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The new online Black Sea Oceanographic Database

**Elena.V. Zhuk, Maxim I. Vetsalo,
Andrey V. Ingerov**

*Marine Hydrophysical Institute,
Russian Academy of Sciences (MHI RAS)*



MHI RAS Black Sea data

- Black Sea Oceanographic data contains over 160,000 hydrological and about 34,000 hydrochemical stations accomplished since 1890 till 2019;
 - Satellite data entering from the MHI Department of Remote-Sensing Methods. They are represented by images obtained from MODIS AQUA satellite in GeoTiff format which contains measured data for three parameters, i.e. sea surface temperature, chlorophyll a concentration, and water leaving radiation;
 - Climatic atlas consisting of the following sections: Seawater Temperature, Salinity, Density, Heat Storage, Oxygen Concentration in Seawater, Aerobic Waters Low Boundary Location, and Hydrogen Sulfide Zone Upper Boundary Location. In total, the atlas includes over 400 maps in jpeg and shape formats;
 - Social and economic data including population in cities, population density, infrastructure (roads and railways), industrial enterprises etc. The information was mainly taken from websites of state statistics.
- According to the basic data types, the module structure of GIS was developed.



Black Sea Oceanographic database

The new improvements of the Black Sea Oceanographic Database-BSOD dedicated to the online access of the hydrological and hydro-chemical data, taking into account users priorities, data types, methods and time of data access are presented.

According to the results of the free DBMS analysis, the PostgreSQL object-relational DBMS was selected for archiving the data in the BSOD. PostgreSQL provides high performance and reliability and the ability to work with a big data. Moreover, the PostgreSQL has the functions allowing to work with GIS objects, using the PostGIS extension and has built-in support for poorly structured data in JSON format.



Structure of the Black Sea Oceanographic database

For the development of the BSOD structure we took into account the dual nature of the processed database queries:

- On one side, the interactive work of the users with metadata was considered and a function which is necessary to generate requests for data was provided.
- On the other side, it was considered and provided the capability to select large data set in accordance with the criteria specified by metadata selection.

Taking these two features into account, the part of the database responsible for accessing the **metadata**, was designed for interactive transaction processing (OLTP access template), while the other part, responsible for the **in-situ data** archiving was developed in accordance with the “star” architecture, which is typical for the OLAP access template.



Structure of the Black Sea Oceanographic database

After analyzing the oceanographic in-situ observations, the following main entities were identified: Cruise, Ship, Station, Measurements, as well as Measured parameters and the relationships between them. A set of attributes was compiled for each of the entities and the tables were designed. The BSOD includes the following:

-Metadata tables : Cruises, ships, stations, stations_parameters.

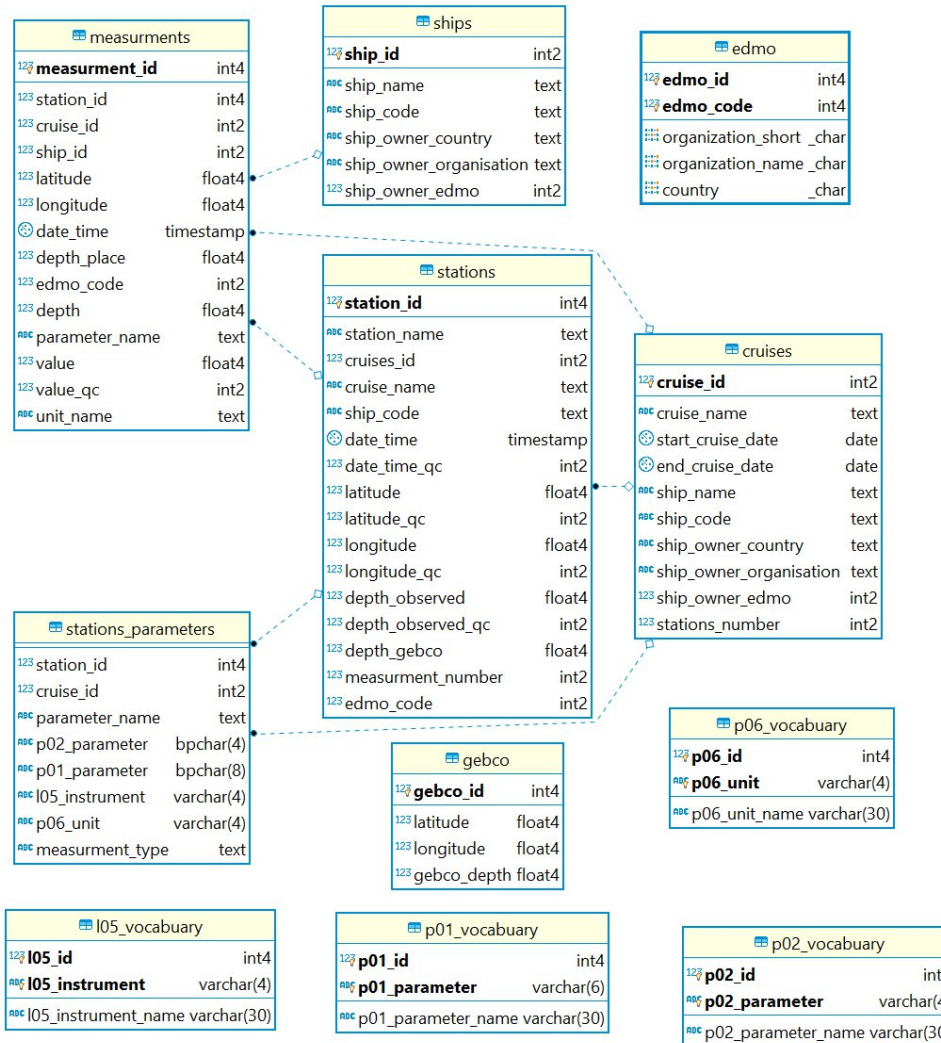
-Data tables: measurements.

