Geophysical Research Abstracts
Vol. 21, EGU2019-17889, 2019
EGU General Assembly 2019

Forward gravity modelling using Newton integrals on a hollow sphere

Ludovic Jeanniot (1), Cedric Thieulot (1), and John Naliboff (2)

(1) Utrecht Univeristy, Faculty of Geosciences, Earth Sciences Mantle Dynamics, Utrecht, Netherlands (l.jeanniot@uu.nl), (2) UC Davis, Davis, California, USA

In order to compute synthetic gravity data one must define a spherical geometry which is filled with a density model from the crust to deep mantle. We use the direct integration method to compute globally gravity acceleration, gravity anomalies, potential and gradients, which requires an adequate discretisation of the domain. We have written a gravity post-processor plugin for this task in the state of the art ASPECT finite element code [Heister et al, GJI 2017].

We first present the results of a benchmark for the gravity post-processor plugin: - A hollow sphere is filled with a constant density of 3300 kg/m^3. - Gravity fields and their derivatives are then calculated at 10 locations above the hollow sphere surface, and compared to their analytical solution. - We perform a series of numerical experiments to test the sensitivity of gravity computation on the numerical discretisation of the hollow sphere, the quadrature order and the altitude at which gravity is calculated.

Because Newton integrals is a function of the distance between the point coordinate at which gravity is calculated and a discretised mass element, the hollow sphere must have a high resolution - at least near surface - to obtain an error in gravity anomalies of an order lesser than the milligal. We therefore use the mesh refinement capabilities of ASPECT to increase resolution towards the model surface.

Three density models are tested separately: a density fields obtained from the S40RTS tomographic model data for the deep mantle, the density model CRUST1.0 for the thin upper lithosphere layer and a composite model WINTERC for the lithosphere and upper asthenosphere (400km deep). For the deep mantle tomographic model, we test the sensitivity of gravity prediction on the use of various conversion scaling factors of shear wave velocity to density. We find that the scaling factor profile has a major impact on gravity prediction.