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Rapid estimation of moment tensors for large earthquakes

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We have developed a method for estimating centroid moment tensor. In order to estimate it from shorter seismograms than those for the routine method in the NIED F-net and AQUA system (Matsumura et al., 2006) assuming point source and impulsive source time function, synthetic seismograms were calculated taking a simplified source time function with a duration time into consideration. We have analyzed seismograms of the 2011 Tohoku earthquake (05:46:17, March 11, 2011 in UTC) recoded by strong motion seismographs of the NIED F-net. These seismograms at 15 stations from 05:44 to 05:52 were applied by a band-pass filter (pass-band: 0.005 ? 0.02 Hz) and inverted to estimate a moment tensor by a similar algorism to the AQUA system with grid-searching for duration time and peak time of source time function. Time window for this inversion was selected to be 300 s from the origin time. As a result, we obtained a best model with a 60-s duration time, a peak time of 05:47:33, and Mw 8.8 under a variance reduction of 75 %, which is better than 63 % for impulsive source time function (duration time = 0 s). We have also tried to estimate the moment tensor of the same earthquake from shorter seismograms at six stations from 05:44 to 05:49. Time window for inversion was selected to be 120 s from the origin time. This result shows weak constraint for duration time; however, the estimated Mw was in a range between 8.6 (for duration time = 0 s) and 8.8 (for duration time = 60 s). Seismograms for this analysis at these six stations located in epicentral distances between 140 km and 310 km may include information of peak moment rate and half duration of the source time function. Consequently, we successfully estimated the Mw from these short seismograms.

Keywords: moment tensor, centroid moment tensor