-Vocabularies: vocabularies were constructed using the SeaDataCloud BODC vocabularies parameters.

-Referencedata tables: GEBCO, EDMO, p01_vocabulary, p02_vocabulary, p06_vocabulary, l05_vocabulary.



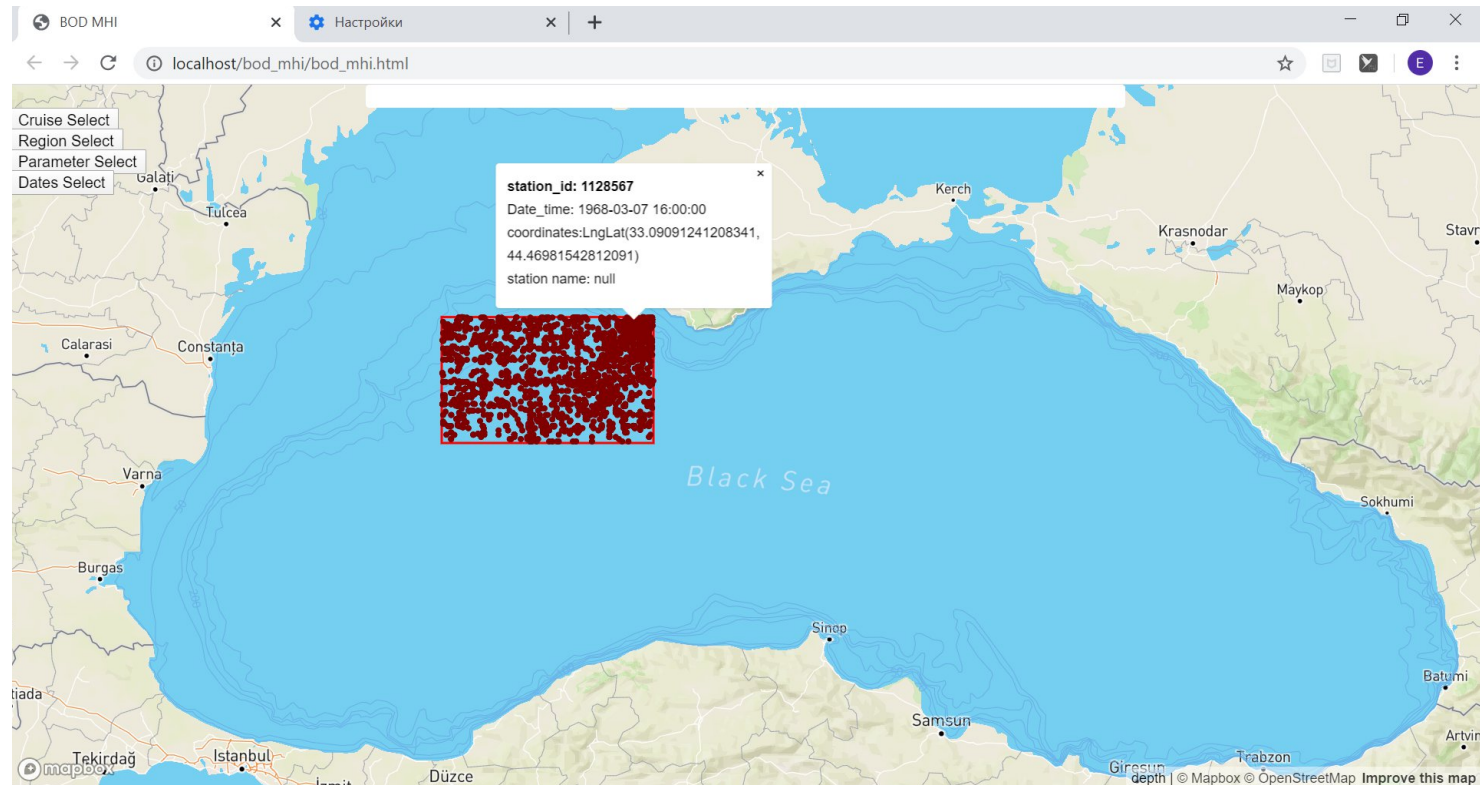
ER-diagram of the Black Sea Oceanographic database





