

3D distribution of intrinsic attenuation factors and random velocity fluctuations in southwestern Japan inferred from seismogram envelopes

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Hi-frequency (> 1 Hz) seismogram envelopes show various envelope shapes due to the influence of seismic scattering as well as intrinsic attenuation of the medium. Intrinsic and scattering attenuation structures inferred from seismogram envelopes are important for precise strong ground motion prediction as well as understanding the Earth structure. Ogiso (2019) have proposed a two-step approach to estimate the 3D distribution of intrinsic attenuation factors and scattering coefficients using envelope fitting method and sensitivity kernels proposed by Takeuchi (2016). In this study, we propose the method to estimate 3D distribution of intrinsic attenuation factors and random velocity fluctuations, which is the improved version of Ogiso (2019).

The same as Ogiso (2019), the proposed method consists of two steps. First, we estimate appropriate attenuation parameters (intrinsic attenuation factor and strength of random velocity fluctuation) for each observed envelope. Second, we map the estimated attenuation parameters in step 1 into 3D space using sensitivity kernels. Radiative transfer theory with non-isotropic scattering coefficients based on the Born approximation is used to model seismogram envelopes. The effect of depth-dependent velocity structure is also considered for modeling envelopes.

The proposed method is applied in southwestern Japan. The estimated structure has three main features: (1) both intrinsic attenuation factors and random velocity fluctuations are stronger in the Kyushu than the other regions, (2) both intrinsic attenuation factors and random velocity fluctuations are smaller in the lower crust than the upper crust, which is clearly found in the Chugoku region, and (3) horizontal heterogeneity in intrinsic attenuation factors at the depth of 10-50 km of the Shikoku region. These features, probably reflecting the tectonic settings of southwestern Japan, seem to be consistent with previous studies.

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