Condition for aseismic transients in a seismogenic patch modelled by rate- and state-dependent friction

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Whether aseismic transients occur as the next earthquake approaches or not is an important problem in the area of disaster mitigation by geophysical observation. We conducted a series of rate-state (aging law) earthquake sequence simulations with inertial effects and revealed that A/B (direct effect/evolution effect) is a key parameter controlling the complexity of interseismic behavior in a seismogenic patch. Interseismically, a creep front invades a locked patch. If $A/B \leq 0.4$, nucleation takes place as soon as the linear stability of the coherent creep is violated, and no significant aseismic transient occurs. If $A/B \geq 0.4$, nucleation size is given by the energy balance criterion, and if $A/B \geq 0.6$, aseismic transients occur after the violation of linear stability and before the creeping region is able to host the nucleation. In addition, enhanced weakening at coseismic slip rate causes slower creep penetration and thus much larger number of aseismic transients before nucleation. Not only $A - B$ but also A/B must be selected carefully to obtain realistic results in numerical simulations.