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# Use of massive parallel computing libraries in the context of global gravity field determination

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The estimation of the global Earth's gravity field parametrized as a finite spherical harmonic series from different types of observations is computationally demanding. The computational effort depends on the maximal resolution of the spherical harmonic expansion (i.e. the number of parameters to be estimated) and in addition on the number of observations (which are several millions for e.g. observations from the GOCE satellite missions). To circumvent these restrictions, a massive parallel software based on high-performance computing (HPC) libraries as SCALAPACK, PBLAS and BLACS was designed in the context of GOCE-HPF WP6000 and the GOCO consortium. A prerequisite for the use of these libraries is that all matrices are block-cyclic distributed on a processor grid comprised by a large number of (distributed memory) computers.

Within this contribution we recall the concept of block-cyclic matrix distributions and show how the satellite only-normal equations are distributed, assembled and handled to compute combined gravity field models of different resolutions. Using this set of standard HPC libraries has the benefit that once the matrices are distributed across the computer cluster, a huge set of efficient and highly scalable linear algebra operations can be used. As an application, we make use of this software to compare the spectral properties of normal equations of the GOCE time-wise method, the ITG-Grace2010s model and of the combined version GOCO01S. We demonstrate the effect of the combination of both satellite only models and the used regularization principle (KAULA stabilization) by analyzing the eigenvalues and their corresponding eigenvectors.