Effect of diffraction on the "cutoff scattering angles" for random acoustic media

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The scattering attenuation in random media is successfully modeled by Wu's and Sato's theories. The key is to eliminate the contribution to the attenuation form forward scattering within a cutoff scattering angle (CSA). However, the choice of the CSA is an open question. Recently, we investigated this question from a viewpoint of causality, and showed the CSA equals 60 (about 65) deg. for 3D (2D) acoustic cases. They are, however, larger than the many experimental estimates (15 to 45 deg.). In this study, we theoretically consider the effect of diffraction on the CSA. As a result, we show that, for rather small propagation distances, the CSA drastically decreases and becomes less than 10 deg. (and also the previous estimates). Further experimental studies are required for this subject.