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The spatial and temporal context of the December 26, 2004 Sumatra-Andaman earthquake

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The M 9.0 earthquake that occurred in the offshore regions of the northwestern of Sumatra on December 26, 2004 is the largest event to have occurred in this region in historic times. In terms of its size and fault length (1000 km) this earthquake is unprecedented in the region although the Sumatra-Nicobar-Andaman section of the subduction zone had produced many large earthquakes in the past. The earthquakes of 1833 (M 8.7) and 1861 (M 8.5) are known to have occurred to the north of the source of the 2004 earthquake. The 1881 earthquake occurred off Car Nicobar, defining a 300-km-long segment extending from south of Car Nicobar to south of Little Andamans. The 1941 earthquake possibly defines a rupture length of 300-400 km extending from Middle Andamans to South Andamans. Further, an earlier earthquake appears to have occurred in the Andaman offshore on 28 January 1679 with its felt area similar to the 1941 Middle Andaman event. An approximately 50-year correlation is also observed between the volcanic eruption in the region and the large earthquakes in the Andaman region. The historical data and estimations based on convergence rate from the Andaman-Nicobar region indicate a recurrence period of 200±50 yr for the large earthquakes (M 7.5-8.0) for different segments. Compared to its smaller preceding historical events, the giant earthquake of December 26 type seemed to be extremely rare in this region. The historical information imply an interval of 1200 years. We present here our near-field observations on the December 26, 2004 earthquake to argue for a long recurrence interval for the giant 2004 earthquake. The overall spatial pattern of the earlier earthquakes shows a northward progression of occurrence of large earthquakes until the event of December 26, 2004. This earthquake that propagated northward until it was arrested in the North Andamans appears to be a rare asperity breaking megathrust event. The temporal variance in the occurrence of this mega-earthquake vis-à-vis the preceding segment-specific large events (e.g. 1881 and 1941) can be interpreted in terms of classical recurrence models available for subduction zones. We believe that the northern segment between North Andamans and Burmese Coast (the Irrawady delta) is the most potential segment that remains to be broken although this part of the arc also presents an intriguing possibility of a creeping segment.