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Climatic variability of the thermohaline structure of the Arctic Ocean surface layer and its conditioning factors

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Thermohaline characteristics of the layer from the ocean's surface down to the horizon of maximum density gradient were investigated. Time series of mean temperature and salinity for the surface layer, the mixed layer thickness and the Brunt-Väisälä frequency at the depth of maximum density gradient for the winter period 1950-1993 and 2007-2009 were obtained. Trends and variances were identified separately for the Canadian and Eurasian basins.

Given the Arctic Ocean water density depends more on water salinity than on water temperature and the thermohaline circulation is mainly determined by salinity distribution, interannual variability of the Arctic Ocean surface layer was analyzed using the method of mean salinity field decomposition on Empirical Orthogonal Functions (EOF). The decomposition was carried out for mean salinity in the to 50 m of the surface layer for the winter season. For further analysis the three initial EOF modes were used since they yield the largest contribution of the total dispersion of the original data (60%).By phase portrait construction the periods when the spatial distribution of the surface layer salinity in winter period remained similar from year to year and the periods when there were significant changes in the configuration of surface layer salinity field were identified. Significant differences in the surface layer salinity structure were found between the winter periods of 2007-2009 and 1950-1993.

The following factors were investigated in order to assess their impact on the surface layer state in winter: river runoff, ice cover of the Arctic seas, the water exchange through the Bering Strait and the Fram Strait, the atmospheric circulation indices for the northern hemisphere (Arctic Oscillation (AO), North-Atlantic Oscillation (NAO), North-Pacific Oscillation (NPO), and the Arctic Dipole Anomaly (DA)). The correlation coefficients between the Arctic Ocean surface layer thermohaline characteristics and the conditioning factors listed above are currently being calculated. At the moment the highest correlation coefficient was obtained for the mean salinity in the to 50 m of the surface layer and mean DA indices in October-April (-0.587). High correlations can be traced even with the shifts of 1-2 years, i.e. the structure of the surface layer salinity reflects the influence not only the atmospheric processes in the previous few months, but also the atmospheric processes that took place 1-2 years ago.

The main factors responsible for variability of the Arctic Ocean surface layer thermohaline structure in winter period will be revealed based on the results of correlation analysis and a statistical model of the surface layer interannual variability will be developed.