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# Scaling A Moment–Rate Function For Small To Large Magnitude Events

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Since the 1980's seismologists have recognized that peak ground acceleration (PGA) and peak ground velocity (PGV) scale differently with magnitude for large and moderate earthquakes. In a recent paper (Archuleta and Ji, GRL 2016) we introduced an apparent moment-rate function (aMRF) that accurately predicts the scaling with magnitude of PGA, PGV, PWA (Wood-Anderson Displacement) and the ratio PGA/2$\pi$PGV (dominant frequency) for earthquakes $3.3 \leq M \leq 5.3$. This apparent moment-rate function is controlled by two temporal parameters, tp and td, which are related to the time for the moment-rate function to reach its peak amplitude and the total duration of the earthquake, respectively. These two temporal parameters lead to a Fourier amplitude spectrum (FAS) of displacement that has two corners in between which the spectral amplitudes decay as 1/f, f denotes frequency. At higher or lower frequencies, the FAS of the aMRF looks like a single-corner Aki-Brune omega squared spectrum. However, in the presence of attenuation the higher corner is almost certainly masked. Attempting to correct the spectrum to an Aki-Brune omega-squared spectrum will produce an "apparent" corner frequency that falls between the double corner frequency of the aMRF. We reason that the two corners of the aMRF are the reason that seismologists deduce a stress drop (e.g., Allmann and Shearer, JGR 2009) that is generally much smaller than the stress parameter used to produce ground motions from stochastic simulations (e.g., Boore, 2003 Pageoph.). The presence of two corners for the smaller magnitude earthquakes leads to several questions. Can deconvolution be successfully used to determine scaling from small to large earthquakes? Equivalently will large earthquakes have a double corner? If large earthquakes are the sum of many smaller magnitude earthquakes, what should the displacement FAS look like for a large magnitude earthquake? Can a combination of such a double-corner spectrum and random vibration theory explain the PGA, PGV scaling relationships for larger magnitude?