A dependence of slip modes and preslip on frictional parameters using a two-degree-of-freedom block-spring model

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We simulate fault slip using a two-degree-of-freedom block-spring model with rate- and state-dependent friction law (Dieterich, 1979) to investigate a variability of preslip and slip modes. In the simulation, we set a friction parameter (a-b)=-0.0002 of the block2 to be an asperity. We examine a distribution of slip modes in the parameter space and the dependence of preslip on frictional parameters at the asperity.

Our result is consistent with that of Yoshida and Kato (2003). The distribution of slip modes in this study is, however, slightly different from that of Yoshida and Kato (2003)

For preslip, as the value of (a-b) becomes smaller, a duration of the preslip becomes shorter, and vice versa. The same result is obtained for the value of Dc. If the values of (a-b) and Dc of block1 is smaller than those of the stability transition boundary, the duration of the preslip becomes extremely small. This means that the preslip is found effectively at the verge of the asperity where the value of (a-b) is around zero.

On the other hand, if the parameters, (a-b) and Dc, are larger than those of the regime where a steady-state slip occurs, the dependence of the preslip on the parameters shows a negative correlation.

We divide the parameter space into four regimes of slip modes which distribute parallel to the stability transition boundary: (1) the instability slip mode in the case of the values of (a-b) and Dc are smaller than those of the stability transition boundary, and as the values of (a-b) and Dc become bigger, the mode changes to (2) the aseismic and unsteady slip mode, (3) the steady-state slip mode, and (4) the aseismic slip(afterslip).