Special data base of Informational – Computational System “INM RAS – Black Sea” for solving inverse and data assimilation problems

A.V. Gusev[1], N.B. Zakharova[1], N.V. Piskovatsky[2], N.A. Aseev[2]

[1]Institute of Numerical Mathematics RAS. Moscow, Russia. *[2]Moscow Institute of Physics and Technology, Moscow, Russian Federation.*

E-mail: zakharova_nb@inm.ras.ru

Purposes and tasks

Development of Informational-Computational Systems (ICS) for data assimilation procedures is one of multidisciplinary problems. To study and solve these problems one needs to apply modern results from different disciplines and recent developments in: mathematical modeling; theory of adjoint equations and optimal control; inverse problems; numerical methods theory; numerical algebra and scientific computing.

The above problems are studied in the Institute of Numerical Mathematics of the Russian Academy of Sciences (INM RAS) in ICS for personal computers.

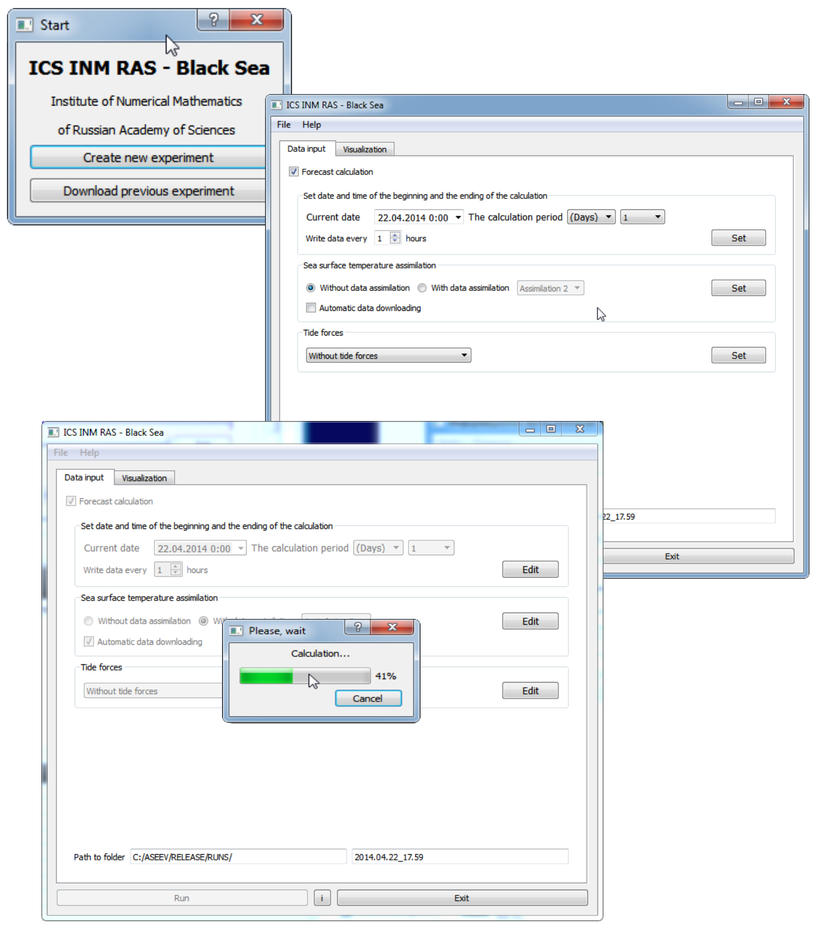
In this work the results on the Special data base development for ICS “INM RAS – Black Sea” are presented.

The variational data assimilation system ICS “Black Sea – INM RAS” will receive and process the following information for the individual areas of the Black Sea and Azov Sea and the Black Sea and Azov Sea as a whole:

- sea currents,
- thermohaline structure and the density of water,
- distribution of basic hydrological and special settings.

