Geophysical Research Abstracts
Vol. 14, EGU2012-4169, 2012
EGU General Assembly 2012


# Waveform inversion of truly broadband seismograms for global tomography

K. Sigloch (1), S. Stähler (1), S. K. Hosseini zad (1), and T. Nissen-Meyer (2)

(1) Ludwig-Maximilians-Universität Munich, Geosciences Department, Munich, Germany (sigloch@geophysik.uni-muenchen.de), (2) ETH Zurich, Geosciences Department, Zurich, Switzerland

At present, waveform inversion methods are typically limited by computational resources, since the cost of forward simulations grows non-linearly with dominant wave frequency. Hence most waveform inversions of body waves still operate around the lower end of the relevant frequency range (e.g. dominant periods of 30-40 sec). The method we pursue, multi-frequency tomography, is an exception in that forward computations are already able to span the full frequency range of teleseismic waves in broadband observations. This is achieved by exploiting extreme computational efficiencies that result from the use of spherically symmetric reference models. The original method of choice was the algorithm by Dahlen et al. 2000 for computing finite-frequency kernels of traveltimes and amplitudes, but we are in the process of switching to kernels from full forward simulations of the wave equation by Nissen-Meyer et al. 2007.

Here we are concerned with the additional challenges that arise in terms of data processing when truly broadband data are being used (as opposed to lowpassed body-wave seismograms). Most notably, significantly more information about source characteristics must be estimated before the waveforms may be used for structural inversion – we find the required level of technical effort is not too far removed from dedicated studies of earthquake characteristics anymore, with the difference that we routinely need to invert for large numbers of source time functions, hypocenters, and moment tensors. We present our efforts to robustify and automate this task using Monte Carlo inversion for source characteristics. This yields full uncertainty estimates for the results, which serve as an important measure of whether a given earthquake can be used at all, or whether it is too complex. We also demonstrate the (systematic) measurement errors that occur in the input data for tomography (traveltimes, amplitudes) when the source wavelet is approximated as a dirac pulse, or when the source depth is mislocated. We discuss cross-correlation measurements derived from broadband seismograms of teleseismic, triplicated and core-diffracted P-waves.