TeraShake: Large-scale Simulation of Ground Motion in Los Angeles for a M7.7 Earthquake on the Southern San Andreas Fault.

K.B. Olsen and the SCEC CME Collaboration

We have carried out some of the largest and most detailed earthquake simulations completed to date (TeraShake), in which we model ground motions expected from a large earthquake on the southern San Andreas fault on a parallel supercomputer at the San Diego Supercomputer Center. The TeraShake calculations simulate 4 minutes of 0-0.5 Hz ground motion in a 180,000 km2 area of southern California, for a M 7.7 earthquake along the 199 km section of the San Andreas fault between Cajon Creek north of Los Angeles, and Bombay Beach on the shore of the Salton Sea. The San Andreas fault south of the 1857 rupture, with average recurrence intervals of 146-220 years, has not seen a major event since about 1690. The simulations include ruptures propagating both northwest-ward and southeast-ward on the fault. The TeraShake simulations use both kinematic (based on the 2002 Denali Earthquake) and dynamic (based on the 1992 Landers Earthquake) source models. We used the SCEC 3D Community Velocity Model Version 3.0 discretized into 200 m3 cubes. The results show that the chain of sedimentary basins between San Bernardino and downtown Los Angeles form an effective waveguide that channels Love waves along the southern edge of the San Bernardino and San Gabriel Mountains. Earthquake scenarios in which the guided wave is efficiently excited (northward rupture) produce unusually high long-period ground motions over much of the greater Los Angeles region. Intense, localized amplitude modulations arising from variations in waveguide cross-section can be explained to a remarkable level of accuracy in terms of energy conservation for the guided mode. While the kinematic and dynamic source models generate similar patterns of peak ground motions, those for the dynamic model are generally somewhat smaller than those for the kinematic source. The main reason for the latter finding is primarily less coherent wavefronts generated by the more complex dynamic rupture history. Adding to the uncertainty is nonlinearity induced by the higher-than-anticipated waveguide amplifications we have identified here, likely causing significant reduction of both shear modulus and Q factor in the near-surface layers.

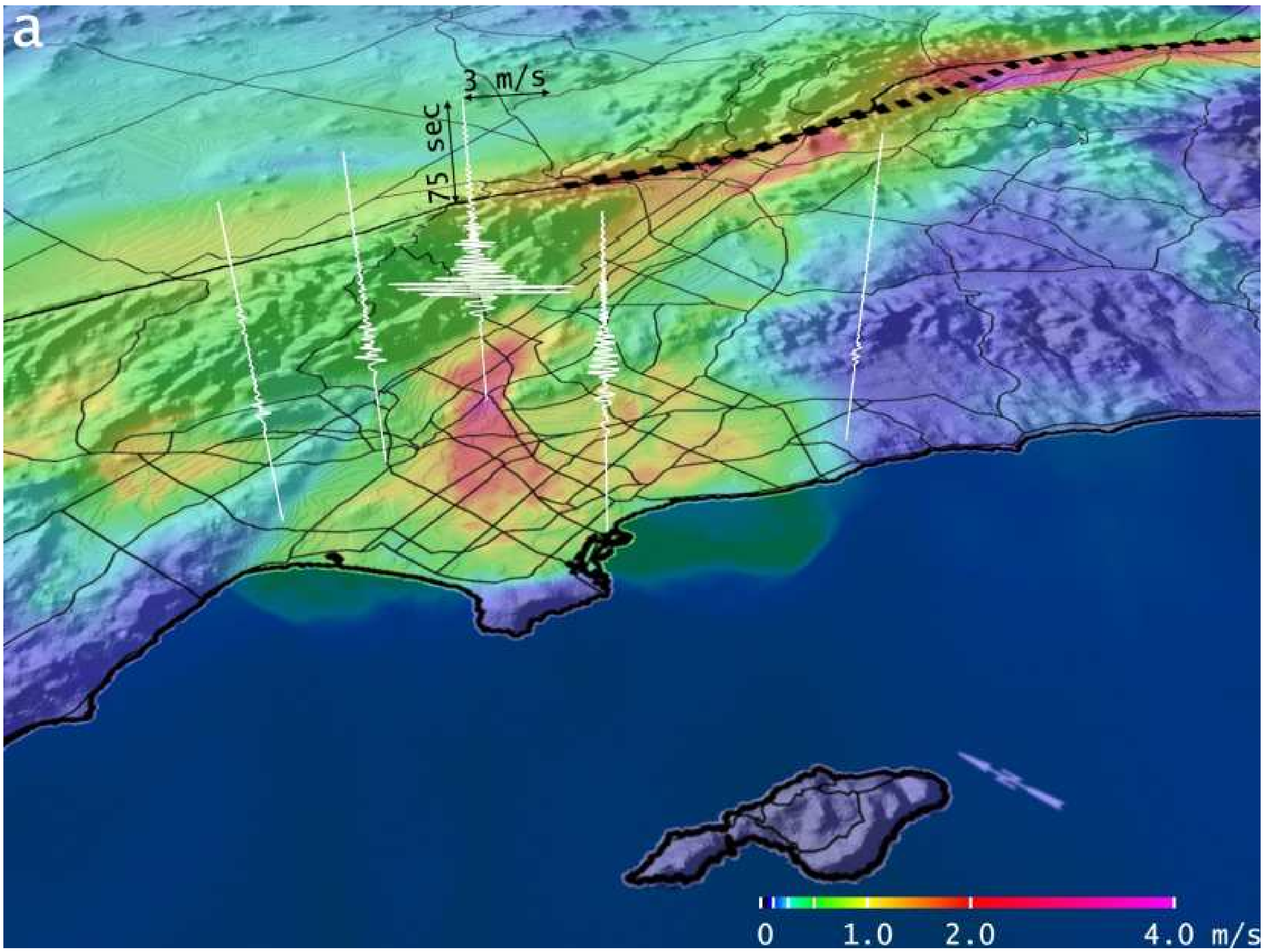

Figure 1: Maximum RMS PGV for the Terashake SE-NW rupture. N50W seismograms are superimposed at locations (from left to right) Westwood, downtown Los Angeles, Montebello, Long Beach, and Irvine.