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

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Abstract

Web service

The report discusses the Web service for storing and processing sea water parameters measured in situ concurrently with satellite survey as developed by Space Research Institute RAS (IKI RAS). 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 quasisynchronous satellite data. The main processes of interest are: coastal currents, submesoscale eddies, internal waves, river and lagoon plumes.

Applicable data

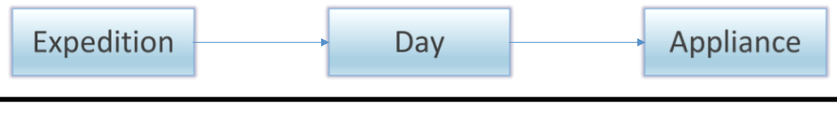
Appliances

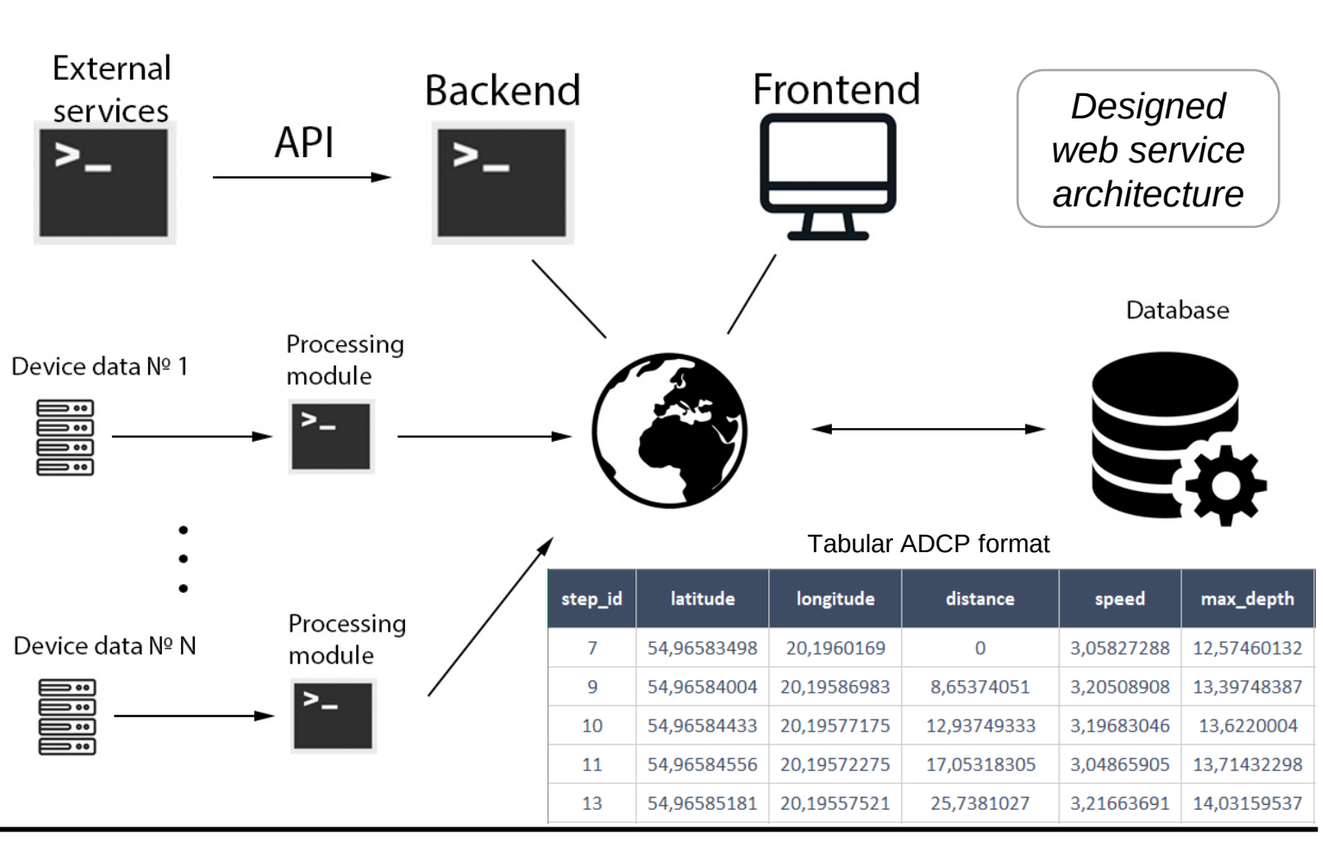
The primary data entering the system are the data archives obtained from the instruments: an acoustic Doppler current meter (ADCP), a hydrological CTD probe of the RBR-Concerto model, and an Airmar meteorological station. Each of the presented devices has its own data type and contains its own hydrophysical parameters, requiring written scripts to import data into a prepared web service. In general, such data is stored in text (.txt) and tabular (.xlsx Excel) formats.

