Permanent Scattering InSAR– A New Technique for Detecting mm-scale Ground Movements, Applied to the Area Adjacent to the Carmel Fault System

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We present the first application of high-resolution deformation detection in Israel by the Permanent Scattering Interferometric Synthetic Aperture Radar (PSInSAR) technique. Conventional InSAR carries the potential to detect sub-centimeter scale target displacements along the satellite's Line-Of-Sight (LOS) direction, with limitations resulting from temporal and geometrical decorrelation, atmospheric artifacts and cycle ambiguity.

The PSInSAR approach (see T.R.E web site: http://213.215.195.35/tresite_eng /tecnicaps/subtecnicaps/interferometria/index.htm) is based on two basic observations: (1) Atmospheric artifacts show a strong spatial correlation, but they are uncorrelated in time. (2) Target motion is usually strongly correlated in time and can exhibit different degrees of spatial correlation depending on the phenomenon at hand. Therefore, atmospheric effects can be estimated and removed by combining data from long time series of SAR images. In order to exploit all the available images, and then improve the accuracy of the estimation, only scatterers slightly affected by both temporal and geometrical decorrelation are selected (hereafter called Permanent Scatterers). This allows pixel-by-pixel selection with no spatial averaging. Relative target LOS-velocity can be then estimated with unprecedented accuracy (often better than 0.1 mm/yr – depending on time span). The results are computed with respect to a ground control point of known location, elevation and motion.

The study area covers Mt. Carmel, between the city of Haifa and the Zevulun plane in the north and Menashe Hills in the south. The area is located adjacent to the Carmel Fault System (CFS), which is regarded as an active fault, with high seismic risk due to its proximity to large population centers and petrochemical industry. The current deformation in this area is presented with an unprecedented spatial resolution.

This study was carried out within the framework of the *Terrafirma* Pan-European service for ground motion hazards. We analyze measurements of deformation time series and average annual rates that were carried out by T.R.E, Milano using 47 ERS-1 and ERS-2 satellite images acquired between April 1992 and December 2001. At present, the observed deformation does not seem to correlate with other deformation indicators, such as water-level changes, catalog seismicity, and slope stability. However, there is apparent correlation between PSInSAR-detected ground movement and deformations observed in pavements and buildings in Lev-Hamifratz shopping center. In addition, an attempt is made to explain some of the observed deformations in the Yoqne'am-Jalame area by a fault model that assumes left-lateral strike-slip motion along the NW-striking Carmel Fault segments.