The difference of occurrence condition of slow slip event in occurring together at multiple asperities

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Slow slip events (SSE) are transient slips without radiation of seismic waves. They are detected by data analysis using crustal deformation data mainly GPS. To understand and reproduce them, several generation mechanisms are proposed. Among them Kato (2003) proposes the indicator of stability whether the slip becomes seismic or aseismic, which affects the differences of slip velocities in earthquakes and SSEs. This indicator is; earthquake occurs if the radius of asperity r is much larger than rc calculated using frictional parameters, silend earthquake or SSE occurs if r˜rc, and stable sliding if r is much smaller than rc. Interpreting based on this idea, the slip stability is determined only there frictional feature.

We show that SSE can occur in case that unstable slips occur together at adjacent multiple asperities, even if earthquake can occur in case that one of asperities exists individually. Considering that short-term SSE occurs with tremor at higher frequency than SSE (Hirose and Obara, 2006), it is possible that slips occur at multiple asperities in a chain reaction. Even if each asperity has unstable frictional parameters those cause earthquakes, a slip at one asperity causes another slips at adjacent ones in continuity while strain energy does not much increase. Thus slip does not accelerate and finally slip ends up SSE. This assumption can be seen in Ariyoshi et al. (2008).

Our simulation model is introduced as follows. We establish a two-dimensional planar square fault 10cm on a side with a dip angle of 10 degrees at 30km depth in a semi-infinite elastic medium. We put two circular patches on the fault as Kato (2004). This fault is divided into 65536 (256x256) cells, which sizes are 100m on a side. Frictional stress and slip on each fault cell changes obeying the rate- and state-dependent friction law. The velocity weakening is given on the cells in the patch, while the velocity strengthening out of the patch. We experiment how the maximum slip velocity changes in case where the distance between two patches and frictional parameters, b and L, change.