Understanding of temporal change in slow earthquake migration speed

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Recent observations show evidence of propagation of postseismic slip, which may contain information about the mechanical properties of faults. Ariyoshi et al. (2019) develop a new analytical relationship between the propagation speed of aseismic slip transients and fault frictional properties, modeled by a rate- and state-dependent friction law. In the paper, we identify systematic dependencies of afterslip propagation speed on effective normal stress σ and frictional properties (the coefficients a and a-b which quantify the instantaneous and the steady-state velocity-dependence of friction, respectively, and the characteristic slip distance L of fault state evolution). Lower values of the parameter $A=a\sigma$ cause faster propagation in areas where the passage of the postseismic slip front induces large shear stress changes $\Delta\tau$ compared to A, which are typically located near the mainshock rupture. In areas where $\Delta\tau/A$ is small, typically more distant from the mainshock, afterslip propagation speed is more sensitive to $(a\text{-}b)\sigma$. The propagation speed is proportional to initial slip velocity and, under the condition that loading span is significantly shorter than the passage of postseismic slip, inversely proportional to L. In this presentation, we extend our relationship to slow earthquake migration process by comparing our analytical solution with simulated results in previous model (Ariyoshi et al., 2012). The result can explain the reason why slow earthquake migration speed increases in the preseismic stage of megathrust earthquake because of increasing the initial slip velocity for small asperity ongoing chain reaction, which might be applicable to the observed slow earthquake activity in the preseismic stage of the 2011 Tohoku earthquake.

Keywords: rate- and state-dependent friction law, subduction zones, megathrust earthquakes

