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Source estimate for the 2004 tsunami in Indian Ocean

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The source area of the December 26, 2004, Sumatra earthquake (Mw 9.0) is enigmatic. The aftershock zone extended from west of Sumatra through Nicobar Islands all the way to Andaman Islands; the total length is over 1,200 km. The seismic wave analyses indicate the southern half ruptured in rather rapidly while the northern half did slowly. Sea level changes in Andaman and Nicobar Islands indicate that the coseismic crustal deformation extended to Andaman Islands, supporting the results of the seismic wave analysis. How about the tsunami source? Here the tsunami source is estimated from tsunami arrival times recorded on tide gauges.

The onset times of tsunami, either upward or downward motion, are read from tide gauge records. Phuket: 111 min (down), Satun: 111 min (down), Sibolga: 120 min, Cocos: 140 min, Male: 194 min, Gan: 198 min, Hanimaadhoo: 212 min, Diego Garcia: 224 min. In addition, information from Indian stations is as follows. Port Blair: 45 min, Vishakapatnam: 156 min, Chennai: 157 min. Tsunami travel times are computed backwards from these stations to estimate the tsunami source area. The results indicate that the source was ~700 km long, but the northern end was not well constrained. More information on tsunami arrival times, or time difference between earthquake and tsunami, from north is needed to better constrain the tsunami source. Detailed bathymetry data around tide gauge stations are also critical for such estimation.

Comparison of observed and simulated tsunami waveforms would also provide additional information, though only those waveforms recorded in the northern directions are sensitive to the source length. In addition, satellite altimeter data at around two hours after the earthquake can be used to constrain the tsunami source (see Hirata et al. in this meeting).