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Simulation of earthquake processes by finite element method:The case of megathrust earthquakes on the Sumatra subduction zone

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Numerical simulation of the earthquake processes is a key method to carry out physical accurate earthquake forecast in the future, but today empirical method is used in earthquake prediction, which is seldom successful. In this study, we use a unified rate-dependent frictional law to formulate two different frictional states, one is sticking, and the other is sliding. Based on R-minimum, time integration method with static explicit is adopted in finite element analysis in order to make the result convergent in calculation. Take as the Sumatra subduction zone as an example, where the major earthquake with Mm=9.3 occurred in 2004, the process of locking, unlocking, and sliding between the subduction plate and the overriding plate is simulated. The result shows that a large magnitude of space of homogeneous media with the same frictional coefficient is a prerequisite for forming large scale of sudden sliding, which is regarded as an event. The earthquakes simulated by the model on the Sumatra subduction zone have characteristics of quasi-cycle in time and of transference in space. The rupture leading to earthquakes propagates upward from bottom. Moreover, the geometry of the Sumatra subduction zone has much influence on the locations of the large events.