January 09, 2010, 7:05pm PST

On January 9, 2010 at 16:27:38PST (January 10, 00:27:38UTC) a Mw 6.5 earthquake occurred approximately 43 km west of Ferndale, California. A Berkeley Seismological Laboratory (BSL) automated finite-source solution was computed for this event 20 minutes after its occurrence. The automated finite-source method is described in Dreger and Kaverina (2000) and Dreger et al. (2005).

Figure 1 shows the automated moment tensor solution (focal mechanism plot) and stations used in the finite-source inversion (blue triangles). Six stations with approximately 120 degrees of azimuthal coverage were utilized.

The Dreger and Kaverina (2000) method tests the two possible nodal planes using both line-source (Figure 2) and planar-source (Figure 3) models. Figure 4 shows the SW striking nodal plane gives the best fit to the data.

The broadband (0.01 to 10 Hz) displacement waveforms (black) and synthetic fits (red) are shown in Figure 5.

The assumed hypocenter is 40.6743 N latitude, 124.6552 W longitude at a depth of 16.4 km. Both the line-source and planar-source models show that the rupture was unilateral extending approximately 20-30 km to the SW at a speed of 2.2 km/s. The finite-source moment magnitude is Mw 6.6 with a corresponding scalar seismic moment of 6.7e25 dyne cm. The peak slip of both the line-source and planar-source models is approximately 2 meters, consistent with expectations for an earthquake of this magnitude.

Update: The new hypocentral depth of 21.7 km, three-component records from station MCCM were added, and a 1 second timing adjustment was applied to all stations to account for unmodeled structure. A rise time of 2s and rupture velocity of 2.2 km/s were assumed. Figure 6 shows the updated model, which remains unilateral to the SW. Slip is located in a narrow depth range +- X km about the hypocenter.

References

Dreger, D. and A. Kaverina (2000). Seismic remote sensing for the earthquake source process and near-source strong shaking: A case study of the October 16, 1999 Hector Mine earthquake, Geophys. Res. Lett., 27, 1941-1944.

Dreger, D. S., L. Gee, P. Lombard, M. H. Murray, and B. Romanowicz (2005). Rapid finite-source analysis and near-fault strong ground motions: Application to the 2003 Mw6.5 San Simeon and 2004 Mw6.0 Parkfield earthquakes, Seism. Res. Lett., 76, 40-48.

Figures

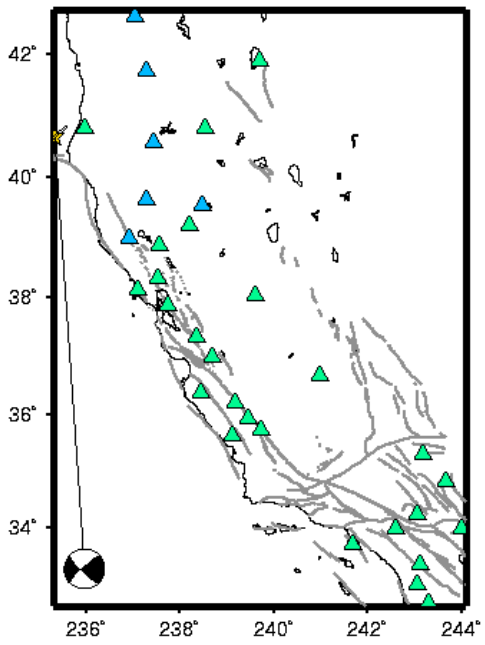

Figure 1. Location map. Star shows the location of the event with the automatic moment tensor solution. Available broadband stations are shown as triangles. The blue triangles show the stations used in the finite-source inversion.

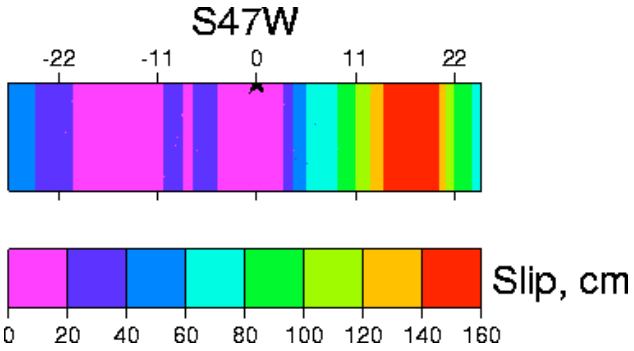

Figure 2. Line-source solution. Rupture is approximately 25 km to the SW along the azimuth S47W.

