

(*EnOI*) method was presented for assimilating observational data in an eddy-resolving model of the World Ocean. The effectiveness of the parallel method developed was studied using temperature and salinity data from *Argo* [2] drifters and *AVISO* satellite altimetry data [3]. These works resulted in the confirmation that the assimilation of data by the forecasted three-dimensional fields of temperature and salinity even in those regions where the data were not available. Consequently, perhaps, from the variety of data on observations of the ocean state, their minimum number can be chosen, so that the forecast accuracy is maximum.

Surprisingly, even an excess amount of data currently exists for the restoration and forecast of mesoscale ocean dynamics. First of all, it concerns satellite data (ocean surface temperature and altimetry). On their basis, methods are developed for measuring salinity and currents of the ocean surface, near-surface wind, etc. The state of the upper two-kilometer ocean layer is monitored by *Argo* buoys. A large amount of information comes from ocean gauges fixed in space. For example, in [4], a methodology for joint processing of small hydrological and satellite altimetry observations is presented. It makes possible to restore the three-dimensional temperature and salinity fields very successfully. All this information is used in systems for the ocean state forecast at different time scales (see the reviews in [5–7]). The work [8] is also worth to be reviewed. There the numerical experiments are carried out based on the joint *ECHAM-HOPE* model and the ensemble assimilation method, and then the results of the perturbations of the model fields and the propagation of these perturbations are analyzed. The study [9] discusses methods for calculating the dynamics of the ocean and the Black Sea using the hydrological observational data assimilation based on the application of the Kalman filter and the principles of adaptation of hydrophysical model fields.

The present papers is aimed to validate a parallel mastering algorithm for the INMIO ocean dynamics model. An attempt to estimate of the sensitivity of the forecast to the initial state and some variations in the assimilated data amount is going to be carried out. Obviously, studies on the dependence of forecast accuracy on the number, type and geographical distribution of ocean data are important for optimizing observational systems. The features of the parallel ensemble optimal interpolation method are also to be denoted.

Ocean Model and Parallel Ensemble Optimal Interpolation Method

To carry out numerical experiments, the INMIO ocean dynamics model will be applied. It was developed to study the circulation of the World Ocean waters and its individual waters in a wide range of spatial and temporal scales. A more detailed description of the model and numerical experiments on its verification with the $0.5^\circ - 0.1^\circ$ resolution is given in [10, 11]. Along with the ocean model, the *CMF3.0* Compact Modeling Framework will be used to solve the problem of joint modeling of the Earth system and its high-resolution components on computers with distributed memory. The *CMF3.0* platform is applied for interprocessor exchanges inside model components, interpolating data between various model grids of components and working with the file system (data input/output) [12].

The ensemble optimal interpolation method *EnOI* is described in detail in [13, 14]. It is currently used for the operational forecast of the ocean state

