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The impact on a combined global gravity field model using simulated GOCE data

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The overall objective is the generation of a high-resolution global gravity field model by combining data from the satellite gravity missions GOCE, GRACE and CHAMP with complementary gravity field information like surface gravity anomalies. Benefit can be taken from their individual strengths and favourable features, and in parallel specific deficiencies can be reduced, leading to an Earth's gravity field model with high spatial resolution and accuracy.
One key issue is the methodology on data combination in terms of optimum weighting of each observation component. The combination strategy is based on the superposition of normal equation matrices, which are obtained by observation equations of spherical harmonic coefficients. The optimum weights for each data set are computed by comparison of their parameters and error estimates with the combined solution in an iterative process. The output are different gravity field models like a satellite-only model and a combined model including also complementary surface data, as well as the associated variance-covariance information. Another issue is to deal with very large matrices which are combined and subsequently solved by Cholesky decomposition. Due to the performance limitation of a single computer parallel processing strategies on a cluster system are implemented. The very high degrees of the spherical harmonics are mainly determined by terrestrial measurements. Considering certain conditions, this type of measurement leads to a block diagonal structure of the normal equation matrix which significantly reduces the time needed for computing the inverse of the matrix because only relatively small subset matrices have to be solved. Therefore, in addition a test environment is created to study the influence of such sparse systems.
First test runs show that especially the medium degrees of the spherical harmonic coefficients of the final geopotential model can be improved by using simulated GOCE data, whereas the higher degrees are dominated by the quality of the surface data.