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Meshless boundary collocation techniques for processing the GOCE gravity gradients in spatial domain

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Meshless boundary collocation techniques like the method of fundamental solutions (MFS) or singular boundary method (SBM) can be efficiently used to model the static gravity field purely from the GOCE gravity gradients. These numerical methods use the fundamental solution of the Laplace equation or its derivatives as basis functions. A numerical solution by MFS or SBM is given as a linear combination of such basis functions and allows solving the problem in spatial domain. In case of processing the GOCE gravity gradients, the system matrix is created by the corresponding second derivatives of the fundamental solution. Hence, the matrix components depend solely on geometrical parameters, i.e. on 3D positions and direct distances between the GOCE observations and source points located on the Earth's surface. Such a configuration is free of singularities and MFS can be applied to derive unknown coefficients at the source points. To obtain precise numerical solutions, such an approach requires very refined level of the resolution. This leads to enormous memory requirements that need to be reduced. An implementation of the Hierarchical Matrices (H-matrices), namely the Adaptive Cross Approximation (ACA) algorithm, can significantly reduce a numerical complexity of this approach and thus improve its efficiency.