



InSAR analysis of the crustal deformation affecting the megacity of Istanbul: the results of the FP7 Marsite Project as a GEO Supersite Initiative

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The North Anatolian Fault (NAF) is one of the most active faults worldwide, extending approximately 1,200 km from Eastern Turkey to the Northern Aegean Sea. During the 20th century series of damaging earthquakes occurred along the NAF, generally propagated westward towards Istanbul; the last one occurred in 1999 at Izmit, a city 80 km away from Istanbul. Within this scenario, the FP7 MARSite project (New Directions in Seismic Hazard assessment through Focused Earth Observation in Marmara Supersite), supported by EU, intends to collect, share and integrate multidisciplinary data (seismologic, geochemical, surveying, satellite, etc.) in order to carry out assessment, mitigation and management of seismic risk in the region of the Sea of Marmara.

In the framework of the MARSite project, we performed the analysis and monitoring of the surface deformation affecting the Istanbul mega city by exploiting the large archives of X-band satellite SAR data, made available through the Supersites Initiatives, and by processing them via the advanced multi-temporal and multi-scale InSAR technique, known as the Small BAseline Subset (SBAS) approach.

In particular, we applied the SBAS technique to a dataset of 101 SAR images acquired by the TerraSAR-X constellation of the German Space Agency (DLR) over descending orbits and spanning the November 2010 - August 2014 time interval. From these images, we generated 312 differential interferograms with a maximum spatial separation (perpendicular baseline) between the acquisition orbits of about 500 m., that were used to generate, via the SBAS approach, mean deformation velocity map and corresponding ground time series of the investigated area. The performed InSAR analysis reveals a generalized stability over the Istanbul area, except for some localized displacements, related to subsidence and slope instability phenomena. In particular, we identified: (i) a displacement pattern related to the Istanbul airport, showing a mostly linear deformation trend with a velocity of about 1 cm/yr, although a slowdown effect is observed starting from early 2014, and (ii) a subsidence phenomenon in correspondence to Miniaturk park with a mean velocity value of about 1.5 cm/yr.

Moreover, by benefiting from the recent launch of the C-band Sentinel-1A (S1A) satellite (April 2014), developed within the European Commission Copernicus Programme, we performed a more recent InSAR analysis of the Istanbul mega city and its surroundings by exploiting datasets collected during the October 2014 - December 2015 time interval. In such a way, we are able to investigate possible changes in the spatial and temporal deformation rates of the detected displacements over time with the aim to improve the comprehension of the deformation processes already occurred and/or occurring in this area.

The obtained results, generated within the MARSite project, are expected to be available to scientific community through the Geohazards Exploitation Platform (GEP), an ESA platform aimed at supporting the exploitation of satellite EO data for geohazards, to be fully compliant with some of the major issues of the Supersites Initiative, as well as to foster the InSAR data sharing within a wider scientific community.