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Modelling Long-term Stress on the Sunda Megathrust and Implications for Earthquake Forecasting

S. S. Nalbant, J. McCloskey, S. Murphy, N. Simao, and T. Lindsay
University of Ulster, Geophysics Research Group, Coleraine, Ireland (ss.nalbant@ulster.ac.uk, +44 28 7012 3391)

Earthquakes occur when stress level on a fault reaches the yielding stress. Inability to know neither absolute stress levels nor yielding stresses on a fault is a major obstacle for seismologists to forecast future earthquakes. The technique of mapping Coulomb stress changes due to earthquakes inherently assumes an arbitrary zero stress level as a starting point in time. How far one should go back in time before the effect of this assumption disappears is unknown at present? In practice, this is actually limited with availability of historical seismic catalogs, rupture parameters and details of heterogeneous secular loading.
We have calculated Coulomb stress changes both coseismic and secular and scaled them with the coupling constants on the megathrust since 1797 which is the starting year of the latest seismic cycle. By the year 2011, the total stress map is dominated by stress drop areas associated with the 1797 (M=8.7) and 1833 (M=8.9) with up to -150 bars. When compared to the largest stress drop area (up to -88 bars) involved in the 2004 M=9.2 earthquake, it is clear that slip distributions and rupture geometries of the 1797 and 1833 in our model are wrong. This is a major obstacle for a reliable earthquake forecasting in the region and highlights the need for developing new techniques to tackle these issues which is underway.