Geophysical Research Abstracts
Vol. 19, EGU2017-11466-3, 2017
EGU General Assembly 2017

Estimation of Maximum Magnitudes of Subduction Earthquakes

Iskander Muldashev (1,2) and Stephan Sobolev (1,2)

(1) German Research Centre for Geosciences GFZ, Potsdam, Germany, (2) Institute of Earth and Environmental Science, University of Potsdam, Potsdam-Golm, Germany

Even though methods of instrumentally observing earthquakes at subduction zones have rapidly improved in recent decades, the characteristic recurrence interval of giant subduction earthquakes (Mw>8.5) is much larger than the currently available observational record and therefore the necessary conditions for giant earthquakes are not clear. However, the statistical studies have recognized the importance of the slab shape and its surface roughness, state of the strain of the upper plate and thickness of sediments filling the trenches. Here we apply cross-scale seismic cycle modeling technique (Sobolev and Muldashev, under review) to study key factors controlling maximum magnitudes of earthquakes in subduction zones. Our models employ elasticity, non-linear transient viscous rheology and rate-and-state friction. They generate spontaneous earthquake sequences and by using adaptive time-step algorithm, recreate the deformation process as observed naturally during seismic cycle and multiple seismic cycles. We explore effects of slab geometry, megathrust friction coefficients, and convergence rates on the magnitude of earthquakes. We found that the low-angle subduction (largest effect) and low static friction, likely caused by thick sediments in the subduction channel (smaller effect) are the key factors controlling magnitude of great earthquakes, while the change of subduction velocity from 10 to 3.5 cm/yr has much lower effect. Modeling results also suggest that thick sediments in the subduction channel causing low static friction, result in neutral or compressive deformation in the overriding plate for low-angle subduction zones in agreement with observations for the giant earthquakes. The model also predicts the magnitudes of the largest possible earthquakes for subduction zones of given dipping angles. We demonstrate that our predictions are consistent with all known giant subduction earthquakes of 20th and 21st centuries and with estimations for historical earthquakes.