From discrete gravity survey data to a high-resolution gravity field representation in the Nordic-Baltic region

S. Märdla[(1)], J. Ågren[(2)] , G. Strykowski[(3)] , T. Oja[(4)] , A. Ellmann[(5)] , R. Forsberg[(6)] , M. Bilker-Koivula[(7)] , O. Omang[(8)] , E. Paršeliūnas [(9)] , I. Liepiņš[(10)] , J. Kaminskis[(11)] and L.E. Sjöberg[(12)]

(1) Tallinn University of Technology, Ehitajate tee 5, 19086, Tallinn, Estonia, (silja.mardla@ttu.ee / +3726202601)

(2) Lantmäteriet, Lantmäterigatan 2 C, 80182, Gävle, Sweden, (jonas.agren@lm.se)

(3) Technical University of Denmark, Anker Engelunds Vej 1, 2800, Lyngby, Denmark, (gs@space.dtu.dk)

(4) Estonian Land Board, Mustamäe tee 51, 10621, Tallinn, Estonia, (tonis.oja@maaamet.ee)

(5) Tallinn University of Technology, Ehitajate tee 5, 19086, Tallinn, Estonia, (artu.ellmann@ttu.ee)

(6) Technical University of Denmark, Anker Engelunds Vej 1, 2800, Lyngby, Denmark, (rf@space.dtu.dk)

(7) Finnish Geospatial Research Institute FGI, Geodeetinrinne 2, FI-02430 Masala, Finland, (mirjam.bilker-koivula@nls.fi)

(8) Norwegian Mapping Authority, Postboks 600 Sentrum, 3507 Hønefoss, Norway, (ove.omang@kartverket.no)

(9) Vilnius Gediminas Technical University, Saulėtekio al. 11, 10223 Vilnius, Lithuania, (eimuntas.parseliunas@vgtu.lt)

(10) Latvian Geospatial Information Agency, Ojāra Vācieša Street 43, LV-1004, Riga, Latvia, (ivars.liepins@lgia.gov.lv)

(11) Riga Technical University, 1 Kalku Street, LV-1658, Riga, Latvia, (janis.kaminskis@rtu.lv)

(12) KTH Royal Institute of Technology, Brinellvägen 8, 11428, Stockholm, Sweden, (lars.sjoberg@abe.kth.se)

The geodetic community has set the goal of accuracy for geoid modelling at the 5 to 10 mm level, which puts equally high pressure not only on the geoid modelling methodology, but also on the accuracy of the irregularly spaced input gravity data and subsequent gravity anomaly gridding. Even though there are geoid computation methods like Least Squares Collocation, which can be applied directly without a prior gridding step, many modelling techniques need a regularly spaced gravity anomaly grid, to be deduced from pointwise survey data located from a few hundreds of meters up to a few tens of kilometers apart.

Accordingly, this contribution aims at minimizing the loss of information and increasing the accuracy of a regular surface gravity anomaly grid computed from pointwise survey data. Mainly two aspects are addressed. First, the treatment of the surface gravity anomaly before interpolation and second, the interpolation process itself. It is difficult to find a method that would be optimum in dealing with a heterogeneous dataset reflecting varying landscape. This contribution aims at determining the best compromise or possibly an adaptive interpolation method considering local properties of limited homogeneous data areas within the full dataset to be gridded. Another aim is to quantify how much the uncertainties in the gridding contribute to the uncertainty of a geoid model.

The problem is illustrated in a number of areas with different characteristics: in rugged mountains (heights up to 2500 m) with steep fjords, marine areas (sparsely covered by less accurate data) and flat terrain (densely filled with accurate data), keeping in mind that for practical reasons the gravity anomaly interpolation should result in a seamless transfer between

the different areas. Test computations are performed on the NKG (Nordic Geodetic Commission) gravity database with about half a million observations covering the Nordic and Baltic countries with surroundings (within geographical limits of 53...74 °N, -2...36 °E) as a part of the NKG2015 geoid modelling project. The final NKG2015 quasigeoid is to be presented in another GGHS2016 contribution. Obtaining the best gravity field representation possible has been a very relevant issue in the project, especially to assert the uncertainties the gridding step yields to the final geoid model. Preliminary results have shown that the care taken in collecting, processing and gridding the gravity data has paid off by resulting in a final quasigeoid model with an RMS discrepancy of 3.0 cm (1-2 cm in regions with a smoother gravity field) with respect to high-precision GNSS/levelling control points after a 1-parameter fit.

Keywords: gravity database, gridding, interpolation, residual gravity anomaly, regional geoid

Session 3: Local/regional geoid determination methods and models

Presentation preference (Oral)