SEISMIC SOURCE SPECTRAL PROPERTIES OF DYNAMIC RUPTURE WITH A SELF-SIMILAR, SELF-HEALING SLIP PULSE

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Large earthquakes commonly exhibit pulse-like rupture modes, in which the local slip duration is longer than the source duration. However, stress drops of small earthquakes are often estimated from far-field body-wave spectra using measurements of seismic moment, corner frequency, and a theoretical model of rupture in a crack-like mode. In this study, we develop fundamental models of earthquake rupture with a self-similar, self-healing slip pulse. We examine the resulting spectral properties, scaled energy, and estimated stress drops, and compare them to those derived from self-similar, crack-like rupture models. We find that the source spectra of pulse-like rupture models show classical double corners, consistent with previous studies. In the pulse-like rupture models, the second corner frequency at small take-off angles to the fault normal vector corresponds to the width of the slip pulse, yet in the stacked spectra over the entire focal sphere, it is caused by the rupture directivity and hence is unrelated to the width of the slip pulse. The spherical averages of P- and S-wave corner frequencies increase with the rupture speed and are higher than those of their crack-like rupture counterparts, as expected. The variability of estimated stress drops due to differences in the rupture speed is larger in the pulse-like rupture models than that in the crack-like rupture models. These results suggest that if small earthquakes are indeed mostly pulse-like ruptures, the large variability of estimated stress drops often seen in observational studies may come from variability in source characteristics almost independent of the actual stress drops.