Geophysical Research Abstracts
Vol. 20, EGU2018-5688, 2018
EGU General Assembly 2018

Propagation of a precursory detachment front along a seismogenic plate interface in a rate-state friction model of earthquake cycles

Naoyuki Kato
The University of Tokyo, Earthquake Research Institute, Japan (nkato@eri.u-tokyo.ac.jp)

A numerical simulation of earthquake cycles on a subduction zone plate interface is conducted by using a rate- and state-dependent friction law. In the model, a reverse fault of a dip angle of 15 degrees is assumed in an elastic half-space, and relative plate motion of a constant velocity is imposed. Simulated earthquakes repeatedly occur on a shallower seismogenic plate interface of steady-state velocity-weakening frictional property, while stable sliding occurs on the deeper part, where velocity-strengthening frictional property is assumed. During an interseismic period, the deep stable sliding causes shear stress concentration at the deeper edge of the locked plate interface, and partial stress drop occurs due to the stress concentration. Aseismic sliding with a sliding velocity significantly smaller than the imposed relative plate velocity propagates updip on the seismogenic plate interface, which is referred to as precursory detachment front. Similar precursory aseismic sliding propagating in a seismogenic fault was observed in many recent laboratory experiments. The sliding velocity of the precursory aseismic sliding oscillates and its amplitude gradually increases. The oscillation period is about 10 years or longer, and it is approximately proportional to the recurrence interval of large interplate earthquakes. An episode of aseismic slip increase may correspond to an aseismic slip event. The slip velocity during an episodic slip event is sometimes close to the relative plate velocity, and it is possibly detectable by geodetic observation or seismicity changes. The average sliding velocity within the seismogenic zone is larger for larger characteristic slip distance and smaller effective normal stress, and is approximately inversely proportional to the time to the occurrence of a large interplate earthquake. Seismic rupture finally occurs after accelerating aseismic slip nucleation process. The location of seismic rupture nucleation is more updip and the amplitude of accelerating preseismic slip is larger for larger characteristic slip distance and smaller effective normal stress as reported in a previous study.