High-order homogenization for simulating local effects of small-scale structures on seismic waves

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S2006. High-order homogenization for simulating local effects of small-scale structures on seismic waves

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For performance reasons, most of the seismic wave equation solvers rely on explicit time-schemes. The downside of such schemes is the CFL stability condition, which makes the global time-step proportional to the minimum local space-step. When handling small geological scales, this dramatically degrades the performance of the solvers. To circumvent this critical issue, long-wavelength equivalent media can be used. In the last fifteen years, non-periodic homogenization proved to be an efficient theory to compute such media. Zeroth-order solutions were proposed in 2D and 3D models of the subsurface such as Marmousi and the SEG-EAGE overthrust, respectively. In the present work, we consider this latter as a case-study to analyse the benefit of taking higher-order terms into account. We show that such terms are able to model local, non-propagating effects of small-scale structures on the seismic wavefield. In some contexts (e.g., ground motion simulation), the correct account of these effects is key.