Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02258, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02258
EGU General Assembly 2008


# Direct BEM formulation for the global gravity field modelling

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A direct formulation of the boundary element method (BEM) for the Laplace equation can be derived through the application of Green's third identity or through the method of weighted residuals. Both methods lead to the same integral relationship that represents a superposition of the single-layer and double-layer potential. Such boundary integral equation can be applied to the geodetic boundary value problems (BVPs). In our approach we use the collocation technique with linear basis functions. An elimination of the far zones' interactions and high-performance computations allow a refined integration over the all Earth's surface. This has an evident advantage for the global gravity field modelling of high resolution.

The presentation discusses the direct BEM formulation applied to the fixed gravimetric BVP. Surface gravity disturbances as the oblique derivative boundary conditions (BC) are "projected" to the Neumann BC. They are given or simulated at collocation points on the real Earth's surface, which is considered as a fixed boundary. Its 3D position is given (i) by mean sea surface KMS04 at oceans/seas and (ii) by the SRTM30 global topography model and the EGM96 geopotential model on lands. At first numerical experiment we present an experimental test of convergence of the method for a homogenous sphere. In case of the real Earth we use two types of datasets (1) surface gravity disturbances simulated from EIGEN-GL04C, and (2) original surface gravity disturbances derived from satellite altimetry at oceans/seas or given by terrestrial gravimetric measurements on lands (if available, e.g. North America, Australia). In both numerical experiments we compare obtained numerical solutions with EIGEN-GL04C.

The presentation also deals with some computational aspects of the method, e.g. numerical complexity of BEM, conditioning of the stiffness matrix or efficiency of parallel computing. We discuss advantages of the proposed approach in comparison with spherical harmonics and we outline its importance for geodesy, especially for the vertical datum problem.