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A Study on Gravimetric Geoid Determination Using Analytical Downward Continuation Technique

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The Stokes' formula requires the gravity anomaly on the Earth's surface be downward continued to the geoid and the mass above the geoid be removed. Although the Earth Gravity Field Models (EGMs) are used to compute quasi geoid models, gravimetric geoid determination is possible taking into account the topographic effects. Analytical or harmonic downward continuation of external gravity potential of the Earth into the topographic masses results in "analytical downward continuation error" or "topographic bias". One of the alternatives to compute topographic bias is spherical harmonic expansion of reciprocal distance including functional coefficients of Earth's radius and topographic height depending on the position. Spherical harmonic coefficients are then expanded into binomial series to compute the difference between the topographical potential and its downward continuation. On any coordinates on the Earth, topographic bias can easily be computed using these coefficients. Topographic bias provides a practical way to compute a regional geoid model transforming height anomalies computed from EGMs to geoid undulations. Using this technique, regional geoid models are determined in two test areas, the Auvergne, France and New Mexico, U.S.A, and compared with the GNSS/levelling geoid undulations and the regional geoid models computed using Least Squares Modification of Stokes' Formula (KTH method).

Keywords: Analytical downward continuation, topographic bias, geoid determination, Earth Gravity Model, Least Squares Modification of Stokes' Formula (KTH method).