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Towards a 1 mm geoid at height reference points of the International Height Reference System (IHRS)

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Regarding the Global Geodetic Observation System (GGOS) we can find the geometric reference frame defined by the International Terrestrial Reference System (ITRS), while a corresponding physical reference frame is still missing. However, this global physical reference frame is essential to understand and model dynamic earth processes even better and is needed to define physical heights accurately and globally consistent. Therefore, currently the establishment of the International Height Reference Frame (IHRF) as an integral part of a Global Geodetic Reference Frame (GGRF) is a main objective of the International Association of Geodesy (IAG). And next to the definition of the standards and selection of IHRF stations around the world, one of the main tasks is the best possible estimation of potential values and their accuracies at the IHRF stations.
In this contribution we investigate, which accuracies can be reached for the absolute potential values of selected IHRF stations, given a high-resolution global gravity model plus a densification with terrestrial gravity observations with certain stations distributions and measuring accuracies. The importance of a high-resolution global model for IHRF definition is displayed and supported by regional refinements in the frame of a Least Squares Collocation (LSC) procedure. We give special emphasis to the consistent error modeling by processing the full covariance matrices in the LSC, so that we include all correlations between the input points to the error propagation. Within a synthetic calculation environment, we furthermore have the possibility to verify our error estimations by comparing them with the deviations from the 'true' simulation world. The South American Andes, we found a meaningful test area for the study for it is one of the most challenging regions worldwide in terms of gravity signal variations, heterogeneous data distribution, accuracies, and topographic effects. Finally, we generalize the results to derive requirements to achieve a 1 mm geoid, corresponding to 0.01 m2/s2 in gravity potential, at selected IHRF reference stations.