Current ground movements in Mt. Carmel: stacking of InSAR measurements and elastic modeling

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The Carmel Fault is considered as "potentially active". We present new Interferometric Synthetic Aperture Radar (InSAR) measurements of the current deformation in the vicinity of the fault in an attempt to resolve the crucial dilemma whether the fault is indeed active or not. Conventional InSAR studies have demonstrated the potential of this technique to detect sub-centimeter ground displacements along the satellite to ground line of sight, with limitations resulting mainly from temporal and geometrical decorrelation, atmospheric artifacts and cycle ambiguity. InSAR is most effective for measurement of large deformation features such as those associated with earthquakes. When trying to apply this technique to measure areas with little or no deformation, such as interseismic deformation, it is difficult, in many cases, to distinguish between the real deformation and the effect of atmospheric signal. To overcome this difficulty in the analysis of the Carmel Fault and minimize the atmospheric noise we use a stacking technique, in which we add the phase changes from all the available interferometric pairs, and divide the sum by the total time span of the measurements. We assume a constant deformation rate and a random atmospheric signal.

We use three different datasets of the European Space Agency (ESA) ERS-1 and ERS-2 satellites, acquired between April 1992 and December 2001. Interferograms were generated by the JPL/Caltech ROI-PAC software.

Our results show a significant improvement of the signal-to-noise ratio as the number of interferograms in the stack increases. Relative uplift rate of ~1 mm/yr is observed in the western side of the Carmel with respect to the eastern slopes. We detect no evidence of surface rupturing on the Carmel Fault itself but we observe an uplifted area in the Hills south of Tivon and east of the N-S segment of the Carmel Fault which suggests transpression at a right bend of the fault due to left-lateral slip. This feature is in agreement with our previous analysis of the region by Permanent Scatter (PS) InSAR. Finally, an attempt is made to explain the observed deformation by elastic dislocation fault models which assume a left-lateral movement on the fault associated with a reverse component.