Earthquake Cycle Model of the San Andreas Fault Constrained by GPS and ALOS Radar Interferometry

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Most slip-rate inversions for the San Andreas Fault (SAF) System use a block modeling approach assuming steady velocities. In this study we invert for the long-term slip rate on 50 major faults of the SAF System using Green's functions for an earthquake cycle model that includes kinematically prescribed slip events for the past 1000 years. We incorporate EarthScope PBO GPS velocity measurements, ALOS L-band InSAR line-of-sight (LOS) velocity data, geologically estimated quaternary fault slip rates, paleoseismic records and estimates of earthquake recurrence interval to construct a high-resolution deformation model of the entire SAF System, extending from the Cerro Prieto fault in the south to the Maacama fault in the north. We simultaneously solve for the fault slip rates and detailed creep distribution in an over-determined least squares problem for deformation computed by a 3-dimensional viscoelastic earthquake cycle model (Figure 1). By doing so we are able to refine the moment accumulation rates and the shear strain rates along major faults of the SAF, some of which are not well constrained by GPS data alone. Based on these results, we demonstrate how earthquake cycles can effect the estimation of fault slip rate in comparison with alternative elastic block models. We find that slip rates are generally increased when including viscoelastic relaxation, particularly along the Mojave segment of the SAF.

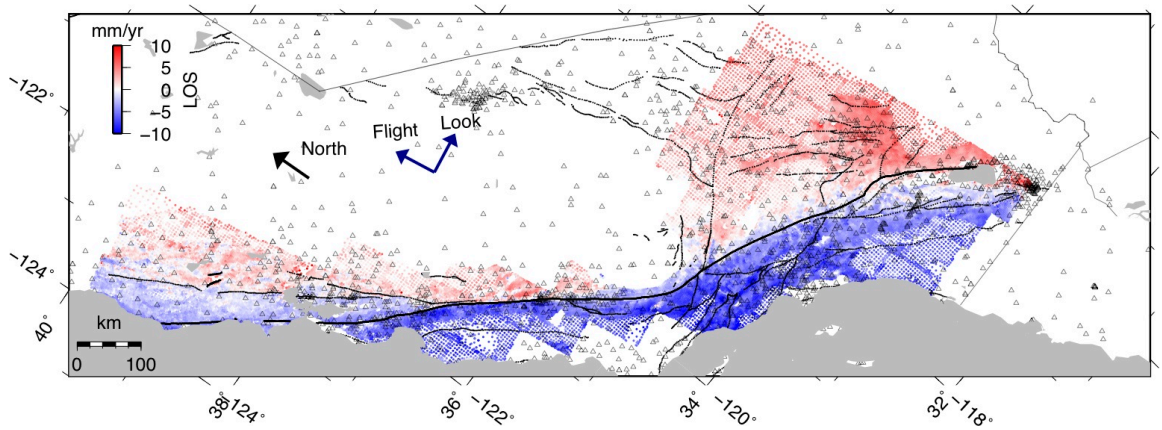

Figure 1. GPS (triangles) and InSAR LOS velocity data (colored grid) used in the slip-rate inversion (Oblique Mercator projection). InSAR data are derived from 1100 ALOS radar interferograms (2006.5-2010). The radar flight direction and look direction are provided. Positive velocities (red) represent ground motion away from the satellite. The geological fault traces are shown as black lines.