Geophysical Research Abstracts
Vol. 15, EGU2013-6925, 2013
EGU General Assembly 2013

Sensitivity analysis of a forward gravity field model for Fennoscandia

Bart Root (1), Pavel Novak (2), Ward Stolk (3), Wouter van der Wal (1), and Bert Vermeersen (1)

(1) Astrodynamics & Space Missions, Delft University of Technology, Delft, Netherlands (b.c.root@tudelft.nl), (2) Mathematics, University of Bohemia, Pilzen, Czech Republic, (3) Geosciences, University of Utrecht, Utrecht, Netherlands

A good representation of the density distribution of the Earth's lithosphere is crucial for geophysical studies. Due to inaccuracies in the seismological data and the conversion to density, density models derived from seismic data usually have large uncertainties. To further constrain these density models, gravity observations can also be used. However, simple conversions from seismological data to density models generally do not result in a forward modeled gravity signal that matches with gravity observations. The goal of this study is to construct a 3D density distribution from seismological observations that agrees with the observed gravity field in Fennoscandia. Here, we investigate the sensitivity of the forward modeled gravity field to several input parameters in the model.

The gravity field resulting from the CRUST2.0 density model is computed with a forward method based on spherical harmonics. The resulting gravity field is compared with the EIGEN-GL04C potential model in the spherical harmonic domain and in the spatial domain, between spherical harmonic degree and order 10-60. In the comparison some correlation between model and observations is seen in the spatial patterns, however the amplitude of the constructed gravity field is a factor of 4 larger than EIGEN-GL04C.

To find out where this discrepancy in the magnitude of the modeled and observed gravity signal is coming from, a sensitivity analysis is performed within the boundaries of the seismological uncertainties. Several aspects of the density models are examined. The effect of lateral resolution, extra mantle layers below CRUST2.0, radial resolution and different shear wave velocity to density conversions, are explored without prescribing isostatic equilibrium. For the conversion of shear wave velocities into density the use of the shear wave velocity anomaly ratio described by Karato [2008] is made. Another conversion method, developed by W. Stolk, is explored.

It was found that improvement of radial resolution has more effect on the gravity signals than lateral resolution. Also, it was seen that the uncertainty in the density values has a larger effect than the uncertainty in crustal thickness. Furthermore, it is seen that the constructed gravity field is sensitive to mantle layers up to the lithosphere-asthenosphere boundary. An improvement in the constructed gravity signal is seen when the conversion methods of Stolk are used for the shear wave velocity to density conversion.