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The Geoid as a Transformation Surface

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Nowadays the amount and accuracy of the available gravity field information (gravity anomalies, deflections of the vertical, etc.) are fairly good. Extended data bases for local (e.g., Austria) and regional (e.g., Europe) applications exist. In combination with the newly available high resolution global spherical harmonic models (e.g., GRACE), precise geoid models can be computed. This opens new possibilities for the use of the geoid. In practical applications the geoid is used to transform the coordinates from national datums to the global datum defined by GPS. In most cases the geoid is tied to few benchmarks (GPS/levelling points) to define the general transformation used for later interpolation. As thereby the geoid surface is distorted, we better call this surface now more generally "transformation surface". But by this approach some legitimate questions arise: Which values to trust more; the GPS/levelling derived geoid heights or the physically derived geoid heights (e.g., by a gravimetric geoid computation)? How to detect outliers in the GPS/levelling data sets? How to discover weak areas in the geoid determination, e.g., by a gravimetric geoid determination? How to optimally combine GPS/levelling and classical geoid determination?

The paper tries to give answers to these questions on the basis of the Austrian geoid computations done by the authors during the last decades. Thereby different methods (window technique, classical remove-restore techniques, etc.), which have been used in several computations, are evaluated. Finally it is tried to give general recommendation on the combination of gravimetrically determined geoid heights and GPS/levelling benchmarks.