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Effect of Critical Displacement Parameter on Slip Regime at Subduction Fault

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It is widely accepted that for the simple fault models value of critical displacement parameter (Dc) in Ruina-Dietrich's rate-and-state friction law is responsible for the transition from stick-slip regime at low Dc to non-seismic creep regime at large Dc. However, neither the value of "transition" Dc parameter nor the character of the transition is known for the realistic subduction zone setting. Here we investigate effect of Dc on regime of slip at subduction faults for two setups, generic model similar to simple shear elastic slider under quasistatic loading and full subduction model with appropriate geometry, stress and temperature distribution similar to the setting at the site of the Great Chile Earthquake of 1960.

In our modeling we use finite element numerical technique that employs non-linear elasto-visco-plastic rheology in the entire model domain with rate-and-state plasticity within the fault zone. The model generates spontaneous earthquake sequence. Adaptive time-step integration procedure varies time step from 40 seconds at instability (earthquake), and gradually increases it to 5 years during postseismic relaxation. The technique allows observing the effect of Dc on period, magnitude of earthquakes through the cycles. We demonstrate that our modeling results for the generic model are consistent with the previous theoretical and numeric modeling results. For the full subduction model we obtain transition from non-seismic creep to stick-slip regime at Dc about 20 cm. We will demonstrate and discuss the features of the transition regimes in both generic and realistic subduction models.