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Regional scale numerical simulation of wave propagation for seismic hazard evaluation study

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Regional seismic hazard evaluation is now often conducted through numerical simulations of seismic wave propagation based on an assumed seismic source, a known crustal model and estimated site amplification. Among many different numerical methods, the finite difference method (FDM) is technically easy to handle and also flexible for including the model input parameters. In many cases, it is sufficient to use a standard version of the FDM, formulated in a pure elastic medium (with or without the use of a simple parameter to approximate the effect of attenuation) with flat ground surface, for example, using a structural staggered grid of 4th order in space and 2nd order in time. This is because we do not always need to simulate ground motions at all frequencies with the same high precision. However in some complex geological situations (steep topography, realistic anelastic attenuation and so on), more sophisticated modelling may be required. In this study, we compare results computed from two different FDMs (elastic and visco-elastic medium, flat and irregular ground surfaces) in the simplified test case where the modelled region contains bathymetric and topographic variations. We discuss how a simple version of the FDM is valid and in which cases we should use a complicated version for the purpose of seismic hazard evaluation.