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An analysis of geoid determination based on terrestrial observations of the radial gravity potential derivatives

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In this contribution we analyze geoid determination assuming terrestrial data in the form of the first-, second- and third-order radial gravity potential derivatives are available. First-order radial gravity potential derivatives are now routinely observed by gravimeters, while new-generation sensors for observing the higher-order gravity potential derivatives are under development and may be exploited for gravity field mapping campaigns in the future. From the mathematical point of view we exploit integral transformations of the three observables onto geoid undulation in spherical approximation.

Firstly, we formulate practical geoid estimators for each of the three gravity field observables. The estimators are composed of two terms, i.e. the truncated integration of the terrestrial data and the effect of the distant zones. Secondly, the global root mean square errors of the estimators are derived. The global root mean square errors are influenced by the accuracy of the terrestrial data, performance of the spherical harmonic coefficients exploited for evaluation of the distant zones and the omission error. Thirdly, the three error sources are analyzed and compared between the three gravity field observables. Also possibilities and requirements to determine geoid with an accuracy of 1 cm are discussed.