Geophysical Research Abstracts, Vol. 7, 00931, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00931

Membrane waves and finite-frequency effects in surface wave tomography

D. Peter, L. Boschi
Institute of Geophysics, ETH-Hoenggerberg, 8093 Zurich, Switzerland

Tomographic models thus far have almost always relied on ray theory, which is valid only at high frequencies; particularly for surface waves we must now go beyond this approximation. Full numerical integration of the equations of motion is computationally too heavy to be run on "normal" computers, on the other hand analytical formulations (based e.g. on Born theory) also rely on a linear approximation. The computational cost of both numerical and analytical techniques in three dimensions is greatly reduced if we restrict ourselves to the two-dimensional problem of surface waves propagations at a selected frequency. Tape and Woodhouse, following earlier work by Tanimoto, have recently proposed that the propagation of elastic waves on a zero-thickness spherical membrane is a good analogue for the propagation of surface waves on the Earth. We show how numerically modeled "membrane waves" can be used to study finite-frequency effects and to formulate a tomographic inverse problem:

In fact, an efficient algorithm for modeling membrane waves numerically will lead to the numerical derivation of finite-frequency sensitivity kernels for surface wave phase velocity tomography. We present here a new finite-differences algorithm that runs on parallel computers; we have successfully tested our numerical solutions for a Gaussian source term against analytical ones in a spherically symmetric Earth. We then introduced lateral heterogeneities to visualize their non-linear effect on phase and amplitude as a function of the shape and location of the heterogeneity itself.