Development of Digital Atlas “Physical Oceanography of the Black Sea – 2020”

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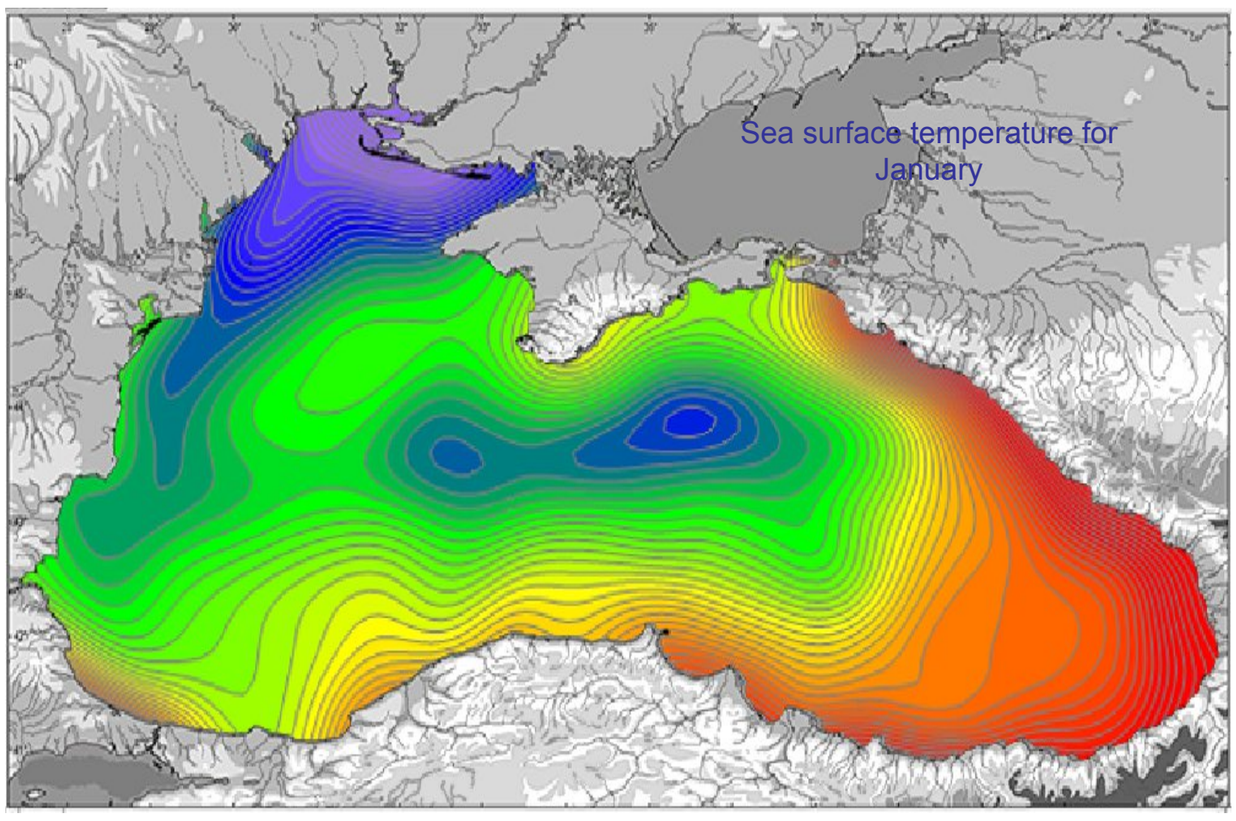
In the framework of international and national projects, considerable experience in development and creation of various maps and atlases reflecting the state of the Black Sea environment has been accumulated in Marine Hydrophysical Institute, Russian Academy of Sciences. Selected maps and entire sections of such atlases as digital atlas “Physical Oceanography of the Black Sea” (2003), “Atlas of the Black Sea and Sea of Azov Nature Protection” (2006), “National Atlas of Ukraine” (2007), “Oceanographic Atlas of the Black Sea and the Sea of Azov” (2009), etc. can be given as examples. Data held in the Oceanographic data bank of Marine Hydrophysical Institute, Russian Academy of Sciences (MHI BOD) served as the informational basis while building maps for relevant sections of the atlases.

