Including Short Period Information Into Full Waveform Tomographic Models

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Thanks to the advent of the Spectral Element Method (SEM) in seismology, the resolution of regional and global tomographic models has improved in the last decade. However, due to computational costs, only relatively long period waveforms are considered, and therefore only long wavelength structure can be constrained. Thus, the resulting 3D models are smooth, and only represent a small volumetric perturbation around a smooth reference model that does not contain short scale information about upper-mantle discontinuities (e.g. MLD, LAB). A decrease in period, necessary for the resolution of smaller scale features is computationally challenging. In order to overcome these limitations and to account for layered structure in the upper mantle, we have developed a methodology that combines full waveform inversion and information provided by short period seismic observables (receiver functions and surface wave dispersion, sensitive to sharp boundaries and anisotropic structure respectively).

To combine short and long wavelength information, we use a procedure based on residual homogeneization (Capdeville et al. 2013). In a first step, receiver functions and dispersion curves are used as constraints to generate a number of 1D profiles beneath selected stations using a trans-dimensional Markov-chain Monte Carlo (McMC) algorithm. These 1D profiles, containing both isotropic and anisotropic discontinuities in the upper mantle, are then interpolated to build a 3D starting model for the full waveform tomographic inversion. This discontinuous starting model is homogenized to avoid meshing problems and heavy computations. The results of the tomographic inversion are volumetric velocity perturbations around the homogeneized starting model, which are then added to the discontinuous 3D starting model. We present here the first results of a multiscale model of the North American continent.

References

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