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Application of space technologies to improve geoid and gravity field models over the Baltic countries

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Different modifications of Stokes's formula are employed for computing high-resolution regional geoid models nowadays. A modified Stokes formula utilizes the low-frequency part of the geoid (described by a global geopotential model, GGM) in conjunction with regional terrestrial gravity data. Recent advancements of the space technology have significantly improved our knowledge of the global gravity field and Earth's topography. For instance, the dedicated gravimetric satellite mission GRACE has enhanced the long wavelength component of the new Earth Gravity Model EGM08. This model will also be used in geoid determination over the Baltic countries.

The quality and resolution of the available gravimetric and topographic data affect directly the quality of subsequent geoid determination. Therefore the data preparation stage needs to contain also a major revision, in order to detect and eliminate the undesired systematical biases, followed by the conversion of all the data into the common gravimetric datum.

The evaluation of topographical effects is acknowledged to be one of the most serious limitations in precise geoid modelling. In this respect significant improvements

are expected due to access to the global high resolution 90 x 90 m^2 SRTM (Shuttle Radar Topography Mission) topographic model, which became available recently. The SRTM model is expected to enhance also the gridding of the anomalies. Gridding is a very critical issue, because any error committed at this stage will directly propagate into the geoid solution.

The gravimetric geoid models generally do not coincide with the local vertical datum, which is usually referred to some tide-gauge at the coastline. This difference can be detected by using another space-borne technique – Global Positioning System (GPS). The comparison of the gravimetric geoid with the GPS-levelling heights allows the geoid model to be adjusted for a large variety of practical applications. In this study a novel geoid determination methodology (developed at the Delft University of Technology) will be applied to model the regional distortions between the gravimetric geoid model and the GPS-levelling data. The solution is formulated using a Cauchy boundary value problem for the Laplace equation, which then is solved through the numerical integration.

Hence, the up-to-date complementary space-borne data-sets offer many challenging (both theoretical and numerical) opportunities for accurate and high-resolution gravity field and geoid modelling on the regional and global scales.