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On the construction of Green's function when combining terrestrial data and global models for Earth's gravity field recovery

Petr Holota (1) and Otakar Nesvadba (2)

(1) Research Institute of Geodesy, Topography and Cartography, 250 66 Zdiby 98, Prague-East, Czech Republic (e-mail: petr.holota@pecny.cz), (2) Land Survey Office, Pod Sídlištěm 9, 182 11 Prague 8, Czech Republic (e-mail: nesvadba@sky.cz)

The combination of terrestrial and satellite data is one of the challenges in gravity field modelling today. Satellite and terrestrial data complement each other. Here we confine ourselves to the combination of terrestrial gravity measurements and Earth's gravity field models. Potential theory and optimization concepts have an important position in solving this problem. In this contribution we focus on a boundary value problem which is formulated for a solution domain represented by a spherical layer bounded by two concentric spheres. In particular we follow the classical solution concept and construct the respective Green's function that enables to exploit available terrestrial gravity data and data deduced from Earth's gravity field models. The transition to the real boundary is then iterative by nature. The starting point is a transformation of spatial coordinates. It offers a possibility for an alternative between the boundary complexity and the complexity of the coefficients of Laplace's partial differential equation governing the solution. A system of general curvilinear coordinates, such that the surface of the Earth is imbedded in the family of coordinate surfaces is applied. The constructed Green's function in combination with successive approximations enables to approach the solution of Laplace's partial differential equation expressed in the system of new coordinates. Finally, also the analytical continuation of the solution is discussed with a particular view to its harmonic branch and regularity at infinity. The reasoning leads to optimization concepts considered in the paper.