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Evaluating Ground Motion Predictions of USGS 3D Seismic Model of the San Francisco Bay Area with Broadband Seismograms

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Disclaimer

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Text

The USGS (Menlo Park) developed a three-dimensional (3D) geologic and seismic model of the greater San Francisco Bay Area for the purposes of computing earthquake ground motions. This model was used to compute scenario ground motions for the 1906 San Francisco (Aagaard et al., 2008b), 1989 Loma Prieta (Aagaard et al., 2008a) and a suite of Hayward Fault earthquakes (Aagaard, et al., in press). While scenario ground motion calculations are important for investigating the amplitude, duration and variability of motions from large damaging earthquakes, the accuracy of such predictions depends on the accuracy of the 3D model. We evaluated the USGS 3D model of the Bay Area by computing predictions of broadband waveforms for 12 moderate (Mw 4-5) earthquakes and comparing them to the observed waveforms (Rodgers et al., 2008). Calculations were performed using *WPP* (an elastic finite difference code developed at LLNL) on massively parallel computers. Data were obtained from IRIS for Berkeley Digital Seismic Network (BDSN) and USArray broadband stations. The figure below shows a snapshot of the vertical component displacements for an earthquake near Glen Ellen (Sonoma County). Also shown is the comparison of the observed (blue) and computed (red) three-component seismograms at two stations: BKS (Berkeley) and JRSC (Stanford). Note that the motions at BKS are more complex and longer duration due to basin propagation effects from the San Pablo Bay, however the 3D model predicts this energy quite well. The motions at JRSC are simpler and the 3D model predicts the weaker late arriving energy on the transverse (T) component. This analysis found that the USGS 3D model could predict the amplitude, duration and waveform shapes of moderate earthquake ground motions quite well however we did find that phase delays reveal that shear velocities in the model were too fast. This information was used to revise the model for subsequent ground motion modeling.

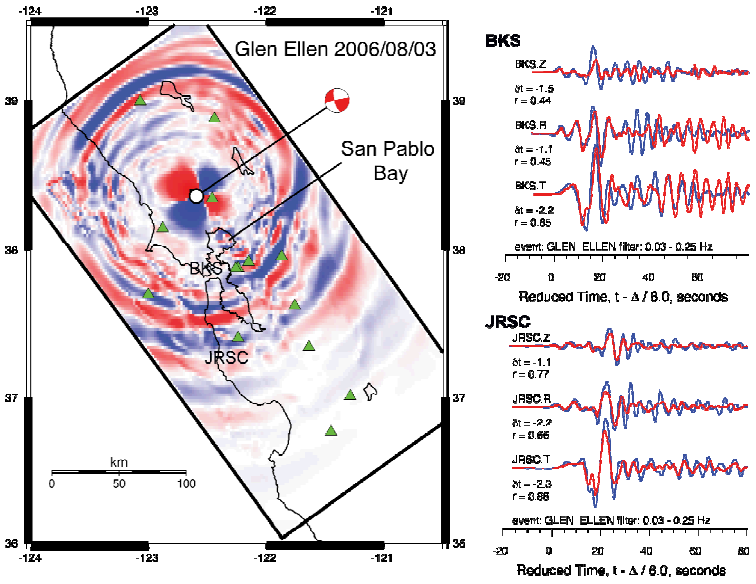

Figure. (left) Snapshot of vertical component displacement for an earthquake near Glen Ellen (indicated by circle and focal mechanism). Motions were computed for available BDSN and USArray broadband stations (green triangles). Note the complexity caused by the San Pablo Bay. (right) Comparison of observed (blue) and computed (red) three-component seismograms at stations BKS (Berkeley, top) and JRSC (Stanford, bottom). Synthetics have been shifted in time to optimize alignment.

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