SLC Sentinel 1 A & B scenes covering the period October 2014 to November 2018 were processed using the SARPROZ s/w following the Persistent Scatterers Interferometry technique (PSI). Field observations include a fault scarp height model (based on field data) and a map of the main ruptures' traces (based on field measurements, using Field Move Clino app).

Combining interferometric results and geological field work can lead to a better understanding of a fault's movement and the ground deformation that it causes and thus contribute to seismic hazard assessment. Although monitoring concerns a short period few patterns of low rate of deformation are detected and an attempt to associate them with the local tectonism.

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