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Investigations of the Barents Sea circulation using three-dimensional mathematical shelf model

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On a basis of developed three-dimensional non-stationary mathematical model the current patterns of the Barents Sea at various hydrological conditions have been investigated. The model includes the equations of movement in a hydrostatic approach with square-law parameterization of nearbed stress, equation of continuity, equation of state, non-stationary equations for temperature and salinity evolution. The vertically integrated equation of continuity with free kinematics condition on a top border is used to determine free surface elevation. The non-stationary equations of turbulent energy generation and its viscous dissipation are used for Reynolds stress closure. To determine the vertical coefficients of heat and salt diffusion the modified Munk-Anderson relation between the Prandtl (Pr) and Richardson (Ri) numbers is used. A two-dimensional numerical filter and improved numerical scheme are used to reduce an effect of numerical instability caused by inconsistent temperature, salinity and level fields. The results of numerical experiments show that the model adequately describes the main circulation features used PHC 2.0 climatology, NCEP/NCAR and ERA40 forcing. The series of numerical experiments with model were carried out on the basis of summer (August - September) temperature and salinity surveys included into new version of oceanographic database for the Nordic Seas developed under INTAS-4620. The significant role of the external forcing (the Atlantic waters inflow through open border) on the circulation regime of the Barents Sea was confirmed. It was shown also that the monthly mean circulation for specific year may differ significant from classical climatologically circulation. Within a framework of hydrostatic approach a number of numerical experiments were carried out for determination of vertical velocity component caused by vertical gradient of density as important parameter of free convection and slope dynamics. This work was supported by INTAS-4620 project “The Nordic Seas in the Global Climate System”.