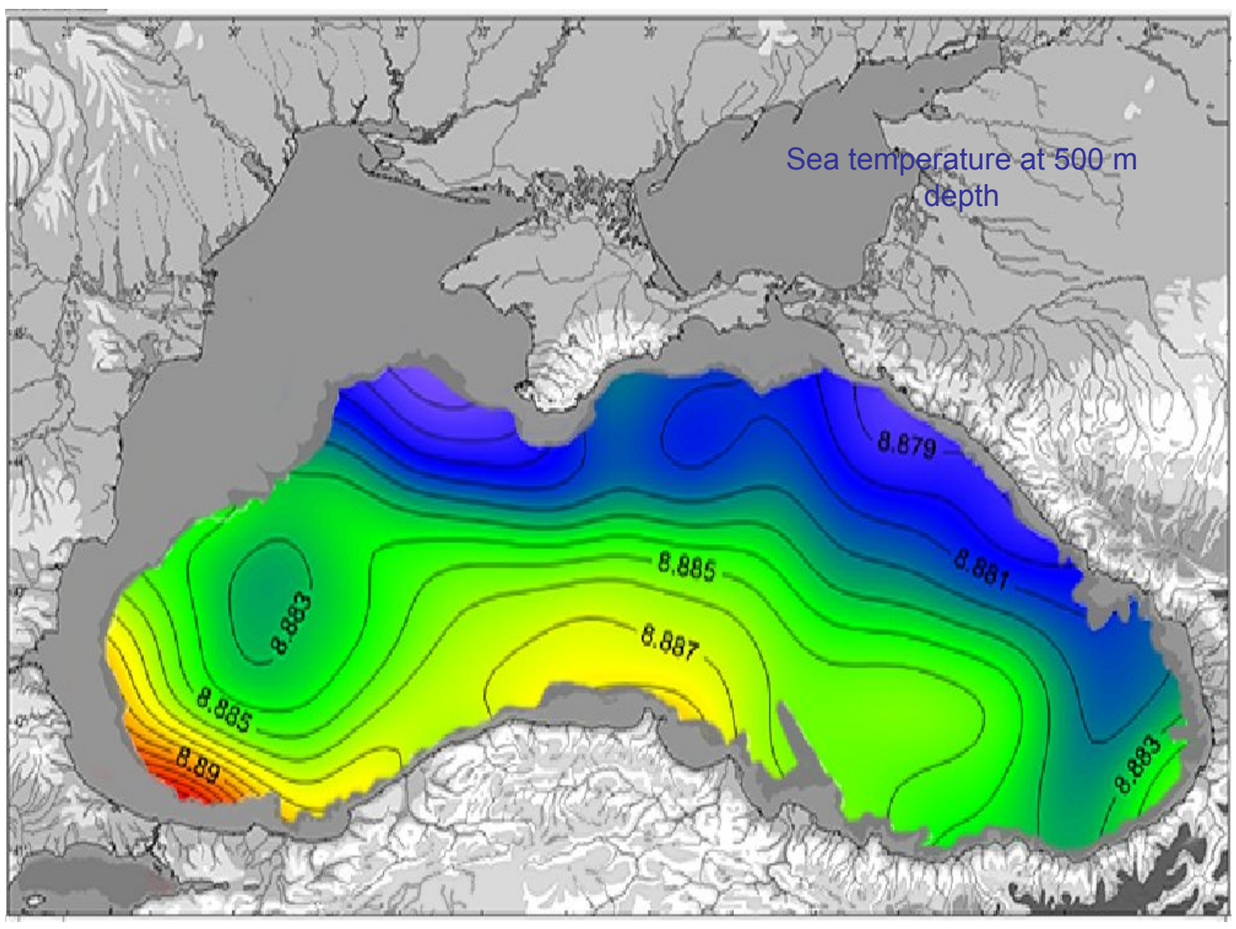
At present, digital atlas “Physical Oceanography of the Black Sea” is available online on the MHI BOD website (http://bod-mhi.ru/climaticAtlas.php) and contains about 350 maps in its three sections. The first version of the atlas was designed in 2003 in the framework of project “Rescue of Black Sea Hydrological Data, Creation Digital Atlas, and Studies of Seasonal and Interannual Variability of Black Sea”. The atlas was highly appreciated by users from different marine research institutions in Russia, Ukraine, and other states and remains to be actively used. However, in more than fifteen years since the atlas release, the array of oceanographic data that can be used for building maps has increased from 105,000 to more than 165,000 stations; methods of mapping have been considerably improved; a new interface has been developed to provide users with more opportunities when working with the atlases. All of that promoted the development of a new digital atlas “Physical Oceanography of the Black Sea – 2020” with its possible location on the MHI BOD website.

