



Analytical solution technique in k - ω and k - ϵ turbulence parameterizations and their implementation in the OGCM

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The main purpose of the work is to improve the ocean general circulation model (OGCM) by including new parameterizations of heat, salt and momentum vertical turbulent exchange, which significantly affects quality of reproducing the ocean circulation and thermohaline structure using the OGCMs based on the primitive equation system. The main instrument of the research is the σ -model of the oceanic and marine circulation INMOM (Institute of Numerical Mathematics Ocean Model) developed at the Marchuk Institute of Numerical Mathematics of RAS. The basic equation set in the incompressibility, hydrostatics and Boussinesq approximations is supplemented with the equations for the k - ω and k - ϵ vertical turbulent exchange parameterizations, which are solved using the splitting with respect to the physical processes. The total equations are split into the stages describing transport-diffusion of the turbulent characteristics and their generation-dissipation. At the generation-dissipation stage, the equations for turbulent characteristics can be solved analytically. This approach allows one to solve the turbulence equations with the time step used in the OGCM. To estimate quality of these two vertical turbulent exchange parameterizations, the joint circulation of the North Atlantic and Arctic Ocean is numerically simulated and the upper ocean layer characteristics are studied. It is shown that the structure of large-scale fields in the North Atlantic and Arctic Ocean is sensitive to the choice between these two vertical turbulence models. In particular, application of the k - ϵ parameterization is accompanied by a noticeably higher rate of water involvement within the seasonal pycnocline in the developed turbulence zone than that resulting from application of the k - ω model.

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References

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