



Performance of the Earth Gravitational Model EGM08 over the Baltic countries

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The Earth's gravitational models (EGM) in conjunction with regional terrestrial gravity data are often used in regional geoid determination. Due to availability, quality, and type of data, the performance of an EGM vary regionally. By comparing EGM regionally with that of external data sets that rely on the same gravity field the accuracy of the EGM can be validated. Accordingly, this study assesses the performance of the new high-resolution EGM08 model over the Baltic Sea region with emphasis to Estonia, Latvia and Lithuania.

Several different sets of the "ground truth" data are used in the comparisons. First, the EGM08-derived height anomalies are compared with an existing regional geoid model. The detected discrepancies range within ± 0.3 m with a mean of -0.02 m, whereas the standard deviation (STD) of the discrepancies amounts to 0.08 m. The largest discrepancies occur in the areas where only a few data points were available either for the regional geoid modeling or at the EGM08 compilation, or both. Second, the free-air gravity anomalies at the terrestrial data-points are compared with the EGM08-derived anomalies. The STD of the anomaly discrepancies is 2.6 mGal. Finally, the EGM08 model is validated with respect to GPS-levelling data. The STD of detected discrepancies is 0.06 m, with a mean of 0.49 m. Thus, the EGM08 based quantities agree reasonably well with the tested datasets. Evidently, most of the historic gravity data in the Baltic Sea region appear to be utilised at the EGM08 construction.

Some facts about the data sets that should be mentioned here are that the gravity data within the land masses of the Baltic countries have been collected before 1990-ies, whereas the modern gravity networks were established decades after the historic gravity surveys. Furthermore, in mid 1990-ies a set of absolute gravity stations was established in the Baltic countries. Thereafter the national gravity networks were re-adjusted. Even though attempts were made to convert the historic survey results into the current gravity datum, the connections between the datasets remain still rather loose. Most likely the gravity network points and the results of new surveys were not used at the compilation of the EGM08. This study shows that the EGM08 agrees reasonably with the historic terrestrial data, whereas at certain geographical locations the EGM08 derived gravity values appear to be systematically biased from the modern gravity network data. Hence, there is still some space for further improvements of the contemporary EGM-s. Clearly, this requests a throughout international and well coordinated co-operation for reconciliation of the historic gravity surveys.