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Source Parameters for the Community Stress Drop Validation Study

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The community-led stress drop validation study initiated in early 2021 aims at understanding and resolving differences in stress drop measurements using a consistent dataset of the 2019 Ridgecrest earthquake sequence. The dataset consists of 13,000 earthquakes with phase arrivals at up to 107 stations in the week following the M7.1 mainshock on 2019-07-04.

Stress drop values are commonly estimated by fitting theoretical source models to direct phase (P- or S-wave) or coda wave spectra. In this work, we contribute to the community-led study using different approaches based on earthquake spectra and an alternative approach based on stopping phases to estimate fault dimension and rupture velocity (the main parameters modulating stress drop). The Ridgecrest dataset offers a unique opportunity to explore the applicability, potential benefits, and limitations of each method due to a wide range of earthquake magnitudes, variety of seismic instruments, and extensive body of supporting research related to the sequence. Furthermore, the sequence enables the comparison between different methods to identify consistencies and differences between estimates using different methodologies.

We will present stress drop estimates using commonly used frequency-based methods, such as single-spectrum and spectral-ratio fitting. We also further examine the validity of the theoretical assumptions made for each method using anstopping-phase based estimates of rupture velocity. First results show clear detections of stopping phases for a subset of earthquakes that imply stress drop values ranging between 0.1 - 10 MPa. The range agrees with the results from the frequency-based methods, and estimates from different methods show similar patterns. The first results also suggest significant deviation of specific individual earthquake estimates, which will also be explored by a detailed comparison of methods.