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Dependence of earthquake stress drop on scaling of frictional parameters

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To understand dependence of stress drop on scaling of frictional parameters, we conducted numerical simulation of earthquake cycles on plate interface. We assume a circular asperity which obeys a rate- and state-dependent friction law. If the critical slip length L is proportional to the asperity radius r, and b-a is a constant, stress drop is independent of the ruptured area size R. On the other hand, if L is a constant independent of r, stress drop decreases with increasing R because earthquake occurs before large stress is accumulated compared with the former case. Numerical simulation shows the stress drop is proportional to Rˆ[-0.43]. Such a phenomenon is not observed for natural earthquakes. Kato (2012) reported that stress drop is proportional to Rˆ[-0.5] on the basis of 2-d simulation results and theory of fracture mechanics if fracture energy is independent of asperity size.

Keywords: stress drop, scaling, rate- and state-dependent friction law, asperity