Envelope in stochastic Green function using scattering theory and its regional dependence

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For prediction of strong ground motion, stochastic Green function method is often used for high frequency. However, its representation of envelope is empirical in most cases. Seismogram envelope of small earthquake has been modeled using scattering theory in the propagation path of seismic waves. We aim to develop new representation of envelope for stochastic Green function by introducing scattering theory. In this presentation, frequency and regional dependences of the envelope of seismic waves will be discussed.

At the place of short hypocenral distance, seismic envelope of S wave portion is impulsive. The envelope gradually broadens with increasing hypocentral distance. The same kind of phenomena is well explained by multiple forward scattering in optics, so that the broadening of seismic S wave is also interpreted by the results of diffraction and forward scattering due to small perturbation of velocity structure. Saito et al.(2002) obtained formulation of the broadening of the S wave by interpreting it as the results of strong forward scattering along propagation path. In their formulation, they introduced relation between seismic wave envelope from point source and inhomogeneity and correlation length of the perturbed velocity structure, in which back scattering is neglected. Their formulation is represented by parameter, tM. tM is small when the envelope is impulsive, and gradually becomes large with broadening.

In this analysis, we focus on the tM representing the width of the envelope. tM is evaluated at each station from the envelope which is obtained from RMS of band pass filtered seismogram of each event. When tM is evaluated, it is possible to infer the shape of the envelope. The frequency dependence, hypocentral distance dependence, and focal depth dependence of tM are obtained for different districts. Seismograms of magnitude less than 5.5 are analyzed because of their short duration (less than approximately 1 second) of source time function.

For cases of focal depth larger than 40km, tM increases with increasing hypocentral distance. On the other hand, for events of focal depth less than 20km, hypocental distance dependence is not observed for 50-200km, that is, tM is approximately 10 seconds for around 3 Hz, which means that the envelope is almost the same independent of hypocentral distance. tM decreases with increasing the frequency, but the frequency dependence is small for larger than 4Hz.

Comparison of the results of Tohoku district with those of Chugoku-Sikoku district shows that the tM at Chugoku-Sikoku district is remarkably small. tM has strong regional dependence.

Frequency dependence, focal depth dependence and regional dependence of tM suggest that it is necessary to introduce the frequency dependence, focal depth dependence and regional dependence into the representation of stochastic Green function.

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