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Source-Scaling Model Implied from Dynamic Rupture Simulation

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ABSTRACT

We present source-scaling relations derived from dynamic rupture simulations. A series of crack and asperity model for surface and sub-surface earthquakes is used in order to find the appropriate model that fit the existing empirical and theoretical scaling law models, as well as observed values of real earthquakes. Our simulations consist of subsurface earthquakes when L<W and surface earthquake when L>=W, where L and W are length and width of the fault, respectively. W_{max} is assuming to be 20km that represents the brittle crust of the earth. The fault models are calculated up to L<=20W_{max}. When compared our results with the empirical relations, the source scaling based in dynamic crack modeling suggests (see fig 1):

1) When L<=2 W_{max} stress drop is constant (around 2.3MPa)
2) When 2W_{max} < L <= 10W_{max} stress drop increase with the seismic moment from 2.3MPa to 10 MPa
3) When L>10W_{max} stress drop constant (<= 10.0MPa)

Our results of dynamic asperity models is still not well constrained, but the preliminary results also suggest increasing the stress drop on the asperity or back ground area for the second scaling.
The average displacement seems to be saturated after L>=15W_{max} and the maximum displacement also suggests saturation when L>=15W_{max} for crack models, however, for asperity models there is not saturation even for L<=20W_{max} .
The results so far are well constrained for crack models, but it is important to mention that our main target is asperity modeling for ground motion prediction that will be presented in future work.

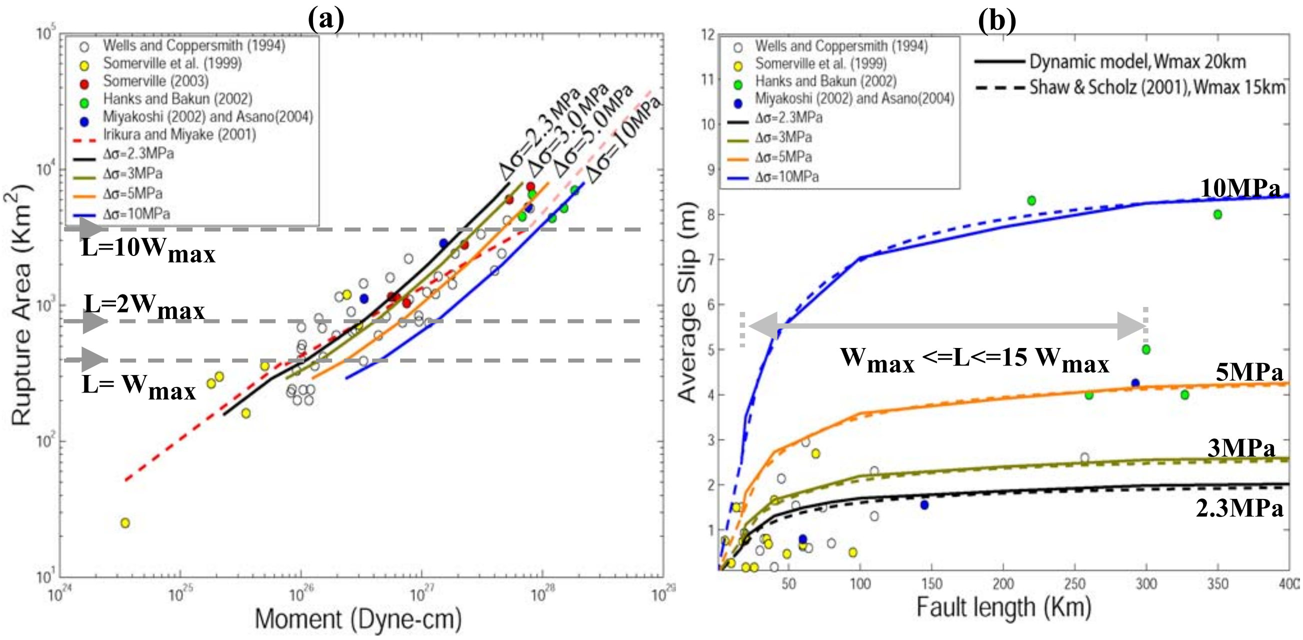

Figure 1. Scaling relationship for crack models with stress drop 2.3, 3.0, 5.0 and 10.0 MPa. (a) Relation between seismic moment and rupture area derived from dynamic rupture simulation (solid lines). Dashed line is empirical relation of Irikura and Miyake (2001). Circles are observation from real earthquakes. (b) Relation between fault length and average slip. The solid and dashed lines correspond to our dynamic modeling and the theoretical model of Shaw and Scholz (2001), respectively.