Geophysical Research Abstracts
Vol. 16, EGU2014-3879, 2014
EGU General Assembly 2014

Near field ground motion variability in kinematic simulations of the 1992 Landers earthquake

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We investigate near field ground motion variability due to five different kinematic rupture models inverted from observed data for 1992 Landers earthquake. The ground motion simulations are accomplished by solving the elastic equation of motion using a generalized finite-difference method (Ely et al., 2008) that handles geometric complexity of the fault, 3D variations in the medium as well as topography. Simulated waveforms are calibrated against near-field strong-motion recordings. We then analyze a large data-set of ground-motions computed at 2000 sites, binned with respect to distance and azimuth to compute mean and standard deviation of peak ground velocity (PGV) and pseudo spectral acceleration (PSA) for all five source models. We consider 1D-velocity structures as used in the source inversions, and honor the geometrical complexity due to segmentation of the rupture models. Our simulations reveal that ground motion variability is reduced as the distance from the fault increases. Variability in the kinematic sources has considerable impact on the resulting shaking variability, although the five source models considered are derived by inversion of seismic and/or geodetic data. Simulated mean PSA and its standard deviation are larger compared to empirical estimates using the ground-motion prediction equation (GMPE) of Boore and Atkinson (2008), whereas simulated PGV are comparable to GMPE estimates. In addition, we find that intra-event ground motion variability is large both in forward and backward directivity region, strongest in the backward region, and smallest in the fault perpendicular direction. We then examine ground-motion variability with respect to directivity effects, due to a combination of rupture propagation and radiation pattern. The comparison of our simulations with and without Spudich and Chiou (2008) directivity corrections to Boore and Atkinson (2008) predictions indicates that slip heterogeneity is the key contributor to ground motion variability in the low frequency range.