# Scaling relation in slip deficit during the interseismic period from numerical simulations

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Scaling relation of “standard” earthquakes can be explained by the hierachical property and structure in fracture energy during the coseismic weakening process from the mechanical point of view (e.g. Aochi and Ide, GRL, 2004; Ide and Aochi, JGR, 2005). Namely it is important that the slip weakening distance in friction law is proportional to the heterogeneity (patch) size. Now we are interested in the scaling of slow or aseismic slip during interseismichardening process. According to the analogy from our previous studies, we consider patches of different sizes, attributed particular frictional parameters. For the simplicity, we suppose a simple equation, $\tau(w) = \Delta\tau(w/w_c)^{\gamma}\exp(1-(w/w_c)^{\gamma})$, where shear friction $\tau$ is a function of cumulative slip $w$ and with a factor $\gamma$ (>0), a constant $\Delta\tau$ and characteristic length $w_c$. We then consider a constant loading rate $V$ surrounding the model area. Stress accumulation on patches prior to the weakening process depends on the patch size, and slip deficit is cumulated the most when stress is at peak. The time to the maximum slip deficit and the slip deficit amount arebriefly proportional to the patch size, regardless if $w_c$ is scale-dependent or not. The numerical simulations suggest that slip deficit rate is size-invariant under the same loading if $w_c$ is proportional to the patch size and $\gamma = 1$. Furthermore if $w_c$ is scale-dependent and $\gamma = 2$, the slip deficit rate is inverselyrelated to the patch size. Namely, slip deficit rate is smaller for a large patch.In other words, large parches always slip slowly, accumulating only a part of plate motion. So-called background stable slip region can be substituted by an extremely large patch, whichmay include small patches rupturing repeatedly (repeating earthquakes).