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A detailed analysis of body waves simulated in homogenized media

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Non-periodic homogenization has proved to be an accurate asymptotic method for computing long-wavelength equivalent media for the seismic wave equation, turning small-scale heterogeneities and geometric complexity into smooth elastic properties. Using homogenized media allows i) decreasing the computation cost of wave propagation simulation and ii) studying the apparent, small-scale-induced anisotropy. After illustrating these two aspects briefly, we propose to analyze in great detail the accuracy of body waves simulated in homogenized 3D models of the subsurface. First, the behaviour of head-, reflected and refracted waves with respect to source-receiver offset, maximum frequency and velocity contrast across a planar interface, is investigated. Then, we consider the SEG-EAGE overthrust model to exemplify how the accuracy of simulated body waves anti-correlates with the distance to seismic source and the amount of apparent anisotropy. In high apparent anisotropy regions, we show that the first-order correction provided by the homogenization theory significantly improves the computed wavefield. The overall results of this analysis better frame the use of homogenized media in seismic wave simulation.