Web interface of the Black Sea Oceanographic database

To provide the online data access to the Black Sea Oceanographic Database, a User Interface-UI was implemented. It was developed using **jQuery** and **mapBox GL** javascript libraries and provides visual data selection for date period, cruises, parameters such as temperature, salinity, oxygen, nitrates, nitrites, phosphates and other metadata.

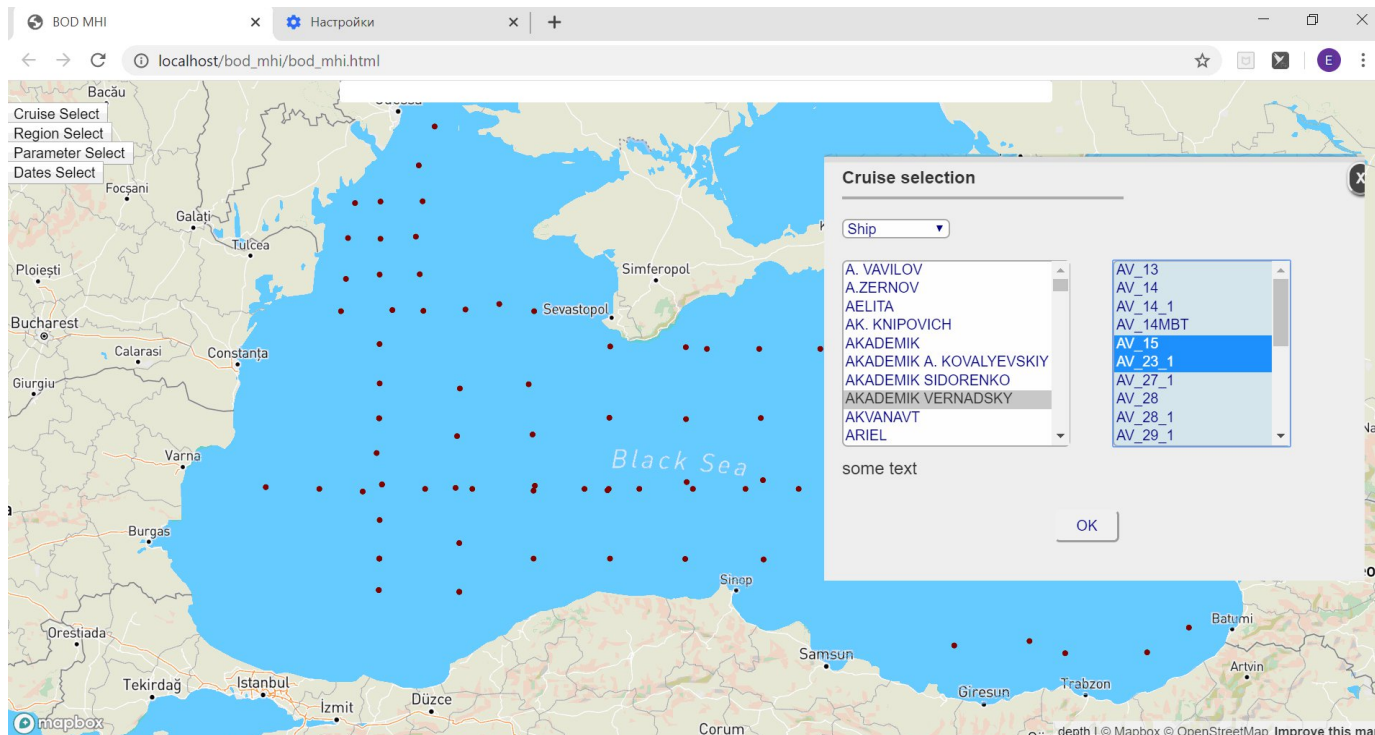




Web interface of BSOD

Cruise selection dialog provides 3 options:

- Cruise selection by cruise name, which visualizes the stations of the cruise through the selected cruise name.
- Cruise selection by ship name, which loads all cruises corresponding to the selected ship name to the neighboring window and display the stations from all selected Cruises.
- Cruise selection by the cruise year, which loads all cruises that were carried out at the selected year to the neighboring window and display stations from all selected Cruises.

