The 1 cm geoid experiment with Least Squares Collocation

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The establishment of the International Height Reference System (IHRS) as part of a Global Geodetic Reference System (GGRS) is currently one of the main GGOS activities, as the physical height is proposed to be an Essential Geodetic Variable. Since 2017 the two IAG/GGOS joint working groups (JWG) 0.1.2 "Strategy for the Realization of the IHRS" and JWG 2.2.2 "The 1 cm geoid experiment" work close together to investigate open issues regarding its practical realization. The contribution of JWG 2.2.2 is the comparison of different methodologies for potential value calculation with identical input data (terrestrial and airborne gravity observations in Colorado, United States). Then, differences in the results, which indicate disparities in the computation methodologies, may be analyzed and preferably reduced by specifying a set of minimum calculation guidelines. These guidelines should then be used for the definition of the IHRS, which is composed of gravity potential values at selected reference stations.

This contribution highlights the TUM solution, which was submitted in the frame of "the 1 cm geoid experiment" and explains exemplarily at the scenario of Colorado the difficulties of defining a 1 cm geoid, which is defined as the minimum requirement of the IHRS. Thereby, we give special emphasis to the occurring differences between terrestrial, airborne and satellite gravity observations as we regard their combination method as one of the main drivers of the final performance. This is particularly significant in the context of our test area, which includes highly mountainous as well as very flat regions and the requirements for potential value calculation might differ according to the terrain.

For the calculation we use a joint Least Squares Collocation approach which includes stochastic information in form of variance/covariance information for all components, enabling us to assign realistic uncertainty estimates to our results. This is of great importance for the reference station definition. In the end, we compare and verify our result either in the general context of all participating groups or by highlighting and explaining the differences to one specific solution. From the results and insights of these experiments, we try to derive generalized conclusions on the realization of the IHRS.