THE BLACK SEA GIS DEVELOPED ON BASIS OF FREE SOFTWARE

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Information resources

The main data resources for GIS are as follows:
– Oceanographic data kept in the MHI Oceanographic Data Bank which contains over 160,000 hydrological and about 34,000 hydrochemical stations accomplished since 1890 till 2016;
– 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;
– Coastal zone data including data for about 105 km coastline from Magry to Adler. These data were obtained in SB IO RAS and transferred to the MHI database in the framework of their joint activities.
According to the basic data types, the module structure of GIS was developed. Each type of data is matched to a module which allows selection and visualization of the data.
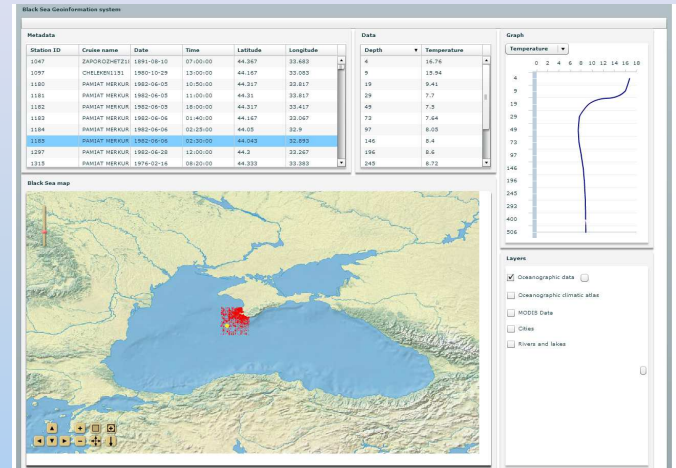

Fig.2. An example of displaying the result of selection of oceanographic data

Black Sea GIS structure

While creating the Black Sea GIS, the primary attention was paid to selecting free and platform independent software capable of providing necessary functionality.
The software for data access and visualization was developed on the basis of client server architecture. Its server part includes an oceanographic database (ODB), a map service, python and php-modules providing data processing and interaction between server and client applications (Fig. 1).
MapServer was chosen to be a map service.
To operate the database, MySQL database management system was selected.
The Black Sea GIS was developed using a module structure that gives excellent capabilities for extending its functionality and integrating new types of data. A special module was developed for each type of data.
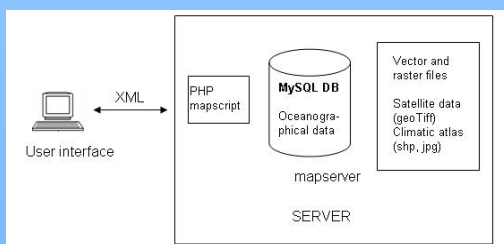

Fig. 1. Black Sea GIS architecture

Fig. 3. Average monthly sea surface temperature in January

The main types of data used are:

1. digital data kept in the database (oceanographic data, coastal zone data);
2. graphical data:
– maps in jpeg format (maps of the Black sea climatic atlas);
– maps in shape format (isolines of the climatic atlas maps, social and economic data);
– maps in GeoTiff format (MODIS satellite data);
– textual data (social and economic information and coastal zone data).

The system includes:

oceanographic data module realizing import/export of oceanographic data in ODV format; selection of oceanographic data on region, time, season, and cruise; visualization of required oceanographic data (presenting stations on the map, making profiles of oceanographic parameters, metadata and data output);
– module of selecting and visualizing maps of the climatic atlas in jpeg and shape formats;
– module of selecting and displaying MODIS AQUA satellite images in GeoTiff format;
– module of selecting and displaying social and economic data for coastal regions;
– module of overlaying various data types.
An example of selecting and visualizing oceanographic data, climatic atlas maps visualisation and overlaying the climatic atlas isolines and a satellite image are presented at the Fig.2, Fig.3, Fig.4

Fig. 4. Overlaying the climatic atlas map and a satellite image.

Conclusions

The accomplished research showed possibility and practical expediency of the GIS development using free software and MapServer as a map service. The openness of the Black Sea GIS architecture gives excellent capabilities for extending its functionality, using new data sources and connecting new databases. At present, the work on improving the Black Sea GIS is continued. We are developing module which gives opportunity to integrate MEDSLIK software in Black Sea GIS