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Accurate and Efficient Viscoelastic Finite-difference Modelling for Analysis of Seismic Wavefields Applied to On-Site Inspection

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Numerical modelling of seismic wave propagation and seismic motion in realistic models of local small-scale near-surface structures requires realistic physical models and sufficiently accurate numerical-modelling method. Realistic models may include non-planar material interfaces, smooth heterogeneities inside layers/blocks and frequency-dependent attenuation. We present an optimized FD scheme with a. reduced grid dispersion in sediments, b. more accurate discrete representation of an interface, c. more accurate representation of realistic attenuation. The reduced grid dispersion in sediments is due to an optimized FD approximation of spatial derivatives. The approximation combines the Taylor-expansion and dispersion-relation-preserving approaches. The resulting scheme differs from the standard (2,4) staggered-grid scheme only by values of two approximation coefficients. A new discrete representation of heterogeneous viscoelastic medium with material discontinuities is based on the assumption that an interface of two viscoelastic media with the generalized Maxwell body (GMB-EK) rheologies can be approximated by an averaged orthorhombic medium with the GMB-EK rheology and the optimal procedure for a joint determination of the anelastic coefficients and distribution of the relaxation frequencies for an arbitrary Q(omega) law. The improved numerical modelling will be applied to the set of structural models of an underground cavity after a nuclear test explosion in the vertical emplacement.

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