Modification of the k-epsilon scheme and its application for describing turbulence in inland water bodies

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A parameterization of the Prandtl number as a function of the gradient Richardson number is proposed in order to correctly take into account stratification when calculating the thermohydrodynamic regime of inland water bodies. This parameterization allows the existence of turbulence at any values of the Richardson number.

The proposed function is used to calculate the turbulent thermal conductivity coefficient in a k-epsilon mixing scheme. Modification is implemented in the three-dimensional hydrostatic model developed at the Research Computing Center of Moscow State University.

It is demonstrated that the proposed modification (in contrast to the standard scheme with a constant Prandtl number) leads to smoothing all sharp changes in vertical distributions of turbulent mixing parameters (turbulent kinetic energy, temperature and thickness of the shock layer) and imposes a Richardson number-dependent relation on the empirical constants of k-epsilon turbulent mixing scheme.

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