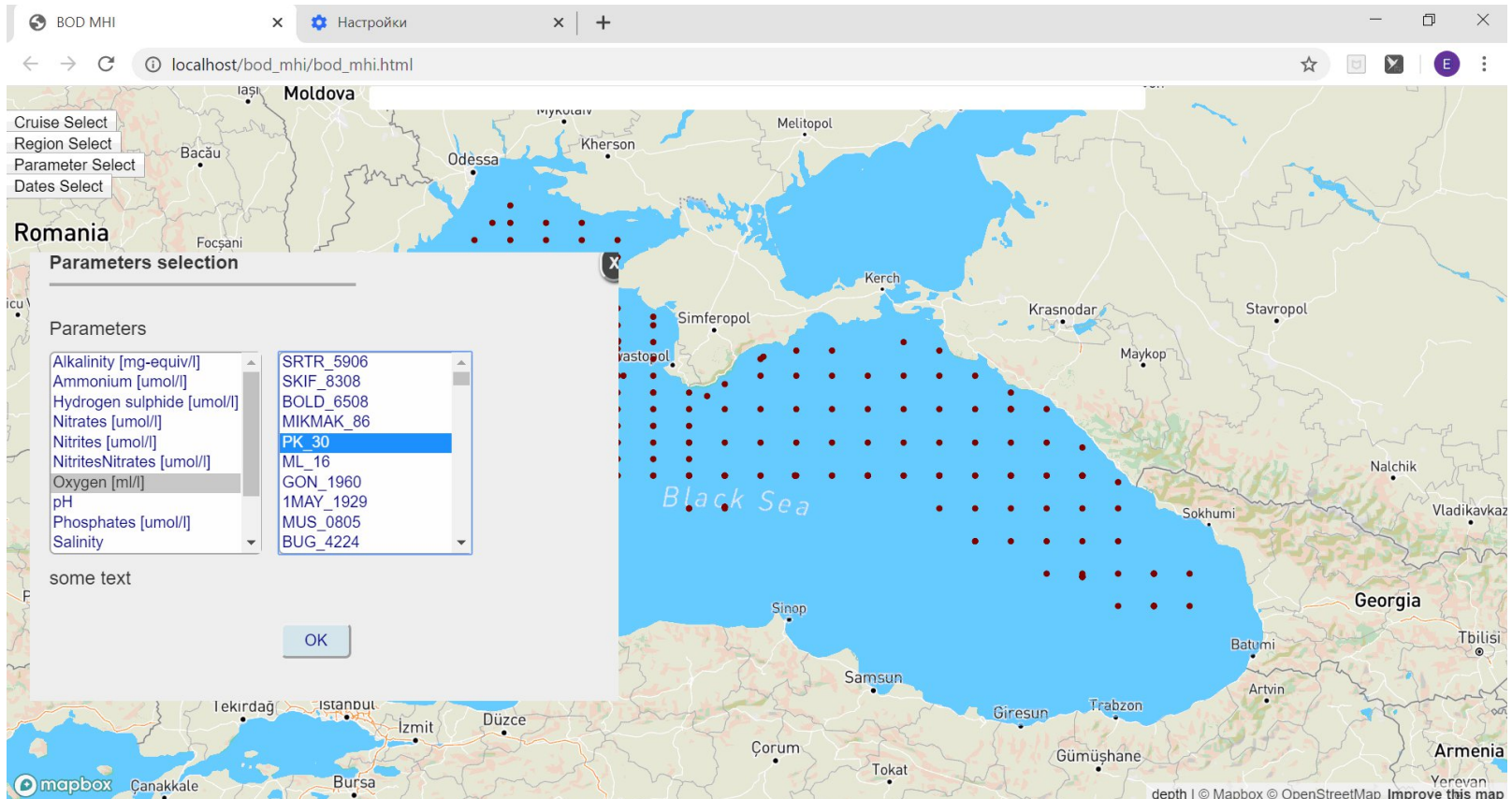




Web interface of the Black Sea Oceanographic database

Parameter selection

Parameter selection dialog allows to select those cruises during which the selected parameter was obtained. At present the available parameter list includes 18 parameters, both hydrophysical and hydrochemical.

