Spatial variations of stress drop within individual sequences: implications for earthquake triggering

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Stress drop is an important parameter not only related to fundamentals in earthquake source physics, but also high frequency ground motions. The rapidly increased seismicity in central US poses significant challenges to earthquake hazard modeling. In this study, we carefully analyze several individual clusters in Oklahoma. For each cluster, we perform a sensitivity test to obtain the parameter ranges that provide most stable results using a stacking EGF approach. Then, we test two hypotheses to assess if there is any robust scaling relationship that extends from small to large magnitude, and the stability of spatial variability. Our results suggest that the large earthquakes consistently have higher stress drop, however, these is not a general scaling relationship. The higher stress drop tends to be related to structural heterogeneity, and the spatial variability of stress drop is stable regardless of large earthquakes. These observations suggest that robust mapping of stress drop distributions would be important for future hazard assessment. To further understand the characteristics of large earthquakes, we perform detailed individual EGF to obtain independent estimates of stress drop. This analysis also enables us to investigate the complexity, rupture directivity and rupture velocity of the best-recorded earthquakes. The results suggest that M3-4 events involve significant complexity, including multiple sub-events and strong directivity effects.

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