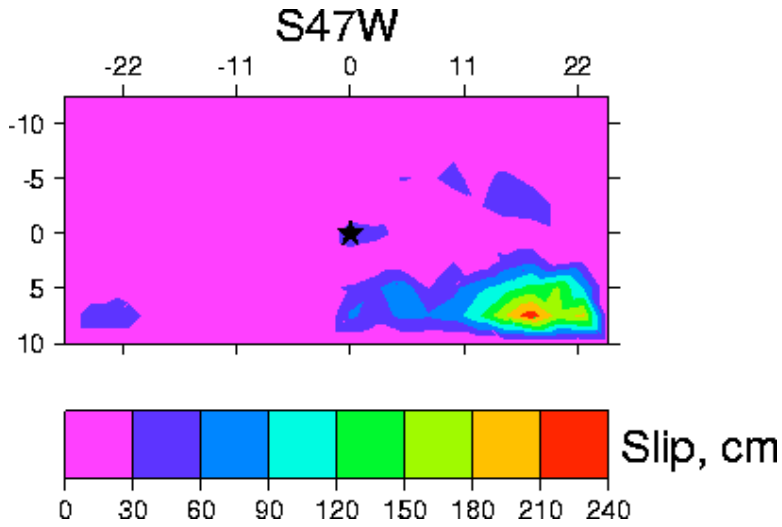

Figure 3. Planar source slip distribution. Hypocenter at 16.4 km depth is shown as a star. Relative depth and strike units are km. Slip is seen to extend approximately 25 km to the S47W.

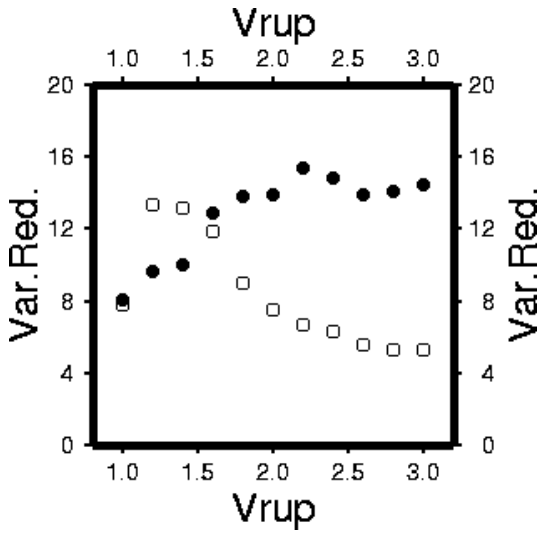

Figure 4. Fit (variance reduction) vs. rupture velocity for the SW (filled circles) and NW striking (unfilled circles) nodal planes. The best fit is for the SW plane and a rupture velocity of 2.1 km/s.

