Geophysical Research Abstracts
Vol. 12, EGU2010-15051, 2010
EGU General Assembly 2010

Effect of coupling and fault strength on earthquake nucleation in subduction zones

Mairead Nic Bhloscaidh (1), John McCloskey (2), Suleyman Nalbant (2), and Chris Bean (1)

(1) Geophysics Group, School of Geological Sciences, University College Dublin, (2) Geophysics Research Group, School of Environmental Sciences, University of Ulster

The recent sequence of large earthquakes in the eastern Indian ocean has ruptured almost 2500km of the Sunda megathrust. The September 2009 Mw 7.6 earthquake under Padang did not relax the megathrust significantly and as a result the 300km Mentawai segment remains largely unbroken: the threat of a large Mw$>$8.5 event to the city of Padang (population 800,000) in the near future remains substantial. Regions of high inter-plate coupling have been found to be roughly coincident with the asperities that have ruptured in past great inter-plate earthquakes (Chlieh et al, 2008), most compellingly in the case of the Mw 8.7 Simeulue-Nias event. It might also be expected that the locations of the nucleation points of these events would show a correlation with the regions of maximum coupling, i.e. events are more likely to nucleate where there has been greatest strain accumulation. It has been shown (McCloskey et al, 2010) that the interaction stresses from the September 2009 event are greatest where the inter-plate coupling is weak, leading to the suggestion that the area has relatively low triggering potential. However, the analyses, presented here, of the relative locations of the nucleation points of events on the megathrust and the regions of maximum coupling suggest that this assumption is not generally valid. The spatial distribution of fault parameters such as coupling and frictional strength is likely to be highly non-uniform, as evidenced by the heterogeneous nature of seismic inversions for the co-seismic slip (e.g. Ammon et al, 2005). Current coupling maps, inferred from geodetic measurements of inter-seismic surface deformation, may be unable to resolve these high frequency variations: a more complex model for the local strain accumulation may be appropriate. Assuming that the values of the co-seismic slip within the rupture area of any event can be used as a proxy for the coupling in this area, some constraint on the finer-scale variability of the coupling with respect to the location of the nucleation point can be obtained. In addition, strong, high frequency heterogeneity in fault strength would allow nucleation of events in areas experiencing relatively small amounts of accumulated strain. Both factors could contribute to the understanding of the observed disparity between the coupling maps and the locations of the nucleation points of these events. A three dimensional numerical rate-and-state model of a fault has been constructed, with heterogeneity in the distributions of both inter-plate coupling and frictional strength, which has been controlled by varying the effective normal stress on the plate interface. Preliminary results are presented.