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Transformation of topography into the structure of Laplace's operator and an iteration solution of the linear gravimetric boundary value problem

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The discussion starts with the relation between the geometry of the solution domain and the structure of Laplace's operator. A transformation of coordinates is used that offers a possibility for an alternative between the boundary complexity and the complexity of the coefficients of the partial differential equation governing the solution. The structure of the Laplace operator is relatively simple in terms of ellipsoidal coordinates which are frequently used in geodesy. However, the physical surface of the Earth substantially differs from an oblate ellipsoid of revolution, even if optimally fitted. Therefore, a system of general curvilinear coordinates such that the physical surface of the Earth is imbedded in the family of coordinate surfaces is used. Clearly, the structure of Laplace's operator is more complex after the transformation. It was deduced by means of tensor calculus and in a sense it reflects the topography of the physical surface of the Earth. Nevertheless, the construction of the respective Green's function is simpler for the solution domain transformed. This enables the use of the classical Green's function method together with successive approximations for the solution of the linear gravimetric boundary value problem expressed in terms of new coordinates. The structure of the iteration steps is analyzed and where suitable and possible modified by means of the integration by parts. Stability and comparison with other methods are discussed.