Geophysical Research Abstracts
Vol. 21, EGU2019-7592-1, 2019
EGU General Assembly 2019

On the controls of mixed layer depth in the inland water objects

Daria Gladskikh (1,2), Victor Stepanenko (3,4), Evgeny Mortikov (3), Georgiy Baydakov (1), and Daniil Sergeev (1)

(1) Institute of Applied Physics of the Russian Academy of Sciences, Nonlinear geophysical processes department, Nizhny Novgorod, Russian Federation (daria.gladskikh@gmail.com), (2) Nizhny Novgorod State Technical University n.a. R.E. Alekseev, Russian Federation, (3) Lomonosov Moscow State University, Research Computing Center, Russian Federation, (4) Lomonosov Moscow State University, Faculty of Geography, Russian Federation

The problem of numerical simulation of thermal regime of inland water objects and, in particular, of turbulent mixing in lakes and water reservoirs is considered. For many objectives of limnology and climatology, it is important to correctly reproduce the vertical distributions of thermodynamic and biogeochemical variables, which are largely determined by turbulent mixing, especially during open water.
In this work, the one-dimensional LAKE model [1] with parameterization of the horizontal pressure gradient in the horizontally averaged thermohydrodynamic equations is used as the main tool for studying the dynamics of the upper mixed layer of the reservoir. The proposed parameterization allows taking into account first horizontal mode of seiches. It was demonstrated [2] that one-dimensional models lacking seiche parameterization overestimate the thickness of the mixed layer during the summer stratification period for lakes and water reservoirs with horizontal size much less than internal Rossby radius. Accordingly, we test the hypothesis that the horizontal size of the water object and the thickness of the upper mixed layer are linked. Specifically, it is assumed that for large reservoirs, with horizontal dimensions exceeding the Rossby deformation radius, gravitational oscillations play insignificant role compared to the rotation (Coriolis force) in the dynamics of the mixed layer.
The hypothesis is verified in the research by the results of numerical simulation, carried out using the one-dimensional LAKE model with parameterization of a pressure gradient. The parameterization, in turn, is verified by comparing the results of 1D model with calculations using a 3D hydrodynamic model, based on solver developed in [3-4], as well as with field measurements data on the evolution of a thermocline in the lake part of the Gorky reservoir.

Acknowledgements
The work was partly supported by RFBR projects 16-05-01094, 17-05-41117, 18-05-00292, 18-35-00602. Simulations with 2D thermohydrodynamic model were supported by Russian Science Foundation, project 17-17-01210.

References
[1] Victor Stepanenko, Ivan Mammarella, Anne Ojala, Heli Miettinen, Vasily Lykosov, and Vesala Timo. LAKE 2.0: a model for temperature, methane, carbon dioxide and oxygen dynamics in lakes. Geoscientific Model Development, 9(5): 1977–2006, 2016.
[2] Stepanenko, V. M.: Seiche parameterization for a one-dimensional lake model (In Russian). Trudy MIPT, vol. 10, N 1, pp. 97-111 (2018).
[3] Mortikov E.V. Numerical simulation of the motion of an ice keel in stratified flow // Izv. Atmos. Ocean. Phys. 2016. 52. P. 108-115.
[4] Mortikov E.V., Glazunov A.V., Lykosov V.N. Numerical study of plane Couette flow: turbulence statistics and the structure of pressure-strain correlations // Russian Journal of Numerical Analysis and Mathematical Modelling. 2019. V. 34, N 2. (in press).