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Determination of gravity potential at oceans using efficient numerical methods

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The presentation discusses the boundary element method (BEM), the finite element method (FEM) and the finite volume method (FVM) applied to the marine gravity field modelling. These numerical methods together with high-performance computing are efficient for precise solutions of geodetic boundary-value problems (BVPs). At oceans/seas, satellite altimetry provides two types of necessary input data (i) mean sea surface (MSS) models that define 3D position of the Earth's surface as a fixed boundary, (ii) derived gravity data that in case of surface gravity disturbances represents the oblique derivative boundary conditions. Here we present three numerical experiments: (1) the direct BEM formulation applied to the fixed gravimetric BVP using the collocation with linear basis functions, where only the Earth's surface is discretized (2) FEM experiment provided by the software ANSYS where the space above the Earth, bounded by the Earth's surface and an artificial boundary away from the Earth, is meshed by series of linear 3D elements (3) FVM based on the balance of fluxes is applied in the same computational domain as in (2). All these experiments result in a determination of the gravity potential on MSS. Finally, the obtained numerical results are compared with gravity potential evaluated from conventional geopotential models based on spherical harmonics, e.g. EGM-96, EIGEN-CG03C or EIGEN-GL04C.