Data processing

«Importer» programs

The programs importing primary data into a web service were written in a high-level Python language employing specialized libraries for processing tabular data, such as openpyxl and xlsxwriter. The algorithm is unique for each device, as each of them loads different hydrophysical parameters. Before adding data to the system, it is necessary to perform primary filtering to separate "production" data from noise. Moreover, there are general principles of processing, such as averaging the parameters of the device. Averaging is carried out based on the coefficients selected by the user in the system. The primary data is saved in local archives with the possibility to download them in the future. Thus, the processed data enters the system and is ready for further visualization.

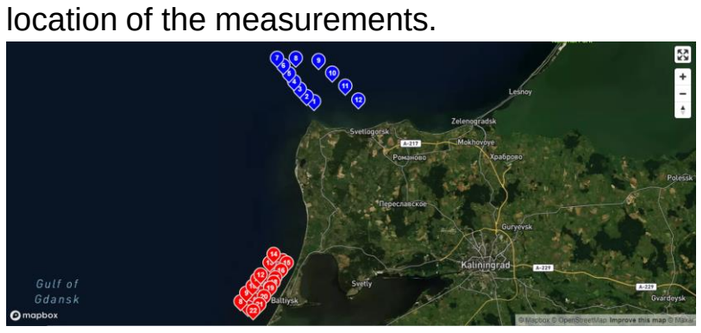




step_id	latitude	longitude	distance	speed	max_depth
7	54,96583498	20,1960169	0	3,05827288	12,57460132
9	54,96584004	20,19586983	8,65374051	3,20508908	13,39748387
10	54,96584433	20,19577175	12,93749333	3,19683046	13,6220004
11	54,96584556	20,19572275	17,05318305	3,04865905	13,71432298
13	54,96585181	20,19557521	25,7381027	3,21663691	14,03159537

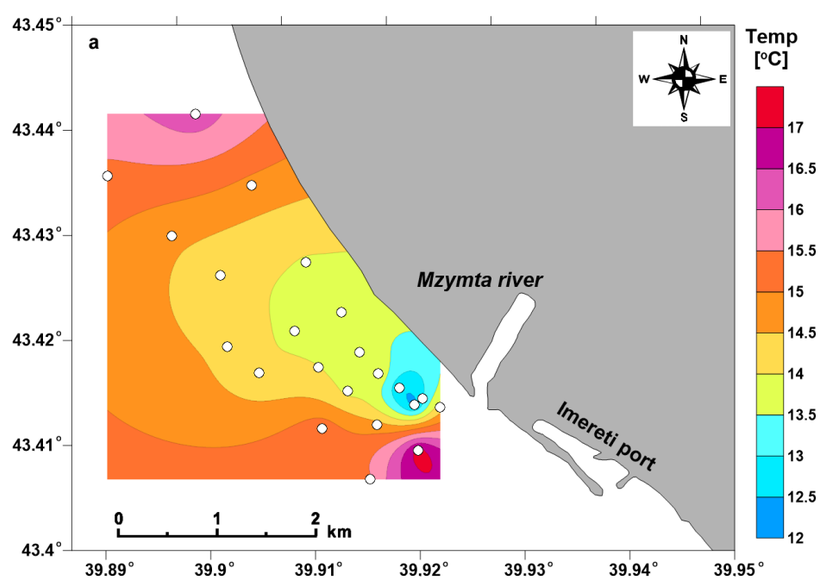
Plotting and Mapping Tools

The results of data processing can be visualized with the help of graphing tools created in the web service, developed using the Plotly library (JavaScript). Graphs are built for each device individually, marking different physical parameters - temperature, salinity, turbidity, etc. on the axes. The graphs contain additional settings, such as contours smoothing, setting the output color palette, and measurement range selection. For example, you can plot a graph for a single CTD station or for a whole day of exploration. The service also has a built-in cartographic interface of the free Mapbox project, allowing to mark the location of the measurements.

