High resolution interseismic crustal velocity model of the San Andreas Fault System from GPS, InSAR, and a dislocation model

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Abstract

We recover the interseismic deformation along the entire San Andreas Fault System (SAFS) at a spatial resolution of 200 m by combining InSAR and GPS observations using a dislocation model. Previous efforts to compare 17 different GPS-derived strain rate models of the SAFS shows that GPS data alone cannot uniquely resolve the rapid velocity gradients near faults [SCEC UCERF workshop report, 2010], which are critical for understanding along-strike variations in stress accumulation rate and associated seismic hazards. To improve near-fault velocity resolution, we integrate new GPS observations [T. Herring, personal communication, 2010] with InSAR observations, initially from ALOS, using a remove/restore approach [Wei et al., 2010]. The integration uses a dislocation-based
velocity model [Smith and Sandwell, 2009] to interpolate the line-of-sight velocity at the full resolution of the InSAR data in radar coordinates. We use GMTSAR software [Sandwell et al., 2010] to process, stack, and filter hundreds of interferograms over the entire SAFS from the Mendocino Triple Junction to the Imperial fault in Mexico. Before stacking the unwrapped interferograms, we correct "phase jump" errors close to low coherence areas, which sometimes will corrupt signals near the fault. The initial results show previously unknown details in along-strike variations in surface fault creep. Moreover, the high-resolution velocity field can resolve asperities in these creeping sections that are important for calculating seismic moment accumulation rates and earthquake hazard probabilities. We find that much of the high-resolution velocity signal is related to non-tectonic processes (e.g., ground subsidence and uplift) sometimes very close to the fault zone. We mask the data from these anomalous zones to better isolate the interseismic signal. The refined model, initially based on ALOS (L-band) data, will be used to help unwrap the phase of C-band interferograms, which suffer from temporal decorrelation along most of the fault system. Multiple look directions will be needed to distinguish the horizontal and vertical motion at full spatial resolution.
Key Reference:


