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# InSAR analysis of ground deformation over the Istanbul Area in the framework of the FP7 MARsite Project

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The FP7 MARsite project (New Directions in Seismic Hazard assessment through Focused Earth Observation in Marmara Supersite), is aiming at providing complete geodetic records of crustal deformation for major continental earthquake occurring in the Marmara region through repeated GPS, InSAR, gravity and seismological observations.
One of the goals of the project is the long-term continuous geodetic monitoring of the crustal deformation affecting the Istanbul area using large archives of X-band satellite SAR data, made available through the GEO Supersites Initiative. To this aim, we processed the available SAR datasets by exploiting the multi-temporal and multi-scale InSAR techniques known as Small BAseline Subset (SBAS, Berardino et al., 2002) and StaMPS (Persistent Scatterer Interferometry, Hooper et al., 2007), which have the potential of providing new insights into the spatial and temporal patterns of the investigated phenomena.
The results achieved in the first 2 years of the MARsite project over the megacity of Istanbul are presented. IREA-CNR applied the SBAS technique to a dataset of 101 SAR images acquired by the TerraSAR-X constellation over descending orbits, spanning the interval from November 2010 to August 2014. 312 differential interferograms were generated.
INGV applied the StaMPS PSI approach (Hooper et al., 2007) to COSMO-SkyMed SAR images acquired from two different ascending tracks, consisting of 29 and 64 image strips for the Eastern and the Western tracks respectively, and covering the period between 2011 and 2013. Two sets of 28 and 63 differential interferograms were generated for the two tracks.
The resulting ground velocity maps show several localized deformation sources in the urban area, due to subsidence and/or slope deformation. No clear long spatial wavelength tectonic patterns are visible, possibly due to the limited extent of the X-band satellite swaths ($\sim$40 km). We identified a displacement pattern related to the Istanbul airport, showing a mainly linear deformation trend with a velocity of about 1 cm/yr.
We started a detailed investigation of the causes of the detected local deformation. We used a stereo pair of very high resolution (0.6 m) satellite images (Pleiades satellite) to carry out a photogeological interpretation which allowed us to identify and characterize various gravitational phenomena in the Avcilar peninsula. The identified gravitational elements are represented by flows, complex landslides, translations and paleolandslides. They have been classified in certain, inferred and quiescent. We identified linear elements associated with landslides, as escarpments and paleo-escarpments over a trench associated to a deep-seated gravitational slope deformation. Terraces, paleo-terraces, counterslope terraces, solifluctions and unmapped landslides were also identified.
The comparison of the identified morphological features with the present ground deformation rates allowed to identify and characterise the active gravitational movements.