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Measurement of statistical fluctuations in seismogram envelopes based on the Nakagami-m distribution

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Seismogram envelopes are usually composed of smoothly decaying part and rapidly fluctuating part. The smoothly decaying part has been used to map the spatial distribution of scattering strength in the Earth in a deterministic way. On the other hand, statistical characteristics of rapidly fluctuating part were found to obey Rayleigh distribution by Takahara and Yomogida (199 2) and later the Nakagami-m distribution by Carcole and Sato (2009). Nakahara and Carcole (200 9) proposed a method to simultaneously estimate coda Q and the Nakagami-m parameter from seismogram envelopes based on maximum likelihood method. In this study, we show the results obtained by the application of the method to real data.

From the data analysis of local earthquakes in the frequency range from 1-32 Hz, coda Q is found to range from 100 at 1-2Hz to 2000 at 16-32 Hz with increasing as frequencies become higher. The obtained values are compatible with previously reported ones (e.g. Carcole and Sato, 2010). The m?parameter varies with events, and is significantly different from 1 for some events. But the mean values of m with respect to the events are close to 1 irrespective of components and frequencies. Variations in m are found to be larger for lower frequencies. To check the dependence of m on hypocentral distance, we investigate a relation between m and the direct S-wave travel time (Ts) instead. The results show that variations in m become smaller for smaller Ts and higher frequencies. This may suggest that m shows smaller fluctuations when many waves are incident from a wider range of directions.

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Keywords: seismogram envelope, fluctuation, Nakagami-m distribution