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Wave propagation modeling in viscoelastic heterogeneous media with CPML : numerical and experimental validation

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We develop a finite difference time domain code to simulate wave propagation in two dimensional viscoelastic media. This code is planed for both seismological and engineering applications. The method is based on the first-order velocity stress formulation of the 2D P-SV wave equation. The scheme used is based on the standard staggered grid of 2^{nd} or 4^{th} accuracy in space, and 2^{nd} order accuracy in time (O(2,2) and O(2,4)). The anelasticity is introduced using a Generalized Maxwell Body (GMB) with L-Maxwell Bodies, and we achieve a constant quality factor Q between 2 and 25 Hz. A crucial step for the numerical validation is to evaluate both numerical dispersion and physical dispersion due to anelasticity and layered structure. For numerical modeling of seismic wave propagation in unbounded media, we implement and validate the convolutional perfectly matched layer (CPML) for a dispersive background. We then compare the results performed by our code with (i) analytical, (ii) canonical solutions (weathered-layer model, 90 degree corner model) and (iii) experimental results acquired on small scale aluminium device. Thus, the implemented code reveals itself as a robust tool to predict wave propagation in earth materials.

Keyword

Wave propagation, Viscoelasticity, CPML, FDTD, experimentation