EARTHQUAKE SEQUENCES ON ROUGH FAULTS: EFFECT OF RESIDUAL STRESS DISTRIBUTION ON SUBSEQUENT RUPTURE

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Faults have geometrical disorder at a wide range of spatial scales from planarity (e.g. Candela et al., 2012). Slip on a nonplanar fault causes spatially heterogeneous stress field (Dieterich & Smith, 2009), modulating the style of the next slip event on the same fault. Thus, it is important to investigate rupture dynamics on rough faults in the context of earthquake cycle simulation.

In this study, we model earthquake sequences on rough faults, using a finite difference model which captures inertial dynamics and plastic deformation during dynamic rupture and a quasi-dynamic boundary integral model which simulates the interseismic period. We use the rate and state friction law for the constitutive law on a prescribed rough fault and the Drucker-Prager yield condition for off-fault plastic deformation.

Our preliminary numerical simulations show that the stress field becomes more heterogeneous with accumulating slip (Figure). This highly heterogeneous stress distribution makes the rupture process complicated, such as supershear transition and rupture termination. Later events are more sensitive to the local geometry of the fault due to accumulated stress heterogeneity.