Complexity in Earthquake Initiation Process

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In the recent years, earthquake initiation process and its scaling relationship has been often studied. One of the studies performed by Iio [1992,1995] indicated that there is a scaling relationship in duration of a slow initial phase that appeared at a beginning of the P-wave.

Sato and Kanamori [1999] showed a model to explain the slow initial phase in which model initial crack size of an event scaled with its final earthquake size. Using this model, some studies (e.g. Sato and Mori [2002], Hiramatsu et al. [2002]) estimated initial crack sizes and discussed their scaling relationships.

Sato and Mori [2002] analyzed moderate to large earthquakes and concluded that scaling relationships appeared in microearthquakes continued to M4 events, but it did not appear in larger events (M6-7). They removed events with 'complex' waveforms (or chose 'simple' waveforms), although all of the larger events have 'complex' waveforms. This may cause the break of the scaling.

In general, while larger earthquakes have complex rupture processes, small events can have both simple and complex rupture processes, and we may conclude that larger earthquakes than a certain size often have complex rupture pattern.

In this study, we analyze frequency distribution of multiple shock events which have complex rupture pattern and its scale-dependency. We use Hi-net waveform data for events in the JMA catalog between June 2002 and January 2003. In this data set, we can use 146 events with magnitudes larger than 3. In addition, we calculate sizes of the first subevents and initiation related paramters for multiple shock events and discuss scaling relationship of earthquake initiation process using the first subevent sizes.