The Giant Sumatra Earthquake Source Model from Satellite Altimetry

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The satellite altimetry to sea surface heights first-time captured the Indian Ocean tsunami generated from the December 2004 giant Sumatra earthquake (JPL/NASA, http://sealevel.jpl.nasa.gov/ mission/jason-1.html). The analysis of the sea surface height disturbance suggests that the giant earthquake propagated at extremely slow speed of 0.7 km/sec, even in the early rupture stage, at least 1200-km-long segment to the north along the northern Sunda Trench. The extremely slow propagation speed produces much long source duration of approximately 30 minutes, approximately four to ten times longer than source duration estimates (180-500 sec) from short-period seismic waves (IRIS, //www.iris.iris.edu/sumatra/). The satellite altimetry data requires total seismic moment of 9.86 x 1022 Nm, making Mw9.3. This estimate is approximately 2.5 times larger than the value (4.0 x 1022 Nm) from long period surface wave analysis but nearly the same as that from the ultra-long period normal mode study (Stein&Okal, Extended abstract, http://www.iris.iris.edu/sumatra/). The maximum amount of slip (~30 m) is identified in a region closest to the northernmost Peninsula of the Sumatra Island in which a huge tsunami run-up height was observed. Based on the extremely slow rupture and too long source duration, the giant earthquake must be tsunami earthquake (c.f., Pelayo&Wiens, JGR, 97, 15321-15337,1992). The average dislocation around the epicenter, the southern end of the entire aftershock zone, is estimated to be approximately 16 m. As Stein&Okal has noted, segments to the south from the aftershock zone, in which two M~9 class earthquakes occurred in 19th century (Newcomb& McCann, JGR, 92, 421-439,1987), should be pay much attention.

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