Geophysical Research Abstracts
Vol. 15, EGU2013-5804, 2013
EGU General Assembly 2013

Ray-Born Modeling in Acoustic and Elastic Media

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One of the most important challenges in seismology is the efficient computation of seismograms in heterogeneous media. We present a tool for the computation of synthetic seismograms using ray-Born theory. The method is applied to both acoustic and elastic media, including the case of transverse isotropy. The Born approximation implies that the Earth's properties can be approximated by a sum of a smooth background model and a small perturbation on which scattering of incidence waves occurs. The validity of this assumption is also investigated. In particular we show comparison of our computations with finite difference modeling for a range of perturbations, propagation distances and frequencies.
In our approach, the computations are performed in the frequency domain. Thus, the scattered wavefield is a product of a perturbed Green tensor and a point source spectrum. In the elastic isotropic case, the perturbed Green tensor has two main components, namely, a source-receiver Green tensor in a background media and a tensor describing scattering interaction on Vp, Vs and density heterogeneities. In the transversely isotropic case, wave scattering occurs also on perturbations of anisotropic parameters with an isotropic background. The amplitude and phase components of the Green tensor are obtained using ray tracing in a smooth background velocity model. The computed waveforms are used to study polarization of earthquake waves as a function of distance, anisotropy and azimuth.