Web service for storing and processing sea water data measured in situ concurrently with satellite survey

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The report discusses the Web service developed by Space Research Institute RAS (IKI RAS) for storing and processing sea water parameters measured *in situ* concurrently with satellite survey. Every year, the IKI RAS team conducts field measurements in the coastal zones of the Black, Baltic and Azov Seas focusing on retrieving information on the 3D structure of hydrophysical processes reflected in quasi-synchronous satellite data. The main processes of interest are: coastal currents, submesoscale eddies, internal waves, river and lagoon plumes.

The measurements are made from small boats using a set of oceanographic instruments, of which the key ones are an RBR-concerto CTD probe equipped with turbidity and chlorophyll *a* concentration (CHL-a) meters and an Acoustic Doppler Current Profiler (ADCP). The CTD sampling rate is 6 Hz, one down-and-up cycle can yield a dataset of over 1500 measurements. As a rule, 30-40 stations are made on ship route. For preliminary data processing, a software module is created implementing processing and sorting of the obtained dataset according to user-defined parameters. The output file contains the list of stations (measurement points) with coordinates and the array of filtered downcast and upcast data. All the data, preliminary and processed, are uploaded to the web service for further processing.

The web service backend is written in the Laravel framework. The main components of the system are presented in Fig. 1. User access to the system tools is realized via a graphics interface developed in the VueJS framework. The interface is very simple and easy to use.

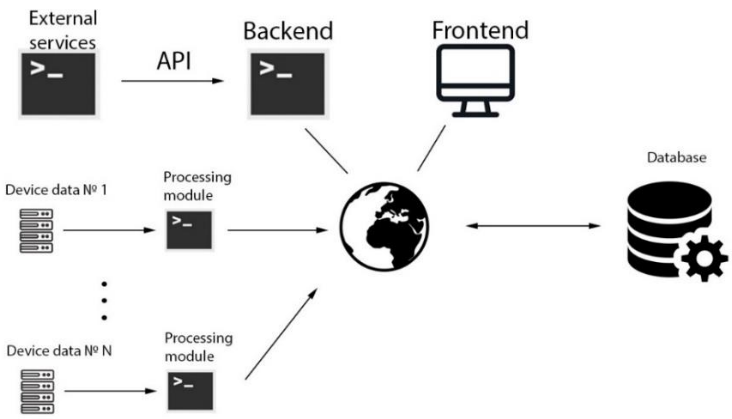

Figure 1. System architecture

As exemplified by CTD data, the database table contains values of station number and coordinates and measured depth, temperature, salinity, sound velocity, turbidity and CHL-a. During a day of work, over 300 thousand values are accumulated in the table. Similar tables are compiled for ADCP data. For individual expeditions, a separate table is created with numbers and dates of specific measurements as well as an array of local archives that is associated with particular expedition. In the system, on the basis of the uploaded data, profiles of physical parameters at the stations are drawn taking into account changes in depth and route distance. Examples of such graphs are shown in Fig. 2.

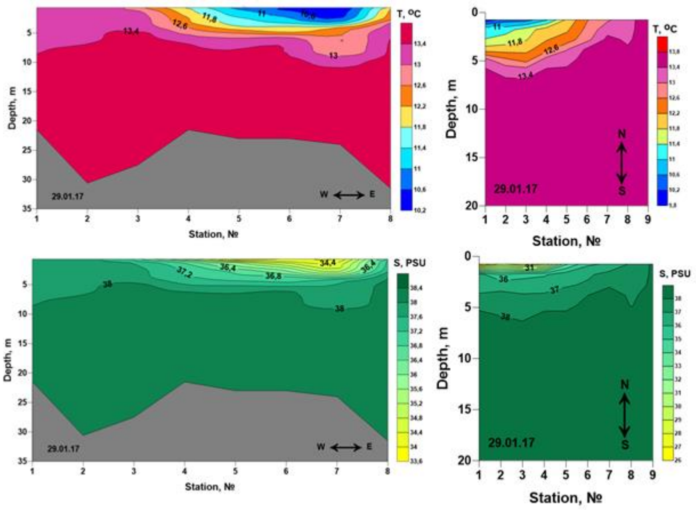

Figure 2. CTD data from one day of measurement

Today, data processing programs are written and incorporated into the system. The basis is the algorithm for filtering and sorting CTD data recorded in Excel format (.xlsx). This format was chosen because of the oceanographic equipment software that exports the raw data in a tabular Excel format (Ruskin, WinRiver). The algorithm for creating new files with processed data and station coordinates (by default absent in CTD logs) is written in Python using OpenPyxl and XlsxWriter third-party libraries. Primary data processing includes removing unnecessary columns, searching for the beginning and end of stations without measurements, which are responsible for calibrating the probe, and averaging the data over the selected parameters. The processed data is stored in the service database, where it is used for subsequent visualization of the results. For this, a cartographic interface displaying selected stations is added to the web service. It is possible to perform joint analysis of measurement data and shipboard meteorological data (Fig. 3).

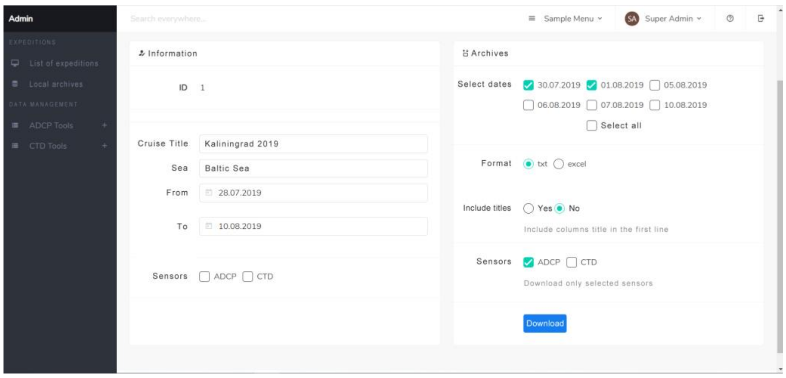

Figure 3: Service interface. Data selection

The joint use of in-situ measurements and remote sensing data in existing scientific works is used as an auxiliary method for various qualitative descriptive work.

That’s why the principal upgrade direction of the web service is the development of an interface with the See the Sea information system (STS). Created and maintained by IKI RAS, STS is intended for studying processes and phenomena in oceans and seas using all available satellite data (Loupian *et all*., 2018 ; Lavrova *et all*. 2019). The data stored in the Web service should flawlessly be supplied to STS for display in its cartographic interface and joint analysis with satellite data.

Nowadays, the web service is used by users of the IKI RAS, but soon the project is planned to be published for the general public, where any scientist, which engage in oceanological research, can store and processing primary observation data in prepared instrument.

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References

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