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An Experimental Accuracy Assessment of the Disturbing Gravity Potential and its First and Higher order Derivatives

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The disturbing gravity potential and its derivatives play an important role in geodesy as characteristics of the Earth′s gravity field but they can also significantly contribute to structural interpretations of geodynamic phenomena. Nowadays, the determination of the disturbing gravity potential benefits from high degree/order harmonic expansions of Earth gravitational models (EGMs)as well as from combination of GNSS and spirit levelling measurements while its derivatives can be determined either from EGMs or from precise terrestrial gravity or astronomical measurements. For many subsequent interpretations their accuracy is the crucial issue. Contrary to GNSS, levelling and, in spite of certain technological advances, astronomical observations are still somewhat awkward and time-consuming observation techniques. Therefore, a question arises about an optimal combination of different observables to get a sufficient number and satisfactory quality of required characteristics. Using an extremely detailed anomalous gravity field description for a small „laboratory“ test area, the Earth Gravitational Model 2008 (EGM08) complete up to the degree/order 2160/2160 (selected degrees up to 2190) and taking a large number of directly observed pairs of natural (astronomical) coordinates along with GNSS/levelling height anomalies as a reference, the accuracy of gravimetric height anomalies and height anomaly differences and of deflections of the vertical is investigated by means of different numerical experiments. Investigations towards near-field and far-field contributions of the terrestrial gravity data are concluded by reflections on optimal spatial distribution of observed deflections of the vertical.