Rupture Characteristics of Megathrust Earthquakes in light of Statistical Source Models

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A statistical source model with correlation length and correlation time for a propagating fault was developed by Haskell (1966) to estimate the energy spectral density. However, the implication of the model could not be fully explored because of the lack of quantitative energy spectral data for large earthquakes at the time. With the use of the globally distributed broadband seismic data since the 1990s, we now have a good global database of energy spectrum up to ~1 Hz for 119 large [Mw 7.0 to 9.2] megathrust earthquakes (Ye et al., 2016). With this database we explore the implications of Haskell's statistical source model for understanding statistical source parameters such as the rupture correlation length and time. We consider two models with different spatio-temporal autocorrelation functions; one involves dislocation acceleration (Haskell, 1966) and the other, dislocation velocity (Aki, 1967). These models have different energy spectral decay rate -4 and -2, respectively. We compare the theoretical relations with the observations to infer effective correlation length and time.