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On the simulation of inland waters in large-scale models: parameterization of mixing processes

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The work is devoted to the study of thermohydrodynamic characteristics of inland waters associated with turbulent mixing and relevant to the problems of meteorology, climatology and hydrology. To describe such characteristics, numerical models of different detailization are used, having their own features and advantages. We consider the one-dimensional LAKE model [1-2] with parameterization of the horizontal pressure gradient well-suited for implementation in large-scale models and climate models. We additionally use the three-dimensional hydrostatic model [3-4] for verification of 1D model ability to correctly reproduce mixing processes by simulating turbulence in inland waters of various horizontal sizes, under different initial conditions and atmosphere forcing. The effects of Coriolis force and internal wave oscillations on the mixing dynamics are analyzed.
In addition, the authors implemented the parameterization of the turbulent Prandtl number into the 3D model. The influence of different parameterizations of turbulent Prandtl number on the mixing processes is studied. Parameterization represents a dependence on the gradient Richardson number and is derived from the geophysical turbulence models [5-6] that take into account the two-sided transformation of the kinetic and potential energies of turbulent pulsations. Implementation of this parameterization is of interest to account for stratification in simulations of thermohydrodynamic regimes and, in particular, its effects on the processes of turbulent mixing and thermocline dynamics. The influence of turbulent Prandtl number parameterization on the results of numerical simulation is demonstrated.

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