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Numerical simulation of the ocean general circulation and its climatic variability for the 1948-2007 using the INMOM

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The experiments with the INMOM (Institute of Numerical Mathematics Ocean Model) for simulating Global Ocean circulation for the period 1948-2007 were performed. The model is constructed in the curvilinear orthogonal coordinate system obtained with from the standard geographical grid using a conformal complex transformation (Moebius). It allowed us to place grid singular points (poles) beyond the computation area, so that the first pole is situated on Taimyr Peninsula, and the second one is on Antarctica symmetrically with respect to Equator. Consequently, the Equator in the model system coincides with the geographical one for better reproducing equatorial circulation that is very significant for the Global Ocean dynamics. The vertical model coordinate is sigma.

The CORE (Common Ocean-ice Reference Experiments) datasets are used to define atmospheric forcing. The 60yr spin-up was performed to obtain quasi-stationary annual cycle of Global Ocean circulation. The run was started from Levitus climatology (1998) with forcing computed from CORE normal year data. Further, the run for simulating Global Ocean circulation using interannual CORE datasets for the period 1948-2007 was performed.

It is shown that simulated climatic characteristics of ocean circulation and thermohaline fields (3D velocity field, SSH, barotropic streamfunction, equatorial circulation structure, MOC streamfunction, MHT) are in good agreement with both observational data and experimental results of the OGCMs – participants of CORE [Griffies et al., 2009].

The INMOM adequately simulates the Atlantic Multidecadal Oscillation (AMO) temporal evolution for the period 1948-2007 that is provided with realistic atmospheric forcing based on CORE datasets. The reproduced minima and maxima of AMO index corresponding to climate cooling and warming respectively have a good resemblance with observed data.

Temporal evolution of the Atlantic ThermoHaline Circulation (ATHC) index defined as Atlantic MOC streamfunction maximum in 30°N-45°N and connected with it MHT for the period 1948-2007 have well presented decadal variations on the background of 50-60yr oscillation with a minimum at the beginning of 60s and a maximum at the beginning of 90s. The ATHC index temporal evolution makes us conclude that the general tendency of North Atlantic circulation since 1993 leads to MHT reducing that damps last decade climate warming.