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Direct methods and an iteration approach in solving the gravimetric boundary value problem

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In this paper the gravimetric boundary value problem is discussed in terms of the so-called weak solution. The approach follows principles of variational methods and leads to Galerkin's approximations. They have a natural tie to a numerical interpretation of the solution. However, an oblique derivative in the boundary condition and the need for a numerical integration over the whole and complicated surface of the Earth in computing elements of Galerkin's matrix make the numerical interpretation of the solution extremely demanding, even for high performance computation facilities. An alternative is considered in the paper. It reduces the demands mentioned above by means of successive approximations of the solution. Step by step they make it possible to account for corrections representing effects caused by the obliqueness of the derivative in the boundary condition and by the departure of the boundary from a more regular surface, a sphere in particular. In consequence an approximation to Galerkin's matrix can be used within this approach, which obviously is an advantage. The convergence of the process is investigated and also examined numerically. In principle the treatment shows that the gravimetric boundary value problem may be solved numerically with an accuracy limited just by computer hardware available. The discussion is added extensive numerical simulations using gravity data derived from the EGM96. The computed solutions are compared with the EGM96 in terms of potential values and gravity disturbances at points on the boundary of the solution domain.