Tectonic Evaluation of the 2009 Padang Earthquake (Mw 7.6) from GPS Derived Coseismic Offsets

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Since 2004, three major earthquakes (2004 Sumatra-Andaman 9.2, 2005 Nias 8.7 and 2007 Bengkulu 8.4) have been caused by ruptures along a length of over 2000 km of the Sunda megathrust. This sequence of megathrust events has left an unbroken patch under Siberut island and the west coast of central Sumatra. This segment of the megathrust , which has not been ruptured since 1797 or the late 1600s, has accumulated interseismic strain that may exceed that relieved by the 1797 event. The 30th September, 2009 (7.6) earthquake, centered nearly 50km northwest of Padang city, killing nearly 2000 people, was not a megathrust event and did not help to release the accumulated strain across it. We present here coseismic offsets computed from Sumatra GPS Array (SuGAr) data from stations operating continuously around the source zone. Constrained by the USGS finite-fault model from teleseismic data, GPS-derived coseismic displacements allow us to model the kinematic characteristics of the rupture. Nearly 5m of slip along a left-lateral, oblique-slip north-south fault in the underlying India-Australia plate, at a depth of 80 km, is our preferred model. This fault geometry is consistent with a vertical left-lateral fault on the ocean floor that has been rotated to a moderate dip as it has been subducted beneath the Sumatran margin.