



Rapid estimation of faulting extent for large earthquakes by locating the end of rupture: application to the 2004, Mw=9.0, South Asia mega-thrust

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The 26 December 2004, Mw=9.0, South Asia earthquake caused a tsunami which devastated coasts around the eastern Indian Ocean within 3 hours. Tsunami hazard warning and emergency response for future large earthquakes in this and related regions would benefit greatly if knowledge of the extent of earthquake rupture were available within minutes after the event. Currently the size and extent of rupture of very large earthquakes are first estimated from moment tensor determinations based on long-period seismic recordings and from examination of aftershock locations; these estimates are not available until several hours or more after the event. Seismic P waves contain information on the earthquake rupture and are the earliest signal to arrive at distant recording stations. Within about 15 minutes after the event the arrival times of the initial P wave are routinely used to locate the point of initiation of earthquake rupture, or hypocenter. The first available information about the termination of rupture is contained in the last P-wave energy radiated from the source. Here we introduce a method to extract arrival times for this energy through analysis of the shape of the short period, P-wave signal. We use these arrival times to estimate the location of rupture termination in the same manner as for the hypocenter location. The required P wave recordings from global seismic stations are available about 20 to 30 minutes after an event. A few minutes later, this procedure provides an estimate of the rupture-termination location, and consequently the extent of rupture for the earthquake, and the rupture duration. This information can aid in rapid assessment and modeling of tsunami hazard and of damage distribution. Application to the 2004, Mw=9.0, South Asia earthquake gives a rupture termination location near the Andaman Islands, about 1100 km north of the hypocenter, and a rupture duration of about 8 minutes.