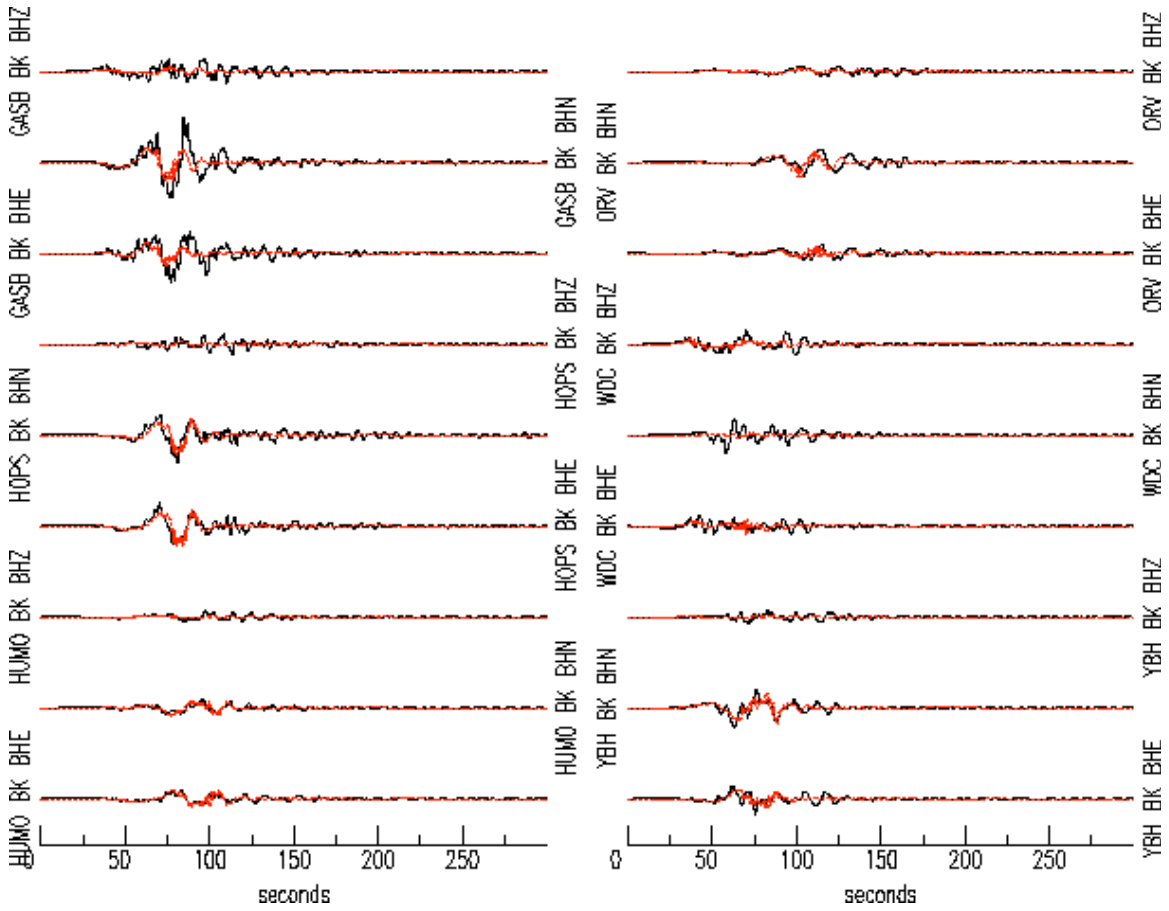

Figure 5. Observed (black) and synthetic (red) displacement seismograms for the best fitting source model (Figure 3). The data and synthetics were bandpass filtered between 0.01 to 10 Hz.

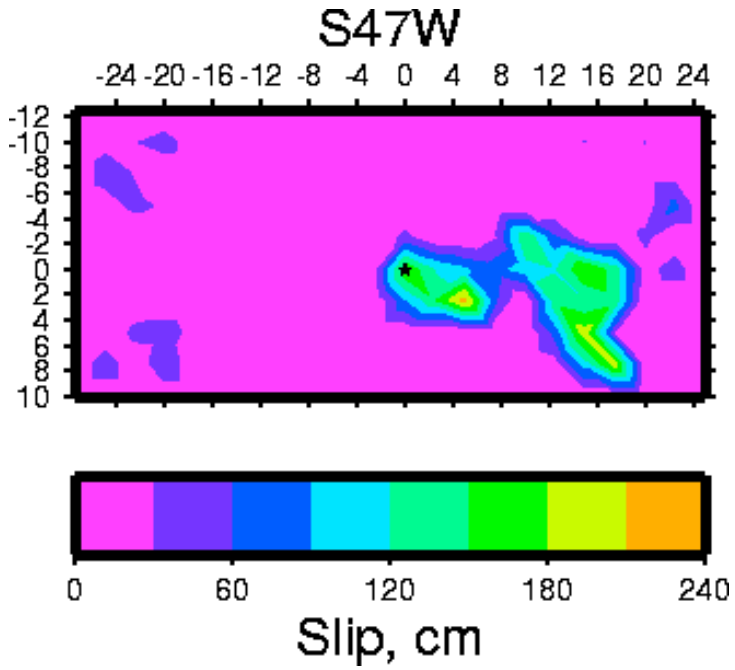

Figure 6. Updated slip distribution. Strike, dip and rake are 227, 81, 6 degrees. The hypocenter is at 21.7 km depth (star). Relative depth and strike units are km. Slip is seen to extend approximately 20 km to the S47W. The scalar seismic moment is 8.0e+25 dyne cm (Mw 6.67). Figure 7 shows the data fits for this model.