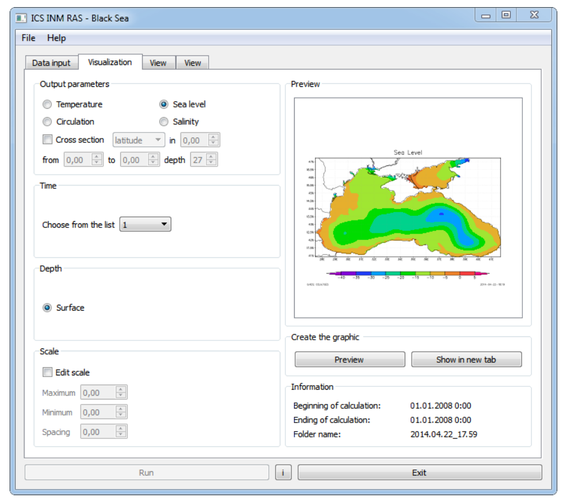
The system will provide a short-term (2 - 3 days) forecast of calculated parameters. This System in conjunction with the subsequent development of the theory and methods of calculation of the physical fields in the ocean and the atmosphere will move to a more successful solution of a number of applied and practical problems arising from the needs of the economy, national security, etc. of a state and society in general.

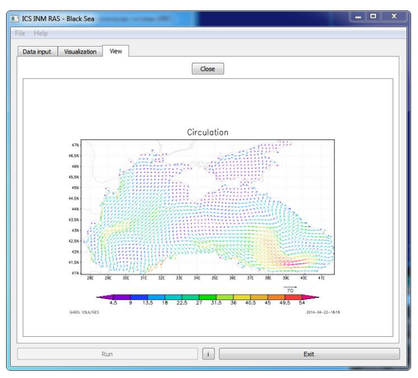
ICS "INM RAS - Black Sea”

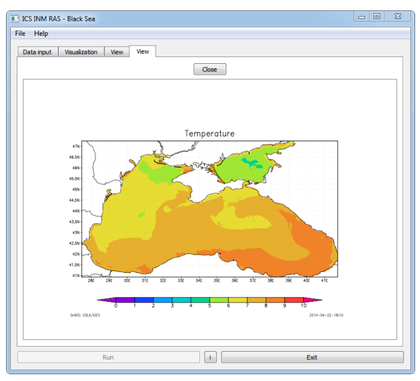


The ICS interface allows one:

- to use the hydrodynamic model of the Black Sea with different parameters:
  - without tidal forces,
  - with the tidal forces,
  - with the tidal forces and additional potential;
- to choose the calculation interval (indicating the start and the end of the numerical model calculation);
- to choose the process of assimilation of the sea surface temperature (indicating periods of assimilation);
- to view the results calculated (Sea surface temperature (SST), salinity, sea level, circulation) in graphics.







Special data base of the ICS

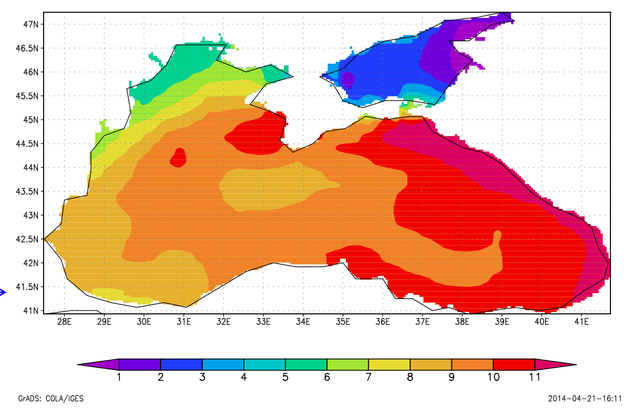
It is possible to use different observation data in the numerical experiments.

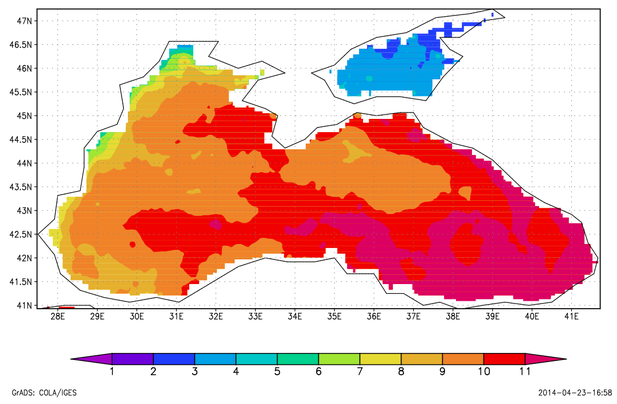
If the calculation will be held on the 2007- 2008 years then the observation data would be SST and Salinity fields calculated by:

