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On the modeling of thermohydrodynamic and biogeochemical processes in the inland water objects

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Currently, one-dimensional and three-dimensional models are widely used to model thermohydrodynamic and biochemical processes in lakes and water rereservoirs. One-dimensional models are highly computationally efficient and are used to parameterize land water bodies in climate models, however, when calculating large lakes and reservoirs with complex geometry, such models may incorrectly reproduce processes associated with horizontal heterogeneity. This becomes especially important for the prediction of water quality and euthrophication.

A three-dimensional model of thermohydrodynamics and biochemistry of an inland water obect is presented, which is based on the hydrostatic RANS model [1-3], and the parameterization of biochemical processes is implemented by analogy with the scheme for calculating biochemistry in the one-dimensional LAKE model [4]. Thus, the three-dimensional model is supplemented by a description of the transport of substances such as oxygen (O_2), carbon dioxide (CO_2), methane (CH_4), as well as phyto- and zooplankton. The effect of turbulent diffusion and large-scale water movements on the distribution of a methane concentration field is studied.

To verify the calculation results, idealized numerical experiments and comparison with the measurement data on Lake Kuivajärvi (Finland) were used.

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