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Global modelling of the dynamic geoid: an integrative approach

M.K. Kaban, I. Rogozhina
GeoForschungsZentrum, Telegrafenberg, Potsdam 14473, Germany (kaban@gfz-potsdam.de)

Joint inversion of the observed geoid with other geophysical data (primarily seismic tomography and surface plate velocities) is a powerful tool to determine structure and properties of the mantle. However, despite of the massive efforts, the obtained results are remarkably various and the generalized dynamic model of the Earth does not exist at the moment. We investigate several factors, which might explain such an indefinite situation. (1) The tomography models used in the previous works are obtained without considering the transition zone. This can lead to false conclusions on the density structure of the mantle. We use the tomography model of Gu et al. (2003), in which mantle velocities have been estimated in a joint inversion with the transition zone discontinuities. The velocity-to-density scaling factor and density jumps at the discontinuities are determined independently to fit the observed geoid and surface plate velocities. (2) Origin of the terms C20 and C40 in the observed geoid relative to a hydrostatic spheroid is not completely comprehended yet. Different authors use the geoid with or without these terms. We demonstrate that the inversion gives essentially different results depending on presence of the C20 and C40 terms. (3) We add lateral viscosity variations and consider full 3D viscosity model of the mantle, which is consistent with the tomography model. Considering all these factors we are able to better explain the observed geoid, especially the mid-scale features, and to construct a consistent model of the Earth mantle.