Geophysical Research Abstracts
Vol. 16, EGU2014-191, 2014
EGU General Assembly 2014

Numerical simulation of turbulence in ocean circulation problems

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The physical formulation, mathematical model and numerical algorithm are given for the turbulence model (TM) presented as a component of the ocean circulation model (OCM) designed for decadal simulations. The turbulence model is based on evolutional equations for turbulence kinetic energy (TKE) and turbulence dissipation frequency (TDF). The numerical solution algorithm for both OCM and TM is based on implicit schemes using splitting upon physical processes and spatial coordinates. It allowed us to obtain analytical solutions for the TM during the TKE generation-dissipation phase of splitting. The numerical simulations were performed for reproducing seasonal cycle and synoptic variability of ocean characteristics. The presented OCM with TM is the INM RAS model of North Atlantic, Arctic Ocean and Bering Sea joint circulation, it has spatial resolution 0.25° and 40 s-levels on depth with refinement near surface for better reproducing turbulent processes. The simulation results of OCM with TM are compared with observational data and other simulations performed with using "traditional" parameterizations of ocean upper layer mixing. It is shown that the OCM with TM adequately reproduces ocean characteristics with insignificant increasing of computational time comparatively to OCM with simple parameterizations. The analysis is given for spatial and temporal distribution of turbulence characteristics.