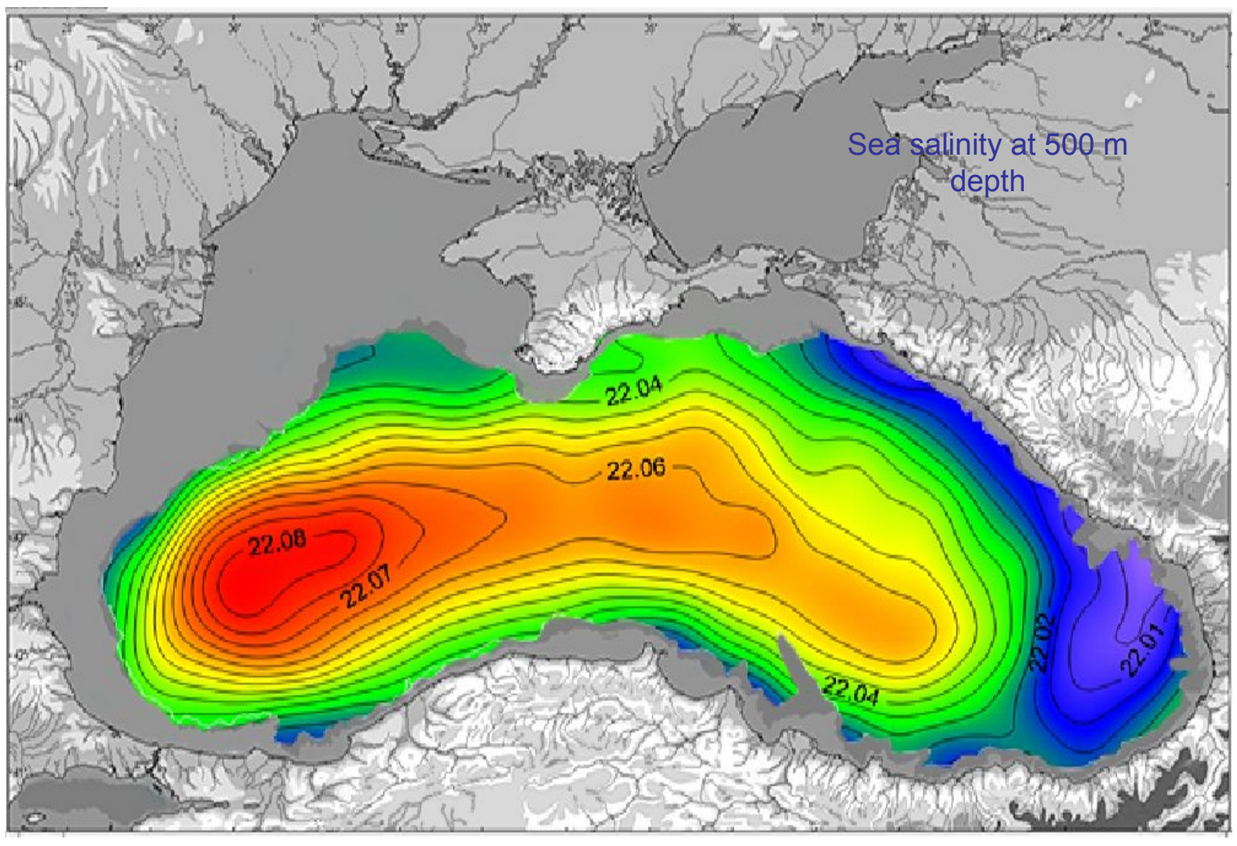
Climatic arrays

In order to calculate the climatic fields of temperature and salinity, several methods were used. The simplest and most obvious is the arithmetic averaging of the reanalysis array data at the regular grid nodes for each month. The second method consists in the approximation of averaged values of reanalysis array or optimal interpolation array by annual and semiannual harmonics. The third method is based on the above-described algorithm of thermohaline field reanalysis with fundamental difference in the fact that vertical and horizontal EOF are calculated not by inter-annual anomalies, but by seasonal ones. Comparison of climatic arrays calculated by different methods showed that when the main features of the field spatial structure coincide, there are regional differences in intra-annual evolution of thermohaline characteristics, especially in salinity. Nevertheless, spatial distribution of the hydrological seasonal cycle amplitude-phase characteristics retains its general regularities not only for different arrays, but also for different ten-year periods. One of the characteristic features of the seasonal temperature cycle is a decrease in annual harmonic phase with an increase in the seasonal amplitude. Seasonal variation amplitude increased after 1980s and by now it reaches its maximum values

An increase in the seasonal amplitude of salinity occurs during the periods of general desalination of the sea. The main regularity of multi-year variations in the amplitude-phase characteristics of salinity is a positive correlation of phase and amplitude of the seasonal variation, which is the opposite of the changes in the water temperature seasonal variation.







Parameters:

Temperature;
Salinity;
Density;
Elements of water stratifications;
Characteristics of cold intermediate layer;
Dynamic topography and geostrophical currents.

Features:

Spatial resolution
0.1°×0.125° (11×8 km)
Average monthly fields 0-250 m, annual fields from 300 m.
Levels:
Every 5 m in 0–100 m,
Every 10 m in 100–300 m,
Every 50 m in 300–1000 m,
Every 100 m in1000–2100m.

Conclusions

The atlas “Physical Oceanography of the Black Sea – 2020” will allow clarifying the understanding of oceanographic peculiarities of the Black Sea and further improve the information management of academic studies and marine economy in the Black Sea basin.

Acknowledgements

The work on creating the atlas “Physical Oceanography of the Black Sea – 2020” and developing MHI BOD databases is carried out within the state task on theme No. 0555-2021-0003 “Operative Oceanology”.