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The source scaling and depth-dependent stress drops for subduction zone events

Y.-T. Ko (1,2), B.-Y. Kuo (1), and S.-H. Hung (2)

(1) Earth Sciences, Academia Sinica, Taipei, Taiwan, (2) Geosciences, National Taiwan University, Taipei, Taiwan

The issue of source scaling between earthquake corner frequency (f_c) and seismic moment (M_o) has caused incessant debate. Both self-similarity and non-similarity of earthquakes across a certain range of magnitudes and event depths are appealing to different investigators. The major difficulty in this topic is that the source characteristic is always concealed from several effects along the raypaths. The only chance to resolve this issue is to robustly extract the source spectra from the observed data. A few commonly used approaches, i.e. empirical Green's function (EGF) method, mitigate the problem; however the reference event must be chosen which may limit the applicability of the method. In this work, we apply the cluster-event method (CEM) to robustly determine the source corner frequency of the events in Japan subduction zone. We demonstrate that the source parameter of each event is statistically better determined with the CEM than with conventional methods, leading to a better constraint on path effect. We found that the corner frequencies satisfy a relationship with seismic moment of $M_o \propto f_c^{-3}$, implying earthquake self-similarity for subduction zone events. The results of this study agree with those of previous studies, except with an upward deviation due to higher corner frequencies and stress drops. This leads to an interesting issue of the depth-dependency of stress drop, suggesting that there are some fundamental changes in strength of fault zone or in mechanism of earthquake source.