Geophysical Research Abstracts
Vol. 14, EGU2012-11133-1, 2012
EGU General Assembly 2012

Frequency-dependent sensitivity to mantle and core-mantle topography

A. Colombi, T. Nissen-Meyer, and L. Boschi
ETH, Geophysics, SEG, Switzerland (colombia@ethz.ch)

We investigate the implications of lateral variations in the topography of global seismic discontinuities, in the framework of high-resolution forward modeling and seismic imaging.

We run 3D wave-propagation simulations accurate at periods of 10 s and longer, with Earth models including core-mantle boundary (CMB) topography anomalies of ∼1000 km spatial wavelength and up to 10 km height with experimenting with a set of different geographic patterns. We obtain very different waveform signatures for *PcP* (reflected) and *Pdiff* (diffracted) phases supporting the theoretical expectation that the latter are sensitive only to large-scale structure while the former only to small scale with respect to seismic wavelength.

PcP at 10s is well suited to map such a small-scale perturbation while *Pdiff* at the same frequency carries a faint signature that does not allow any tomographic reconstruction. Only at higher frequency the signature becomes stronger.

We present a new algorithm to compute sensitivity kernels relating seismic travel times (measured by cross-correlation of observed and theoretical seismograms) to the topography of seismic discontinuities at any depth in the Earth using full 3D wave propagation. Calculation of accurate finite-frequency sensitivity kernels is notoriously expensive, but we reduce computational costs drastically by limiting ourselves to spherically symmetric reference models, and exploiting the axial symmetry of the resulting propagating wave-field that collapses to a 2D numerical domain.

We compute and analyze a suite of kernels for upper and lower mantle discontinuities that can be used for finite frequency waveform inversion. For the travel-time residuals calculated from 3D wave propagation, we compute using our efficient approach the

matrix for various parameterizations and source-receiver distribution. Finally, upon the choice of an adequate numerical scheme, we invert the residuals travel-time synthetics.