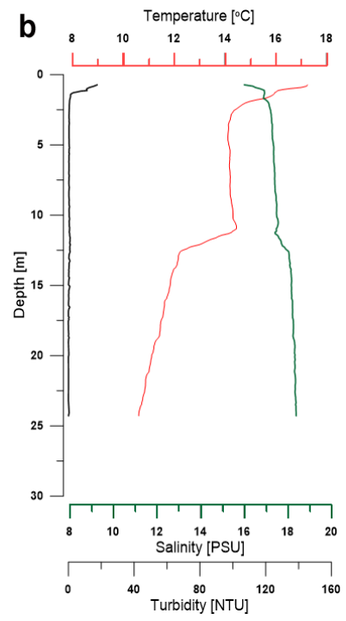


***Mapbox** cartographic interface. Red and blue marks indicate CTD measurements performed in the Baltic Sea on 08/18/2020 and 08/23/2020, respectively.*

Data visualization



Map of water temperature spatial distribution on 2 May 2019: from CTD measurements.



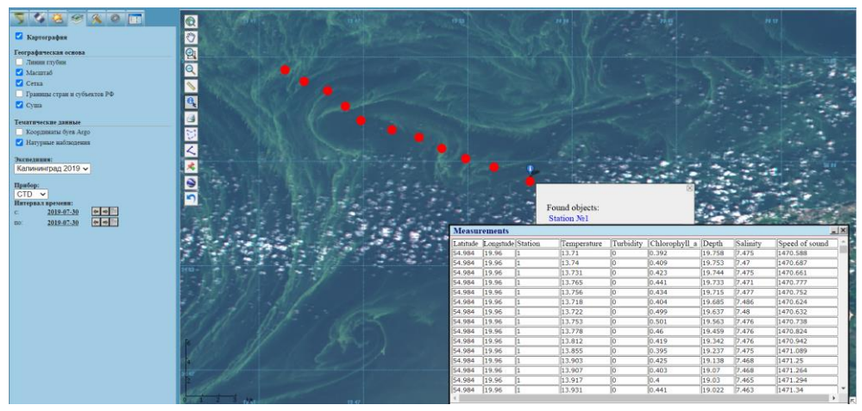
Typical CTD casts. Station 134 - near plume boundary.

«See the Sea» integration

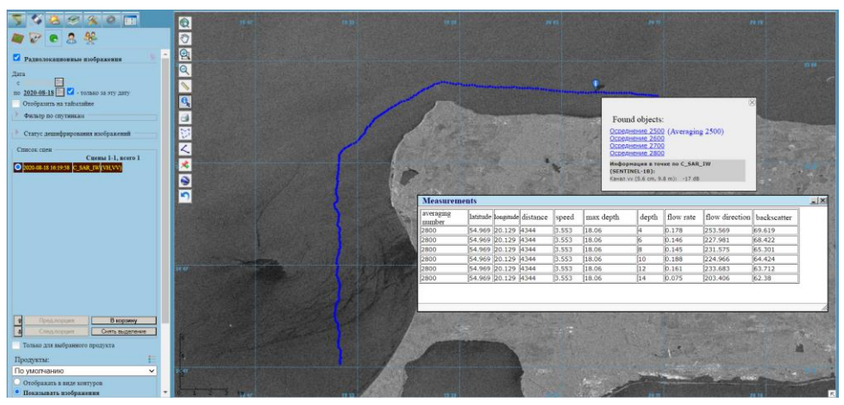
API

The data in the web service is integrated into the «See the Sea» (STS) satellite monitoring system. Thus, the user has the ability to work with satellite data, superimposing the results of sub-satellite experiments on space images of the optical and radar range. To load oceanological data into the STS system, a program interface was written, which transmits the coordinates and time of the measurements carried out together with the displayed hydrophysical parameters. The user has the opportunity to select any already loaded expedition, the device and the date of the expedition. Thus, it will be possible to view information for each measurement and perform other operations directly in the STS, for example, to verify satellite data based on the in-situ measurements.

The development of the See the Sea information system is supported by theme “Monitoring”, registration no. 01.20.0.2.00164. The information system is functioning with use of the data from the “IKI Monitoring” Center for Collective Use.



STS cartographic interface, which shows an image of the optical range of the Baltic Sea from the Sentinel-2B space system for 07/25/2019 10:05:24 GMT. Red marks superimposed CTD data (measurement stations) for 07/30/2019.



Radar image of the Baltic Sea from the Sentinel-1 satellite for 08/18/2020 16:19:58 GMT. ADCP data for the same period of time are superimposed with blue marks.