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Problem of variational data assimilation for the study of the adequacy of a tidal dynamics model

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The study of the adequacy of difficult mathematical models of geophysical hydrodynamics is very important today. For investigation and the numerical solution one can involve methods of the inverse problems theory [1], approaches of the optimal control theory and the adjoint equations [2], modern methods of numerical mathematics. We consider one of such problems – a problem on the adequacy of a model of tidal dynamics in the World Ocean.

In the considered mathematical model, as one of "additional sources" we use a vector function F. As the criterion that the model correctly reproduces really modelled physical processes we choose the requirement that sea level function (a deviation from the ocean equilibrium level) coincided with the satellite observation data of sea surface height. This criterion can lead to a problem of minimization of a quadratic ("cost") functional for the purpose of variational assimilation of satellite data and calculation of F. After the solution of this problem we estimate the norm of F which is taken as a measure of the adequacy of the considered mathematical model. We prove the uniqueness and dense solvability of the minimization problem. We prove that the minimum of the "cost" functional is zero (therefore, the norm of F really reflects the degree of the adequacy of the model). Also we present special algorithms of approximation of the tidal dynamics model and the adjoint problem [3], results of numerical experiments and its analysis.

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