Geophysical Research Abstracts,
Vol. 11, EGU2009-1298, 2009
EGU General Assembly 2009

Constructing probabilistic models for realistic velocity distributions based on forward modeling and tomographic inversion: applications for active and passive source observation schemes

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Seismic tomography is like a photography taken by a camera with deformed and blurred lenses. In the resulting tomograms, colors (amplitudes of anomalies) and shapes of objects are often strongly biased and are usually not representing the reality. We propose an approach which allows investigating properties of the “camera” and retrieving most probable shapes and amplitudes of anomalies in the real Earth. The main idea of this approach is to construct a synthetic model which, after performing forward modeling and tomographic inversion, reproduces the same amplitudes and shapes of patterns as after inversion of observed data. In this modeling, the conditions of the tomographic inversion (damping, grid spacing, source location parameters etc) should be absolutely identical to the case of the observed data processing. The a priori information, if available any, should be taken into account in this modeling to decrease the uncertainty related to fundamental non-uniqueness of the inversion problem. In the talk, several examples of applying this approach at various scales for different data schemes are presented: (1) regional scheme which uses the global data of the ISC catalogue (with examples of regional upper mantle models in Europe and central Asia); (2) local earthquake tomography scheme (illustrated with models in Toba caldera area and in Central Java); (3) seismic profiling which is based on active source refraction travel time data (with examples of several deep seismic sounding profiles in Central Pacific and subduction zones in Chile).