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Source physics interpretation of non-self-similar double-corner frequency source spectral model JA19_2S

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Source spectral models developed for strong ground motion simulations are phenomenological models that represent the average effect that the source processes have on near fault ground motion. Their parameters are directly regressed from the observations and often do not have clear meaning for the physics of the source process. We investigate the relation between the kinematic double-corner frequency (DCF) source spectral model JA19_2S (Ji and Archuleta, BSSA, 2020) and static fault geometry scaling relations proposed by Leonard (2010). We derive scaling relations for the low and high corner frequency in terms of static stress drop, dynamic stress drop, fault rupture velocity, fault aspect ratio, and relative hypocenter location. We find that the non-self-similar low corner frequency scaling relation of JA19_2S model for 5.3<**M**<6.9 earthquakes is well explained using the fault length scaling relation of Leonard's model combined with a constant rupture velocity. Earthquakes following both models have constant average static stress drop and constant average dynamic stress drop. The high frequency source radiation is controlled by seismic moment, static stress drop and dynamic stress drop but strongly modulated by the fault aspect ratio and the hypocenter's relative location. The mean, scaled energy (or apparent stress) decreases with magnitude due to the magnitude dependence of the fault aspect ratio. Based on these two models, the commonly quoted average rupture velocity of 70-80% of shear wave speed implies predominantly unilateral rupture.