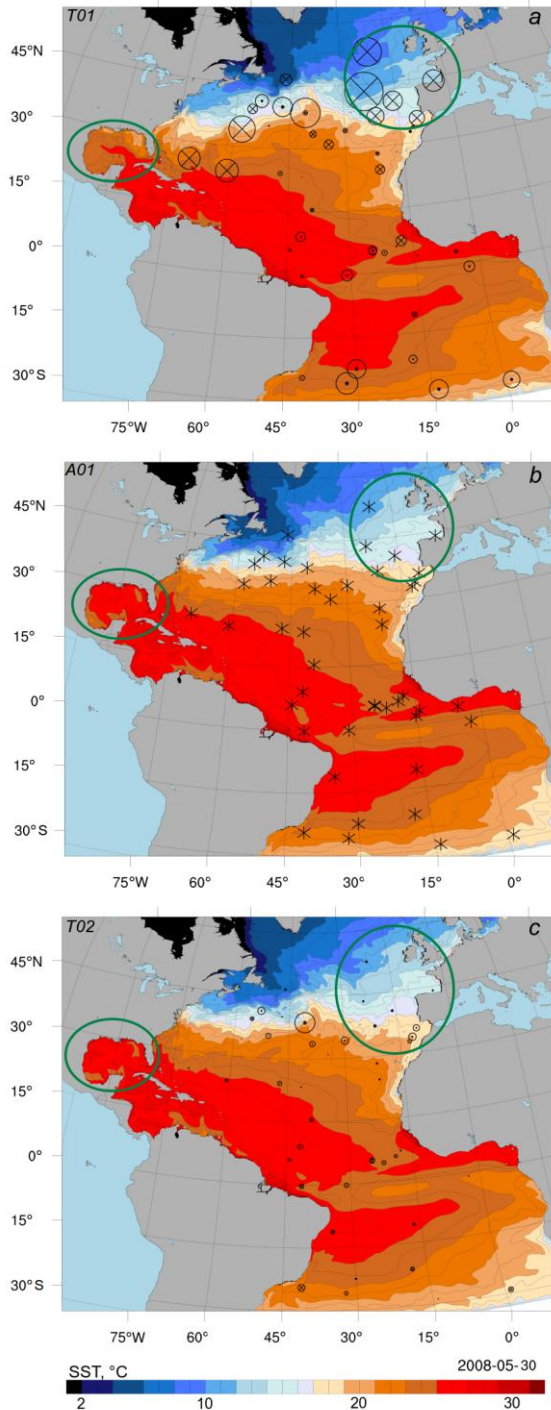


Fig. 1. Sea surface temperature (SST) in the North Atlantic Ocean model on 30.05.2008 in the A01 “true” experiment (b) and also in the T01 (a) and T02 (c) experiments with the perturbed initial condition

Fig. 2 shows the difference between the SST model fields in the T01, T02 experiments and in the A01 “true” experiment for May 30, 2008 (model date). Comparing Fig. 2a and 2b, it is clearly seen how the assimilation corrects the solution in the entire computational domain, and not only at the points where the Y_{SOD} data are located. The effect of data assimilation in the area of the Gulf Stream is especially pronounced.

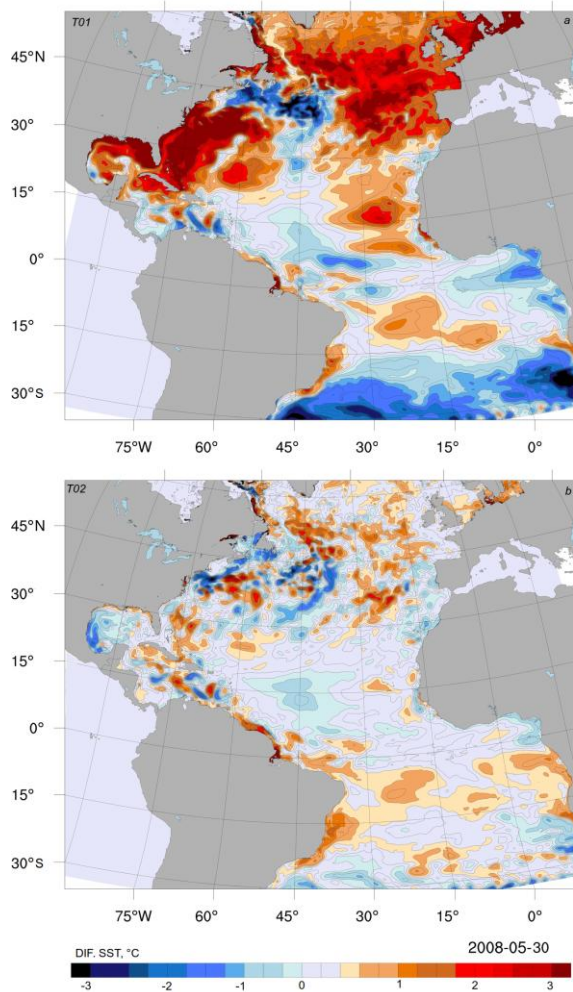


Fig. 2. Difference between the sea surface temperature (SST) model fields on 30.05.2008: $SST_{A01} - SST_{T01}$ (a); $SST_{A01} - SST_{T02}$ (b)

Graphs of the root-mean-square and average errors of SST calculated over all the computational nodes of the model grid are given in Fig. 3. They show that the Y_{SOD} assimilation greatly approximates the SST model field in the T02 experiment to the model field in the A01 experiment over the entire computational domain. This confirms the correct operation of the implemented data assimilation method, the use of which with the application of Y_{SOD} small observational data (located with the same density as the *Argo* data) can bring all the model solution to the “true” ocean state (A01experiment).

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All the authors have read and approved the final manuscript.

The authors declare that they have no conflict of interest.