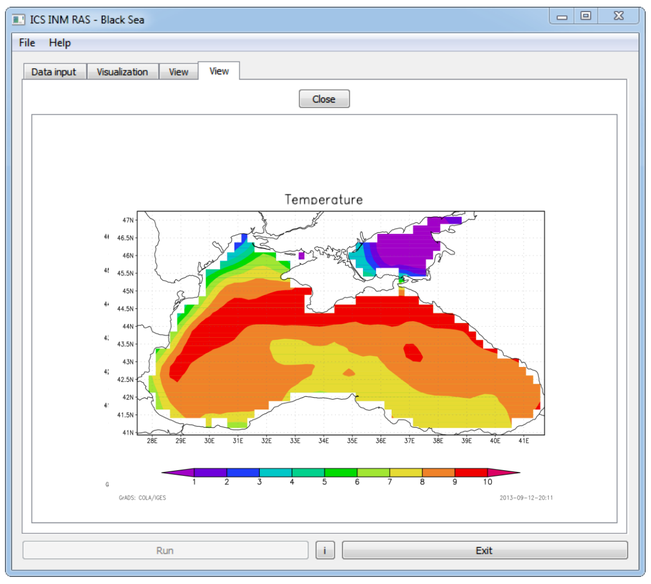
- The inverse distance interpolation method

  (Black Sea surface temperature field for the date 01 January 2008)

- The new method of interpolation data based on both the characteristics of the sea currents and the inverse distance interpolation method [5].







If the calculation will be held on the 2014 year data, then it would be operational observation data that describe the Black sea state.

At the current moment the observations that are used in the ICS for the operational calculation have been received from the European project called MyOcean (myocean.eu). It is filled with observation data (SST, Salinity fileds and other sea parameters).

The ICS is proposed to be a tool for practical experiments for the research purposes only.

Black Sea surface temperature observation data for 01 January 2013 (24 hours) from MyOcean

Conclusion

The ICS “INM RAS – Black sea” interface allows one to take advantages of powerful variation data assimilation system “INM RAS – Black sea” quickly and conveniently .

It is possible to use calculated fields of SST and Salinity for the numerical experiments. Moreover there is a possibility to use operational observation data in the calculations. It allows one to calculate short-term forecasts of SST, Salinity, Circulation and Sea level fields in the Black Sea area by means of the ICS “INM RAS – Black sea” .

The function of the experiment results review is available in the ICS. The ICS that is developed in this work has friendly interface so you can use it immediately with out any difficulties and preparation.

The system is available for users on-line after the registration at the www.adeq.inm.ras.ru. You can use ICS “INM RAS – Black sea” for the research purposes.

This study was supported by the Russian Foundation for Basic Research (project No 13-01-00753, 14-01-31195) and by Presidium Program of Russian Academy of Sciences (project P-23 “Black sea as an imitational ocean model”).

Reference

1. V.I. Agoshkov, M.V. Assovskii, S.A. Lebedev, Numerical simulation of Black Sea hydrothermodynamics taking into account tide-forming forces. Russ. J. Numer. Anal. Math. Modelling (2012) 27, No.1, pp. 5-31.

2. E.I. Parmuzin, V.I. Agoshkov, Numerical solution of the variational assimilation problem for sea surface temperature in the model of the Black Sea dynamics. Russ. J. Numer. Anal. Math. Modelling (2012) 27, No.1, pp. 69-94.

3. V.B. Zalesny, N.A. Diansky, V.V. Fomin, S.N. Moshonkin, S.G. Demyshev, Numerical model of the circulation of Black Sea and Sea of Azov. Russ. J. Numer. Anal. Math. Modelling (2012) 27, No.1, pp. 95-111.

4. Agoshkov V.I.,Assovsky M.B., Giniatulin S. V., Zakharova N.B., Kuimov G.V., Parmuzin E.I., Fomin V.V. Informational Computational system of variational assimilation of observation data “INM RAS – Black sea”// Ecological safety of coastal and shelf zones and complex use of shelf resources: Collection of scientific works. Issue 26, Volume 2. - National Academy of Sciences of Ukraine, Marine Hydrophysical Institute, Sebastopol, 2012. Pages 352-360. (In russian)

5. Zakharova N.B., Agoshkov V.I., Parmuzin E.I., The new method of ARGO buoys system observation data interpolation. Russian Journal of Numerical Analysis and Mathematical Modelling. Volume 28, Issue 1, 2013. pp. 67-84.