

Interferometric Synthetic Aperture Radar (InSAR) is a method for mapping 1-dimensional displacements of the earth's surface. Combining images acquired from multiple unique satellite orbit paths allows for the two dimensions to be reasonably well resolved. However, the dimension parallel to the satellite flight path (typically north-south) is poorly resolved by InSAR. We present comparisons of methods for recovering 3D displacements using multiple line-of-sight geometries from InSAR measurements. This includes a method that takes advantage of constraints from elastic Green's functions and requires no prior assumptions about the physical processes governing the deformation. We tested this method on an uplift signal in the Coachella Valley of southern California -- a site of active groundwater entrainment. This area is covered by 2 overlapping paths from both ascending and descending orbits, providing 4 unique line-of-sight geometries. We constructed time series composed of 397 Sentinel-1 SAR images between November 2014 - May 2019 to analyze the deformation history and apply our method to recover 3D displacements. We found that our method improves upon more commonly used inversion methods and allows for better characterization of the displacement field and associated stresses acting on the basin bounding faults.