Surface Deformation in Western Basin and Range Observed by Satellite Radar Interferometry.

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The Western Basin and Range Province is one of the most active areas in North America, accommodating 25% of the relative plate motion between the Pacific and North American plates. This area is a typical example of an active continental extension, but it is not well understood what mechanism drives deformation and how it distributes at depth. In order to understand the pattern of deformation in this region we need to resolve the surface deformation field with precise measurements and broad spatial resolution. We use ERS 1,2 Interferometric SAR (InSAR) time-series data to study 5 descending swaths nearly 700 km long, covering the Central Nevada Seismic Belt (CNSB) in the west, the Eastern California Shear Zone (ECSZ) in the south and the Nevada-Utah border in the east (Fig. 1). Each track consists of about 40 orbits, which significantly reduces atmospheric errors when producing dense networks of interferograms. We only exploit pixels of the interferograms, which remain coherent through time in the SAR dataset. Our time-series mean velocity maps reveal several tectonic and non-tectonic signals in Line-of-Sight (LOS). Our results indicate that some regions are experiencing LOS elongation, such as Lone Tree Gold Mine, which reflects subsidence due to groundwater pumping. In CNSB we detect a broad area of uplift with velocities as high as 2 to 3 mm/yr. Previous studies based on averaging of 8 independent interferograms explained this uplift as post-seismic mantle relaxation after a sequence of four earthquakes (M ~ 7) that occurred in the first half of the 20^{th} century. Additionally we observe localized deformation near some faults with velocities as high as 3 to 4 mm/yr that may reflect both tectonic horizontal motion and deformation due to hydrological processes. We take the advantage of the different viewing geometries of the overlapping areas to invert the data for the 2D velocity field in vertical and east-west motion. We apply this method in two test areas, Cortez Mountain Fault and Long Valley Caldera. To validate the 2D inversion we produce synthetic time-series with different deformation models and analyze the contribution of short and long-wavelength noise. Long-wavelength noise is introduced to InSAR data from uncertainties in the satellite orbits, and an improper estimation and removal of these artifacts can lead to significant error in the estimated displacements. To understand how these errors affect our results we produce time-series in non-deforming areas and analyze long-wavelength residuals in terms of vertical and horizontal baseline errors, however ERS SAR imagery in non-deforming areas is limited in temporal and spatial coverage. We thus extend our analysis of ERS data using the InSAR time-series near the Nevada-Utah border, were observations show low rates of deformation as expected.

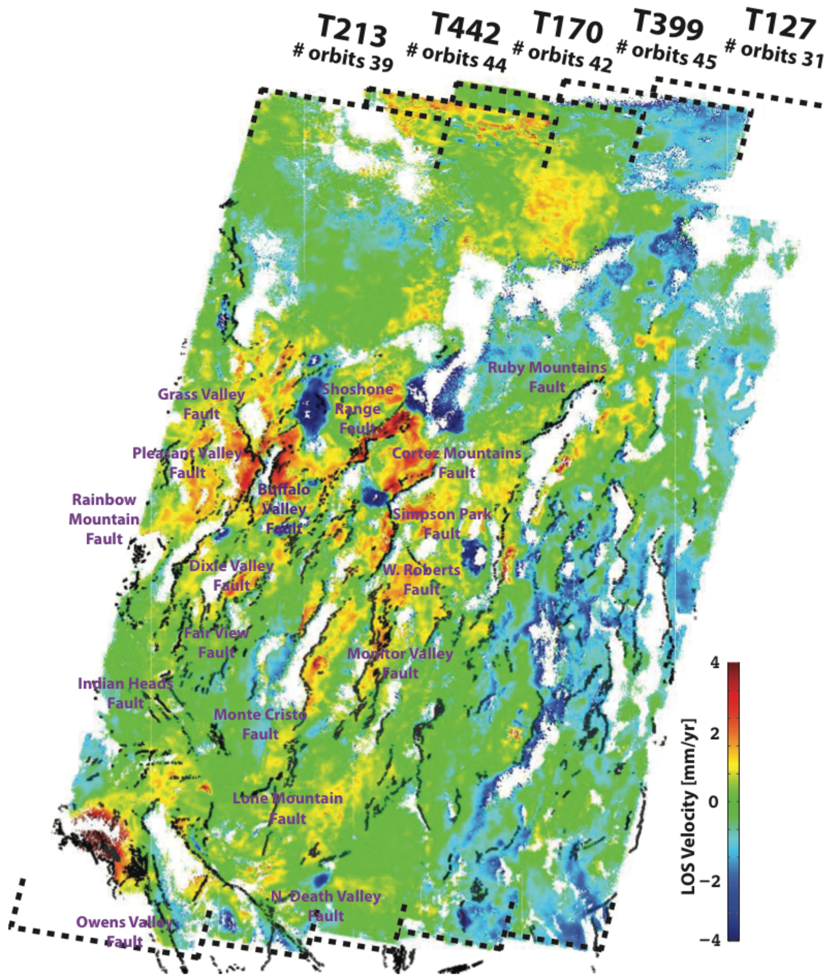

Figure1. InSAR time-series results showing the mean LOS velocities for five adjacent tracks in western and central Basin and Range province. Orbital errors are corrected using the horizontal and vertical baseline error correction and assumed zero deformation. Solid lines are Historic and Holocene to Latest Pleistocene Faults (U.S. Geological Survey and California Geological Survey, 2012).