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Study of Least Squares Collocation and Multi-Resolution Representation for Regional Gravity Field Modelling

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The analysis of the Earth's gravity field plays an important role in various disciplines of geosciences. While modern satellite gravity missions make it possible to define a globally consistent geoid with centimeter accuracy and a spatial resolution of 80-100km, it stays a major challenge to consistently combine global low-resolution data with regional high-resolution gravity information. Therefore, a variety of different regional gravity field modelling methods have been established during the last decades.
In our analysis, we investigate the spectral combination of heterogeneous gravity data within two different calculation methods: First, the statistical approach of Least Squares Collocation (LSC) which uses the covariance information of input and output data to result in a full variance-covariance matrix. Second, the Multi-Resolution Representation (MRR) based on spherical radial basis functions. The MRR combines a low-pass filtered global geopotential model with satellite gradiometer and/or terrestrial gravity data by means of band-pass filtering. We examine the theoretical concepts and the computational differences and similarities between both approaches. Through fast changing topography, mountains as well as oceanic regions, our study area in the South American Andes is challenging and perfectly suitable for this examination. The use of synthetic data in closed-loop tests enables us to a very detailed investigation of predicted and actual accuracies of geoid determination. Furthermore, we point out respective advantages and disadvantages and link them to the calculation concepts of the two methods. The results contribute to the project "Optimally combined regional geoid models for the realization of height systems in developing countries (ORG4heights)" and, thus, aim to finally integrate the regional solutions into a global vertical reference frame.