

Rupture Initiation Sizes for Moderate to Large Earthquakes

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We studied the beginnings of the P waveforms for a wide range of earthquakes from M 3.5 to M7.9. Our analyses included earthquakes of the 2000 Izu Islands swarm (M3.8 to 4.9), 1999 Chi-Chi, Taiwan earthquake (Mw 7.6), 2000 Western Tottori earthquake (Mw 6.6), Northern Miyagi sequence (Mw 3.5 to 6.1), and 2003 Tokachi-oki earthquake (Mw 7.9). We used high-quality seismograms that were recorded usually within 20 km of the epicenters to examine the initiations of the ruptures. For the M7.9 Tokachi-oki earthquake we used data from an ocean-bottom seismometer at an epicentral distance of 36 km. Estimates of the beginning size of the seismic rupture were determined using the model of Sato and Kanamori (1999). We made corrections for the local attenuation and geometry of the fault. Our results indicate that for all the earthquakes, which had final sizes of kilometers to nearly 100 kilometers, the initial crack size was relatively small with dimensions of several tens of meters. For the larger earthquakes, we did not see any indication of a long smooth rupture initiation. Also, we could not see a clear dependence of the final size of the earthquake on the initial crack size. These results suggest a large earthquake rupture is a cascade type of process, and does not depend on the initial size of the source of initiation.