Slip-length scaling in multi-segment rupture

Yuko Kase[1]

[1] Active Fault Research Center, AIST, GSJ

We investigate slip-length scaling, simulating dynamic rupture on a single fault and a multi-segmented fault under a depth-dependent (horizontally homogeneous) stress condition and a fractal-like heterogeneous stress condition. Under the depth-dependent stress condition, slip drastically increases with fault length on the single fault, while slip gently increases with fault length on the multi-segmented fault. Under the fractal-like heterogeneous stress condition, on the other hand, slip is independent of fault length, and a multi-segment rupture hardly occurs.

We put vertical strike-slip faults in a 3-D, semi-infinite, homogeneous, isotropic, and linear elastic medium. Two fault models are assumed. The first has a single fault whose width is 15 km and whose length is 15-105 km. The second has 2-7 segments both of whose width and length are 15 km. We also assume two stress conditions: a depth-dependent stress condition and a fractal-like heterogeneous stress condition. A fractal heterogeneous slip distribution of Mai and Beroza (2002) is converted to the fractal-like heterogeneous stress condition, using Okada (1992) and Kase et al. (2003). We calculate spontaneous rupture processes in each combination of fault models and stress conditions, and investigate surface slip-length scaling.

Under the depth-dependent stress condition, slip increases with fault length on the single fault, and the slip is saturated on a fault with more than 90 km length. Slip on the 90 km-length fault is more than five times as much as on the 15 km-length fault. On the multi-segmented fault with more than three segments, slip gently increases with fault length. Slip on the six segmented 90 km-length fault is about two times as much as on the 15 km-length fault. Under the fractal-like heterogeneous stress condition, on the other hand, slip is independent of fault length. Slip on the 90 km-length fault is 1.3 times as much as on the 15 km-length fault. The multi-segment rupture hardly occurs. Small unruptured areas remain on the fault. Such areas work as barrier like segment edge.