Synthesis of Scalar Wavelet Intensity Propagating through Random Media Having Power-Law Spectrum (2)

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High-frequency seismograms of small earthquakes show the excitation of long lasting coda waves and the broadening of the apparent duration of the S-wavelet with travel distance increasing. We study the propagation of a scalar wavelet through von Karman type random velocity fluctuations as a mathematical model. When the center wavenumber of the wavelet is higher than the corner wavenumber, we can not use the conventional Born approximation because of a large phase shift. Taking the center wavenumber as a reference, we divided the power spectral density function of random velocity fluctuation into two parts in the previous work (Sato and Emoto, GJI, 2017). The short-scale spectral component is chosen to satisfy the applicable condition of the Born approximation, which leads to the wide-angle scattering per volume. We have applied the Markov approximation to the long-scale spectral component to take into account the successive contribution of narrow-angle scatterings. Then we have convolved both contributions in time domain. Here, we newly propose to use the phase screen approximation based on the parabolic approximation to the long-scale spectral component, which leads to the narrow-angle ray-bending per length. Thus we introduce simultaneously both wide-angle scattering and narrow-angle ray-bending into the Monte Carlo simulation code in the framework of the radiative transfer theory. According to this stochastic synthesis, the wavelet intensity time traces show the envelope broadening with peak delay at large distances and the excitation of long lasting coda waves at short distances. We confirm that newly synthesized intensity well explains the averaged intensity calculated by finite difference simulations from the onset through the peak to coda for special cases. The proposed new method easily adopts the spatial variation of randomness and intrinsic absorption.

Keywords: seismic wave propagation, random media, scattering

