Geophysical Research Abstracts, Vol. 9, 05064, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-05064

Inversion of SPICE benchmark dataset and test of global tomographic models

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The existing tomographic methods result in different models due to different parameterization, scale resolution and theoretical approach. In order to test how current imaging techniques are limited by approximations in theory and by the inadequacy of data quality and coverage, we have generated complete synthetic seismograms for a complex 3D global anisotropic anelastic model developed within SPICE (Seismic wave Propagation and Imaging in Complex media: a European network). The model has realistic, Earth-like properties, but its geographic distribution of seismic anomalies is unlike that observed tomographically in the Earth. The synthetic seismograms have been made available to the scientific community worldwide at the IPGP website http://www.ipgp.jussieu.fr/∼qyl/.

We are now inverting fundamental modes of Rayleigh waves for the dataset in three steps: (1) use Roller-Coaster method (Beucler, et al., 2003) to calculate the phase velocity for each source-receiver path; (2) use CLASH method (Beucler and Montagner, 2006) to calculate the anisotropic phase velocity distribution for different period; (3) compute the 3D velocity model from phase velocity. Preliminary results will be presented during this meeting.

Data collected in the SPICE tomographic model database (http://www.spice-rtn.org/research/planetaryscale/tomography/) show that the correlation between recent global tomographic models is generally high at long wavelengths, but the same models are less similar at shorter wavelengths. A helpful way to assess how well a model represents Earth structure is by comparing predictions from a model with real data. To this end, we are using the coupled spectral element method (CSEM) (Chaljub et al., 2003; Capdeville et al., 2003), which can incorporate the effect of three-dimensional variations with very little numerical dispersion, to compute long-period (larger than 100s) synthetic seismograms for different global tomographic models. Then, comparing modeled records with real data for large (Mw>8) eathquakes, we will see how well different tomographic models can explain observations of both Love- and Rayleigh-wave overtones and fundamental modes.