Resolving Vertical Tectonics in the San Francisco Bay Area from Permanent Scatterer InSAR and GPS Analysis

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Abstract

Using a combination of GPS-measured horizontal velocities of 200 sites and range-change rates determined with the permanent scatterer InSAR method in the San Francisco Bay area, we resolve vertical motions in the region at sub-mm/yr. precision. The highest displacement rates are due to non-tectonic processes, such as active landslides (Hilley et al., 2004), subsidence and rebound over aquifers (Schmidt et al., 2003), and rapid settling of unconsolidated sediments along the Bay margins (Ferretti et al., 2004). Residual displacement rates are determined by removing the contribution of the GPS-derived horizontal velocity field from the InSAR range-change rates. To isolate vertical tectonic rates, we use only those InSAR measurements made on material that was not Quaternary substrate, which is susceptible to non-tectonic and seasonally varying ground motions. The InSAR residuals indicate significant uplift over the southern foothills of the active Mt. Diablo anticlinorium, the Mission Hills stepover region of the Hayward and Calaveras faults, and the central and southern Santa Cruz Mountains located along a restraining bend of the San Andreas fault. Along the section of the San Andreas fault, where the 1989 Mw=6.9 Loma Prieta earthquake occurred we find a zone of 1–2 mm/yr. subsidence and residual contraction in the GPS data that appears to be a transient feature associated with persistent postseismic viscous relaxation following the earthquake.