Alternative Methods for Geoid Determination and Its Geophysical Implications for Data Sparse Regions

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Abstract

Gravity information is vital for many geodetic and geophysical studies. One of the fundamental geodetic applications of gravity data is geoid determination. GPS-leveling data is also an important source of information for precise geoid determination. Since geoid reflects density distribution of Earth's internal masses, it can be used for geophysical investigations. However, high quality and dense gravity and GPS-leveling data are not available for many developing countries due to financial and physical difficulties.

In order to examine this issue, alternative methods, based on latest high quality global gravity and digital terrain models, are proposed for precise geoid determination and its geophysical interpretations, especially for regions where the required survey networks are not sufficient. In geoid determination, long and medium wavelength gravity field structures are determined from the recent global gravity field model, the Earth Gravitational Model 2008 (EGM2008), while the short wavelength structures are calculated from the global digital terrain model (the Shuttle Radar Topography Mission (SRTM) elevation data). Residual topography reduced geoid undulation differences between GPS-levelling and EGM2008 are modeled as a trend and a corrective surface separately. The long wavelength component of the gravity field of the geoid obtained by filtering in various aspects is subsequently employed for Moho depth determination.

For numerical analysis, different test areas are employed based on terrain conditions and data availability. The comparison and validation of the computed geoids in the Canadian and Sri Lankan regions are carried out using the available geoid and GPS-levelling data. The results suggest that the computed geoid models in both regions are able to be used to support GPS-levelling in the third order height networks. The results of Moho depth

computation in the test area of USA are in a good agreement with seismically determined Moho depths than those obtained by global Moho models.

Keywords: Earth structure; EGM2008; Geoid; GPS-levelling; Gravity anomalies; Moho discontinuity; RTM.