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The use of Least-Squares Collocation for the processing of GOCE data

Abstract

The method of least-squares collocation (LSC) is based on ideas developed by H. Moritz for optimal interpolation, prediction, filtering and parameter estimation. The method was further developed by T.Krarup, for the use of solving partial differential equation like the Laplace equation using heterogeneous data both at the boundary and in space.

The method is therefore well suited to handle data to be measured by ESA‘s Gravity and Ocean Circulation Explorer mission. Orbit data observed by GPS may be used to determine the long-wavelength part of the gravity field while the band-limited gradiometer data may be used to determine shorter wavelengths down to 100 km.

The satellite is expected to collect millions of data, and this makes it impossible to use LSC which requires as many equations to be solved as the number of observations. However, LSC may be used to grid the data by prediction, and the gridded data results in systems of equations which can be solved by fast methods. Unfortunately the gridded data has to be considered as having uncorrelated errors. For small grids with 20000 observations numerical simulations have shown that error-correlations of computed spherical harmonic coefficients may be up to 40 % too small.

Other applications of LSC are in the use for GOCE calibration, where high quality ground data are used to predict GOCE measurements at satellite altitude.