An Entire Spectrum Modernization of the Geoid Model ---------- from data collection to modeling and customer services

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SUMMARY

Determining the shape and size of the Earth is the main objective of geodesy, the science that supports geomatics, surveys, and many civil engineering applications. An accurate geoid model with high resolution is a must to achieve these goals. The U.S. National Geodetic Survey (NGS) is updating its leveling based vertical datum to a pure geoid based one, i.e., NAPGD 2022 (North American-Pacific Geopotential Datum of 2022). This paper summaries the main efforts toward this end, which include new gravity data collections, modeling methodology updates, model validations and product distributions. While relying on the satellite gravimetric missions in the middle to long wavelengths, NGS launched the so-called GRAV-D (Gravity for the Redefinition of the Vertical Datum) project to collect airborne gravity data that almost homogenously covers the entire territory of the U.S. with an extension of about 200km to its neighboring countries and open ocean areas along the coastlines. It requires a whole spectrum modernization of the geoid modeling computation procedures to best use these airborne gravity data with the signals from satellite models, surface gravity surveys, and high-resolution digital elevation data and satellite altimetry in the context of regional geoid model determination, albeit it is still fundamentally based on the boundary value problem theory. A series of research has been conducted on the key steps such as downward continuation, topographic modeling, and the use of local functions. This paper will be focused on the practical impacts rather than complicated mathematical derivations that have been done in previous studies. Several validation tests on land and multi-year/multi-mission averaged water surface heights are used to evaluate the geoid models. Considering the access of high-performance computation in the near future, we also propose to provide on-line real time computations for critical points in addition to interpolating from the pre-computed grids, which will be useful especially when a more realistic accuracy estimation is desired.
