Attenuation characteristics of high-frequency seismic waves in Northeast India

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We studied frequency dependent attenuation of body (Q_p^{-1} and Q_s^{-1}) and coda (Q_c^{-1}) waves in northeast (NE) India in the frequency range of 1.5-24 Hz by adopting both single and multiple scattering models. We estimated Q_c^{-1} by using bandpass-filtered coda envelopes based on single isotropic scattering model and Q_p^{-1} and Q_s^{-1} by extended coda-normalization method in five central frequencies of 1.5, 3, 6, 12 and 24 Hz. We used earthquakes ($2.5 \leq M \leq 5.0$) within epicentral distance of 22-300 km and recorded by a local network of ten broadband stations in NE India. Both Q_c and Q_s increase with lapse time and frequency. The values of Q_p^{-1} and Q_s^{-1}, corresponding to spectral amplitude decays, show strong frequency dependence and are expressed as $0.035 * f^{-0.96}$ and $0.014 * f^{-0.94}$, respectively, in 1.5-24 Hz. The results show that both P- and S-waves undergo a strong attenuation along ray paths. Increase in Q_c with lapse time can be explained as the result of the depth dependent attenuation properties and multiple scattering effect. The high values of Q_p^{-1} and Q_s^{-1} correspond to seismically active areas with complex tectonics due to the ongoing underthrusting of the eastern Indian plate beneath the Eurasian plate. The ratio Q_p^{-1}/Q_s^{-1} is found to be larger than unity for the whole frequency range. We adopted energy flux model (EFM) and diffusion model for the multiple scattered wave energy in three-dimensions. The results show that the contribution of multiple scattering dominates for longer lapse time close to or larger than mean free time of about 60 s. The estimates of Q_c are overestimated at longer lapse time by neglecting the effects of multiple scattering. Some discrepancies have been observed between the theoretical predictions and the observations, the difference could be due to the approximation of the uniform medium especially at large hypocentral distances.