

The NKG2015 gravimetric geoid model for the Nordic-Baltic region

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There is a long tradition of geoid determination within the Nordic Geodetic Commission (NKG). This cooperation between the Nordic and Baltic countries has so far resulted in the sequence of NKG geoid models NKG1986, NKG1989, NKG1996, NKG2002 and NKG2004. In 2010, the NKG Working Group of Geoid and Height Systems started a new project to develop the next model in this series, NKG2015.

The NKG2015 geoid model project has consisted of both a data update phase, in which the data of all the participating countries have been carefully updated, and a computation phase, which has included comparisons and benchmarking of different regional geoid computation methods. Since 2010, the NKG gravity database has been thoroughly modernized, quality checked and significantly updated. A new regional NKG Digital Elevation Model (DEM) with 3''x3'' resolution has been compiled and an ice thickness model derived for the glaciers in Norwegian mountains. A new NKG GNSS/levelling database has also been created. Considerable efforts have been spent on transforming the different national datasets to consistent and common reference systems/frames, as well as to the common postglacial land uplift epoch 2000.0 with zero permanent tide system. The GNSS-derived ellipsoidal heights have also been transformed from the national ETRS 89 realisations to a common ETRF2000 frame, using the transformation parameters from the NKG2008 GNSS campaign. The geoid computation was made by five computation centres using different geoid modelling methods, strategies and software packages. Different versions of the remove-compute-restore technique with Wong and Gore kernel modification and of the Least Squares Modification of Stokes formula with Additive corrections were compared and evaluated. It was specified that all centres apply the same GOCE/GRACE model GO_CONS_GCF_2_DIR_R5.

The main purpose of this paper is to present the NKG2015 geoid model project and describe the computations that led to the new NKG2015 geoid model. The final gravimetric model, which was chosen mainly based on the comparison with GNSS/levelling data, is computed by Least Squares Modification of Stokes' formula with Additive corrections. The model is also compared with other models available over the region. It is further shown how the

transformation to a common ETRF2000 frame affects the GNSS/levelling evaluation. The NKG2015 geoid model agrees very well with GNSS/levelling with a standard deviation of 3.0 cm after a 1-parameter fit for the whole Nordic-Baltic region. The corresponding numbers are 9.0 cm for the preceding NKG2004 geoid model, 4.7 cm for the global combined EGM2008 model, 4.4 cm for the European gravimetric EGG08 model and 4.2 cm for EIGEN-6C4, which shows that the new NKG2015 geoid model is a significant step forward. In areas with a smooth gravity field, the standard deviation is considerably lower, around 1-2 cm.

The gravimetric NKG2015 geoid model will now be used as a basis to compute national height correction models, for instance in Sweden. Since the model has been fitted GNSS/levelling with a 1-parameter transformation, and since it also includes a correction between the zero and non-tidal tide systems, it is also directly usable for GNSS height determination.

Key words:

Nordic Geodetic Commission, NKG2015 geoid model, regional geoid modelling, gravity, GOCE

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