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Stress and seismicity evolution on heterogeneous faults with various roughness.

W.-H. Wang(1,2), S.-M. Huang(2,2)

1. Institute of Applied Geophysics, National Chung Cheng University, Taiwan, ROC, (seiwhwg@eq.ccu.edu.tw)
2. Institue of Seismology, National Chung Cheng University, Taiwan, ROC, (sei9016@eq.ccu.edu.tw)

We simulate earthquake failure sequences along cellular fault zones with different degree of heterogeneity in prescribed stress drop. Without changing the mean stress drop, heterogeneity is mainly gained by increasing the roughness of the stress drop distribution. The rupture processes are assumed to be quasi-static. In contrast to previous studies, which show heterogeneous faults tend to generate earthquakes with a broader range of size, our simulations indicate that an increase in roughness tends to decrease the amount of model earthquakes with magnitude greater than 6 but increase in the number of small earthquakes. In addition, the model large earthquakes seem to be more clustered in cases of high degree of heterogeneity and their locations usually fall into the areas with a small gradient of prescribed stress drop. In terms of stress evolution, we find that change in roughness does not alter the long-term probability for the appearance of asperities or barriers among our models. By contrast, we find that high stress cells are more often clustered in a homogeneous fault zone than in a heterogeneous one. We conclude that an increase in roughness leads to a more random distribution of asperities and barriers in a fault zone. As a result, there is larger chance for ruptures to be arrested by high stress drop barriers in a heterogeneous fault zone before they grow to a large size.