Geophysical Research Abstracts
Vol. 17, EGU2015-10551, 2015
EGU General Assembly 2015

Methods for joint inversion of waveform and gravity information for 3D density structure

Nienke Blom (1), Christian Böhm (2), and Andreas Fichtner (2)

(1) Universiteit Utrecht, Earth Sciences, Utrecht, Netherlands (n.a.blom@uu.nl), (2) ETH Zürich, Earth Sciences, Zurich, Switzerland

We develop a joint inversion scheme combining seismic waveform and gravity information to better constrain the Earth's 3D density distribution. Our inversion schemes are based on numerical wave propagation, adjoint techniques, gravity and other non-seismological constraints to enhance resolution.

Density variations drive convection in the Earth and serve as a discriminator between thermal and compositional heterogeneities. However, classical seismological observables are only very weakly sensitive to density with significant trade-offs, while potential field measurements such as gravity suffer from inherent non-uniqueness. To put additional constraints on density structure, we develop inversion schemes in which the waveform and gravity data are inverted jointly for both density and seismic velocity parameters.

Our inversion scheme is intended to incorporate any information that can help to constrain 3D density structure. This includes gravity-derived quantities such as the mass and moment of inertia of the Earth, but also mineral physical constraints on maximum density heterogeneities (assuming reasonable variations in temperature and composition).

In a series of initial synthetic experiments, we aim to construct efficient optimisation schemes that allow us to assimilate all the available types of information. For this, we use 2D numerical wave propagation combined with adjoint techniques for the computation of sensitivity kernels. With these kernels, we drive gradient-based optimisation that incorporates our non-seismological constraints. Specifically, we assess the usefulness of an inversion scheme where the Earth's mass and moment of inertia are enforced in the model by means of a projected gradient scheme.

These synthetic experiments will allow us to assess to what extent velocity and density structure need to be coupled in order to obtain useful and meaningful results to a density inversion.