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Global FD computation of seismic waveform for an axisymmetric Earth with anelastic attenuation

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In order to reveal detailed structure of the Earth's interior, we need to employ waveform inversion. The waveform inversion is the method that determines structures by minimizing the difference between observed waveforms and theoretical seismograms. For the direct comparison between them, employment of realistic attenuation is crucial since it affects amplitudes, traveltimes, and waveforms of observed seismograms. Stress-strain relation in a viscoelastic material is represented as a convolution in the time domain, so incorporation of the anelasticity into time domain methods such as the finite-difference (FD) method had been quite difficult before the so-called memory variable was introduced (e.g., Emmerich & Korn, 1987, Geophysics; Carcione et al., 1988, Geophys. J. R. astr. Soc.).

On the other hand, in the field of global seismology, axisymmetric FD modeling (e.g., Igel & Weber, 1995, GRL) has usually been employed to save computational resources. The axisymmetric modeling uses a structure model with rotational symmetry about an axis through a seismic source, and then solves the elastodynamic equation in spherical coordinates. The axisymmetric modeling has been a powerful method especially in global seismology since it can correctly model the 3-D geometrical spreading effects with computational resources comparable to 2-D modeling. Recently we proposed implementation of an arbitrary moment tensor point source into axisymmetric FD scheme (Toyokuni & Takenaka, 2006, EPS). Nevertheless, anelastic attenuation has not been incorporated in the conventional axisymmetric global FD modeling. In this presentation, we employ the anelasticity in the axisymmetric FD scheme through the memory variable, and show some numerical examples.