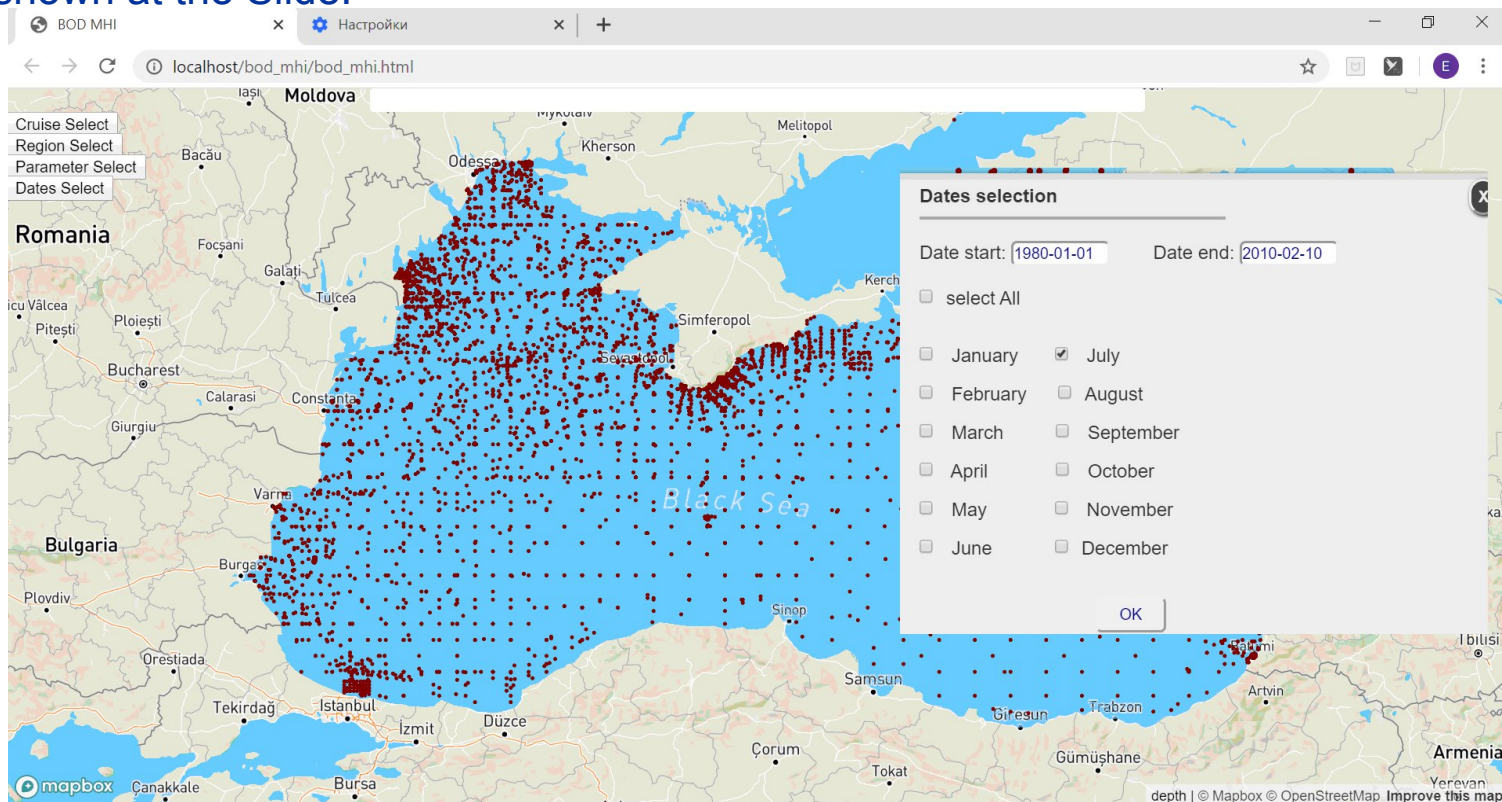




Web interface of the Black Sea Oceanographic database

Dates selection

Dates selection dialog provides the possibility to set dates interval and/or months for which the stations should be selected. An example of selection of all oceanographic stations which were carried during July, in the period from Jan 01, 1980 to Feb 10, 2010 is shown at the Slide.





CONCLUZION

The new improvements and the optimization of the online Black Sea oceanographic database structure and using the mapBox GL for cartographic data visualization, made possible to significantly speed up (by an order of magnitude) the loading and visualizing of database request results.

The introduction of new elements in the user interface of the online Black Sea oceanographic database has improved and expanded the functionality of its GIS.