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Coupled North Atlantic and Arctic Oceans modeling

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A coupled North Atlantic and Arctic Ocean circulation model is presented. It is based on the algorithms of the sigma-model of ocean general circulation developed at the INM RAS. The model is supplied with a block for calculating sea ice thermodynamics. In order to eliminate the sources of instability and noise generation related to the converging meridians at the North Pole, rotation of the spherical coordinate system is performed, so that the poles of the new system appeared at the geographical equator beyond the integration domain. This allowed us to adequately reproduce the fields of the ocean characteristics without critical reduction of the model time steps.

The resolution of the grid is 1/3 degrees. The integration domain includes Atlantic Ocean from 20 S, Arctic Ocean and Bering Sea. The spatial dimension of area is 468x333x27. Time step for integration is 1 hour.

The results of the modeling are compared with the observations. An analysis of climatic seasonal evolution of the circulation, thermohaline fields, and ice characteristics in the Atlantic and Arctic regions is given, as well as the results of the modeling in the transition area between them located in the Norwegian and Greenland seas. It is shown that the model adequately reproduces the main Arctic and Atlantic currents, they are Gulf Stream, Labrador Current, Transpolar Drift and others. The particularities of the dynamical and thermohaline fields of the ocean, the winter intensification of the Gulf Stream, the vertical velocity inversion in its core, the highly saline tongue of the Mediterranean waters in the intermediate layers of the Atlantic, the particularities of the circulation in the surface fresh water mass of the Arctic Ocean, the basic characteristics of the warm and saline Atlantic waters penetrating into the Arctic Ocean, the basic features of the exchange between the Atlantic and Arctic oceans, and other known features of the oceanic fields and their seasonal evolution are reproduced. The

model show how the set of exchanges between the Atlantic and Arctic oceans influences the modes of spatiotemporal variability of the North Atlantic dynamical and hydrological fields on scales from years to decades. The Arctic circulation is proved to be very important to formation of Labrador Current and consequently allows to describe Gulf Stream structure more adequatly.