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The new version of the Institute of Numerical Mathematics Sigma Ocean Model (INMSOM) for simulation of Global Ocean circulation and its variability

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In this paper, we present the improved version of the ocean general circulation sigma-model developed in the Institute of Numerical Mathematics of the Russian Academy of Sciences (INM RAS).

The previous version referred to as INMOM (Institute of Numerical Mathematics Ocean Model) is used as the oceanic component of the IPCC climate system model INMCM (Institute of Numerical Mathematics Climate Model (Volodin et al 2010,2013). Besides, INMOM as the only sigma-model was used for simulations according to CORE-II scenario (Danabasoglu et al. 2014,2016; Downes et al. 2015; Farneti et al. 2015). In general, INMOM results are comparable to ones of other OGCMs and were used for investigation of climatic variations in the North Atlantic (Gusev and Diansky 2014). However, detailed analysis of some CORE-II INMOM results revealed some disadvantages of the INMOM leading to considerable errors in reproducing some ocean characteristics. So, the mass transport in the Antarctic Circumpolar Current (ACC) was overestimated. As well, there were noticeable errors in reproducing thermohaline structure of the ocean.

After analysing the previous results, the new version of the OGCM was developed. It was decided to entitle is INMSOM (Institute of Numerical Mathematics Sigma Ocean Model). The new title allows one to distingwish the new model, first, from its older version, and second, from another z-model developed in the INM RAS and referred to as INMIO (Institute of Numerical Mathematics and Institute of Oceanology ocean model) (Ushakov et al. 2016). There were numerous modifications in the model, some of them are as follows.

1) Formulation of the ocean circulation problem in terms of full free surface with taking into account water amount variation.

2) Using tensor form of lateral viscosity operator invariant to rotation.

3) Using isopycnal diffusion including Gent-McWilliams mixing.

4) Using atmospheric forcing computation according to NCAR methodology (Large and Yeager 2009).

5) Improvement river runoff algorithm accounting the total amount of discharged water.

6) Using explicit leapfrog time scheme for all lateral operators and implicit Euler scheme for vertical diffusion and viscosity.

The INMSOM is tested by reproducing World Ocean circulation and thermohaline characteristics using the well-proved CORE dataset. The presentation is devoted to the analysis of new INMSOM simulation results, estimation of their quality and comparison to the ones previously obtained with the INMOM. The main aim of the INMSOM development is using it as the oceanic component of the next version of INMCM.

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