Review of source models of the 2004 Sumatra-Andaman earthquake

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The 2004 Sumatra-Andaman earthquake was the largest earthquake since the 1960 Chilean earthquake (Mw 9.5) or 1964 Alaskan earthquake (Mw 9.2). The seismic moment is estimated as 4-10 x 10^{22} Nm (Mw 9.0-9.3) from the earth's free oscillation amplitudes [Park et al., *Science*, 2005, Stein and Okal, *Nature*, 2005]. The Harvard CMT was initially Mw 9.0 for a point source, but it became Mw 9.3 assuming five point sources [Tsai et al., *GRL*, 2005].

From array analysis such as Hinet in Japan [Ishii et al., *Nature*, 2005] or hydrophones in Diego Garcia [Tolstoy and Bohnenstiehl, *SRL*, 2005] yielded the source length of 1200 - 1300 km and the rupture duration of 500 s .

Analyses of seismic body waves and surface waves indicate that the largest moment was located off northern Sumatra Island (around 4 deg N), followed by at around Nicobar Islands (around 7 deg N) [Ammon et al., *Science*, 2005]. Around Andaman Islands at the northern end of the aftershock area (north of 10 deg N), the seismic moment was estimated to be small and slow slip was speculated [Bilham, *Science*, 2005; Lay et al. *Science*,2005]. However, no such slow slip has been detected from GPS or seismological data [Subarya et al., *Nature*, 2005; Velasco et al., *GRL*, 2006].

Analyses of satellite images indicate that the sea level changes were observed on Sumatra, Nicobar and Andaman Islands, suggesting that the source length was as long as 1600 km [Meltzner et al., *JGR*, 2006; Tobita et al., *EPS*, 2006]. Field investigations indicate that the largest subsidence was 3 m at Great Nicobar island, while the small islands west off Middle Andaman uplifted about 1.5 m [Malik and Murty, *Current Science*, 2005; Kayanne et al., *GRL*,2007]. Tide gauge record at Port Blair on South Andaman shows a slow subsidence with a duration of at least 15 min but probably up to 35 min [Singh et al., *GRL*, 2006].

The tsunami source was estimated from tsunami arrival times as 600 - 700 km [Lay et al., *Science*,2005], but later revised to be ˜900 km [Neetu et al., *Science*, 2005] extending only to the south of Andaman Islands. The satellite altimeter data supports longer, more than 1000 km long, tsunami source [Fine et al. *GRL*, 2005; Song et al., *GRL*, 2005; Hirata et al., *EPS*, 2006]. The tide gauge data do not support tsunami source in the north, beneath north and middle Andaman Islands [Tanioka et al., *EPS*, 2006; Fujii and Satake, *BSSA*, 2007], although Piatanesi and Lorito [*BSSA*, 2007] estimated slip on the deeper part of slab, east of north Andaman Island. Joint inversion of tide gauge and satellite data prefer the source length of ˜900 km [Fujii and Satake, *BSSA*, 2007]. Seno and Hirata [*BSSA*, 2007] speculated that the fast rupture was followed by slow slip at shallower part near the trench.

A model combining near-field and far-field GPS data, sea-level changes and seismic data [Chilieh et al.,*BSSA*, 2007] indicates a 1500-km-long coseismic rupture with peaks in moment release at 4 deg N, 7 deg N and 9 deg N with a total moment equivalent to Mw 9.15. In addition, a model of postseismic deformation suggests that slip continues on the interface beyond the 500-sec seismic slip, with postseismic geodetic moment release of about a third of coseismic moment.