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Band-limited topography effects in airborne gravimetry using space localizing base functions

A. A. Makhloof, K.H. Ilk

Institute of Theoretical Geodesy, University of Bonn (atef@geod.uni-bonn.de)

Airborne gravimetry enables the measurement of the Earth's gravity at aircraft altitude with an accuracy of 1-2 mgal and with a spatial resolution of approximately 2 km. After downward continuation these data can be used for the determination of the gravimetric geoid. The downward continuation requires a data filtering to reduce the intrinsic instabilities. To improve the conditions for the downward continuation it is helpful to apply in addition a remove-restore technique based on known gravity field information provided by digital elevation models, available nowadays for most parts of the world. For the envisaged accuracy and resolution of airborne gravimetry we need an adequate digitial elevation model and an economic mathematical procedure to determine the topographic-isostatic gravity field effects at the specific altitude of the aircraft. Here we propose a hierarchical mathematical determination procedure which is able to determine the topographic-isostatic effects at aircraft altitude also for high resolution digital elevation models. The method is based on a spherical harmonic expansion of the topography up to a reasonable degree to model the long wavelengths structures and by spherical splines as space-localizing base functions to cover the high frequent part of the topographic effects. The procedure is demonstrated based on Helmert's condensation methods by a simulation scenario and shows the efficiency of the proposed method and its superiority if compared to the integration method or a pure spherical harmonic procedure. The proposed algorithm can be used for different topographic isostatic models such as Airy-Heiskanen model.