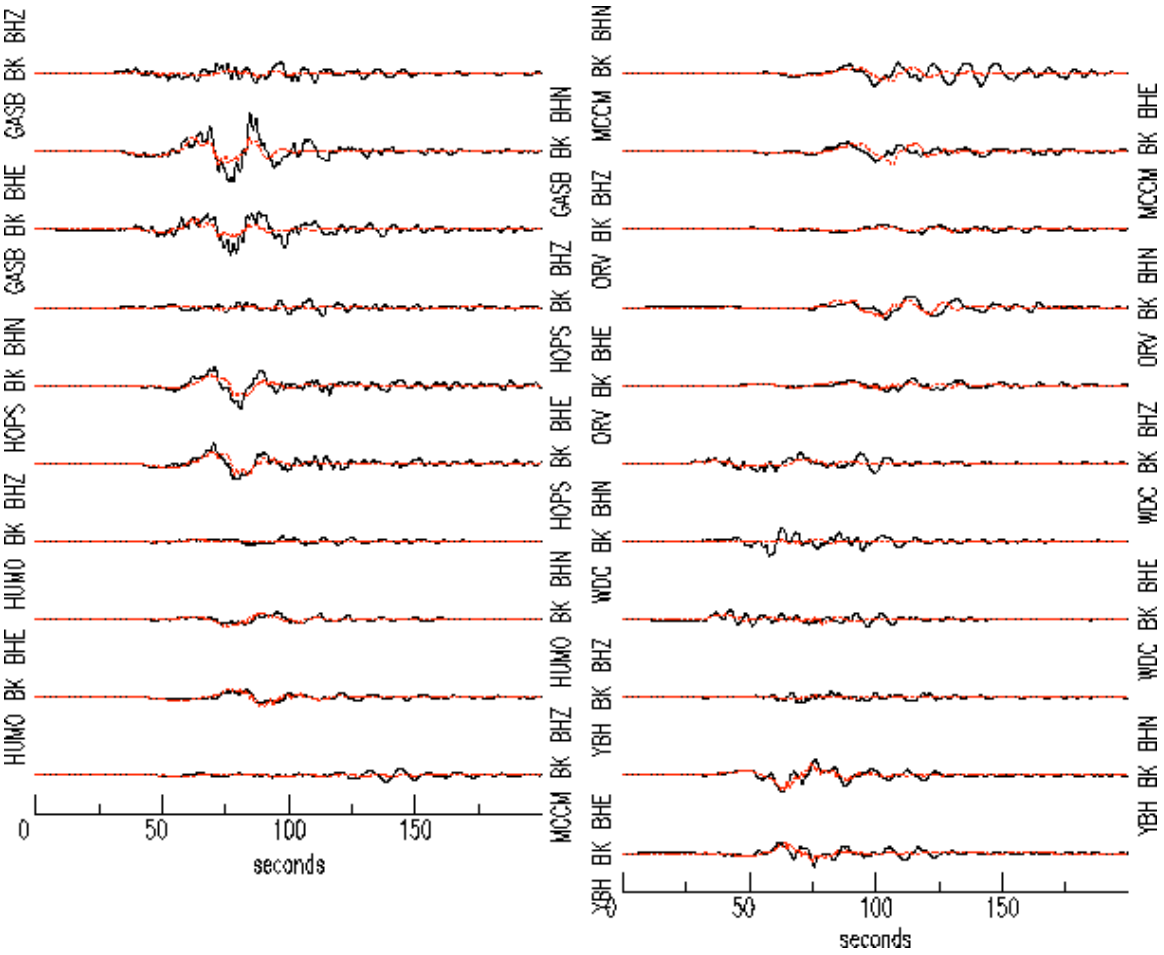

Figure 7. Observed (black) and synthetic (red) displacement seismograms for the best fitting source model (Figure 6). The data and synthetics were bandpass filtered between 0.01 to 10 Hz.