

Interaction of earthquakes and slow slip: Insights from fault models governed by lab-derived friction laws

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Motion of plates in the Earth crust is accommodated through fault slip. That includes both fast events (earthquakes) and slow relative motion, as evidenced by seismic and geodetic observations. We study mechanics and physics of earthquakes using a unique simulation approach that reproduces both earthquakes and slow slip, with full inclusion of inertial effects during simulated earthquakes, in the context of a 3D fault model. The approach incorporates laboratory-derived rate and state friction laws, including the effects of

shear heating during rapid, seismic slip, involves slow, tectonic-like loading, resolves all stages of seismic and aseismic slip, and results in realistic rupture speeds, slip velocities, and stress drops. Our simulations show that a number of observed earthquake phenomena can be explained by interaction of earthquakes and slow slip, including transition to intersonic rupture speeds during earthquakes, peculiar properties of small repeating earthquakes, and complex spatio-temporal patterns of earthquake sequences.