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Kinematic Inversion of the 2004 Mw6 Parkfield Earthquake from Strong-Motion Seismic Data and High-Rate GPS Data

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The 2004 Mw6 Parkfield earthquake was very well recorded in the near-field by a variety of geophysical instruments. In particular, a dense network of strong-motion seismographs and continuous 1-Hz GPS receivers recorded the mainshock. In this presentation we show a space-time slip distribution for the 2004 Parkfield earthquake from the combined inversion of seismic data from 43 strong-motion stations and GPS data from 13 high-rate receivers. All data used in the inversion were recorded within 20 km of the segment of San Andreas Fault that broke during the mainshock. We take into account local amplifications and resonances that affect individual seismic stations, by use of a correction factor and a weighting scheme, both based on observations of the 1983 Mw6.5 Coalinga earthquake. We apply a non-linear simulated annealing algorithm (Liu and Archuleta, JGR 2004) to invert both seismic and GPS data. This inversion procedure yields slip amplitude, rake angle, rupture velocity and rise time. The inversion is done in four-steps: 1) we invert the continuous 1-Hz GPS and seismic (strong-motion integrated) displacements; 2) we take the rupture model obtained in the previous step as a starting model to perform an inversion with the same data as above (differentiated continuous GPS + seismic strong-motion), but using velocity waveforms; 3) we use the rupture model obtained in the previous step 2 as a starting model, and repeat steps 1 and 2. This last step will refine the rupture model. This approach allows us to include the static field information in the inversion while keeping the high-frequency information of the velocity records. Previous inversions, based solely on strong-motion seismic data (Custodio et al., GRL 2005, Liu et al., BSSA submitted), have imprecise resolution of the slip that is more than 15 km NW of the epicenter. Given that the GPS network is located around Middle Mountain, NW of the epicenter, we expect the GPS data to provide a substantial improvement in the precision of the rupture models based on seismic data only.

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