COSEISMIC OFF-FAULT DAMAGE, ITS IMPLICATIONS ON THE RUPTURE DYNAMICS AND BUILDING SEISMIC OBSERVABLES

Kurama OKUBO [1], ***Esteban ROUGIER*** [2],
Harsha S. BHAT [3], ***Marine A. DENOLLE*** [1]

[1] Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA, USA
[2] EES-17 - Earth and Environmental Sciences Division, Los Alamos National Laboratory, NM, USA
[3] Laboratoire de Géologie, Ecole Normale Supérieure, Paris, France

Off-fault medium can be damaged due to the stress concentration caused by dynamic earthquake ruptures. The rupture dynamics, radiation and overall energy budget are thus modified by the coseismic off-fault damage because of the feedback from the secondary fracture network. What is the role of co-seismic damage in arresting ruptures? Does co-seismic damage interfere with the rupture with various degrees of geometrical complexity (kinks, step overs, roughness)? And if so, what are the seismic observables (P or S far-field pulse shapes, radiated energy, stress drop...) that are indicative of the degree of co-seismic damage? We attempt to address these questions with 2-D dynamic earthquake rupture modelling in planar and geometrical complex faults with and without damage. Preliminary results with a planar finite fault show that the secondary fractures are massively activated around the tip of fault due to the large stress concentration, which sustains the radiation caused by the secondary fractures even after the rupture reaches the edge of fault. For preliminary results with a single kink bent on the extensional side, the rupture propagates on the pre-existing fault without off-fault fractures around the kink. However, for the cases with a kink bent on the compressional side, instead of propagating on the pre-existing fault, a major fault blanch is activated in the direction of conjugate shear failure planes. We further explore increasing degrees of geometrical complexity and produce far-field body-wave pulses to explore the seismic signature of co-seismic damage.