SSS24-03   Room:303   Time:May 20 09:30-09:45

Theoretical background for estimating attenuation structures with seismic interferometry

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Seismic interferometry or the noise correlation method has provided passive methods for travel time tomography. However, it is not clear yet whether amplitudes of Green's functions retrieved from cross correlations can be reliably used to estimate attenuation. Recently, an equation was conjectured by Prieto et al. (2009), which is thought to be an extension of the SPAC method (e.g. Aki, 1957) to lossy media, and it was used to estimate attenuation structures from amplitudes of the retrieved Green's functions. However, the conjecture is not clearly proved yet though numerical and analytical studies are being made. In this study, I prove a theoretical relation between the SPAC method and seismic interferometry for heterogeneous lossy media, and then develop a theory to support the conjecture by the help of the relation. The conjecture turns out to be derived for homogeneous lossy media under two assumptions of (1) weak attenuation and (2) larger station separations than a considered wavelength. Based on the results, applications of seismic interferometry to the estimation of attenuation should be conducted in relatively homogeneous regions with weak attenuation. Applications to attenuation tomography in heterogeneous regions still need to be investigated theoretically.

Keywords: seismic interferometry, SPAC method, attenuation