MAR-S GIS-DATABASE, A NEW TOOL DEDICATED TO SAFETY ASSESSMENT OF THE ROMANIAN MARITIME SPACE

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Abstract. The MAR-S project aimed the experimental-demonstrative implementation of a set of geophysical methods of investigation and monitoring of the Romanian maritime space, together with the organization of the previously existing and new acquired information in a dedicated GIS-database, which allows the assessment of present maritime space security and set up the future surveillance strategy. A dedicated database was developed in order to catalog and hierarchize natural and anthropic structures, constructions, marine infrastructure elements and submerged objects which could pose risks for the maritime space safety. Historic and present-day information from this database is available to produce GIS thematic maps.

Key words: Black Sea, maritime space, security, database, PHP, PostgreSQL, GIS

1. INTRODUCTION

The political and military developments that took place in the Black Sea region over the past years have significantly changed the regional security climate. Like other European countries, given the rise in regional instability, Romania is conducting major actions aiming at characterizing the security of its maritime space. The execution of the experimental-demonstrative research project *"Implementation of a geophysical investigation and monitoring tool of the Romanian maritime space security – MAR-S",* carried out during 2017-2018, is only one of the means by which the national scientific community has aligned itself with this national objective. The project both aimed to create and demonstrate the effectiveness of a complex geophysical investigation tool for the maritime space and to re-evaluate, specifically structure and hierarch all available old and new acquired geophysical, topo-hydrographical data, the geographical and historical information within a dedicated GIS-database.

The project is part of the series of initiatives dedicated to the study of maritime space security and the submarine cultural heritage associated with it. Previous steps envisaged, for example, the regional characterization of the Romanian and Bulgarian maritime space, with focus on its cultural heritage load (*e.g.* Caraivan *et al.*, 2015, 2018), punctually the maritime space security of the Bulgarian harbor Burgas (Dimitriu *et al.*, 2017), or the assessment of the prospective submerged cultural heritage off the Romanian coast (*e.g.* Dimitriu, 2012, Dimitriu *et al.*, 2017, 2018).

2. METHOD

The specific information was gathered from official sources, such as the naval events registers of the Romanian Naval Authority, the "*Notices to Mariners"* issued by the Maritime Hydrographic Directorate, as well as from publications, printed and electronic maps and navigation charts, newspapers, media and internet. A most valuable source of information, also considered, is represented by the marine geophysical databases owned and administrated by NIRD GeoEcoMar.

As a result of the complex analysis of all types of data available, the information was structured into the following main and secondary categories:

- **Port Facilities** – Bridges, Quays, Mooring buoys and Concrete platforms,
- **Fishing & Farming areas** – Fishing nets areas, Fishing facilities and Marine farms,
- **Maritime Hydrocarbon Infrastructure** – Drilling/ Exploitation rigs, Underwater wells, Pipelines and Protection perimeters,
- **Dangerous Areas** – Rocky seabed, Shallow waters, Submerged wave-breaks, Concrete platforms, Dikes & jetties, Artificial reefs, Obstacles & restrictions, Unidentified underwater objects, Maritime works, Prohibited areas, Military drill areas,
- **Waste Waters Pipelines**,
- **Submarine Cables**,
- **Naval Incidents & Ship Wrecks** – Ship wrecks in situ, Dismembered ship wrecks sites, Recommissioned ships sites, Quayed[1] ship wrecks, Naval incidents and Uncertain incidents/wreckages,
- **Snags**[2],
- **Magnetic Targets**
- **Acoustic Targets**.

The MAR-S project database was developed for adding/ displaying/editing all the data collected during the MAR-S sea cruises and those collected in previous research projects. In addition, its interoperability with the OpenGeo server, which renders the maps obtained from the processed data, was also considered.

This database is unique in the information gathered with regards to submarine hazards on the Black Sea Romanian shore. The data gathered has geographical coordinates that are not accessible to the public but only the interested parties based on security protocols discussed during the project.

For the general public the data is displayed with manipulated coordinates useful only for a general localization of the hazards.

In the development of the database, open source technologies were used, like: PHP for programming DB queries, POSTGRESQL with GIS extensions used as DB Server for data storage, HTML 5 + CSS3 + JavaScript for programming the access interface. The database is hosted on a Linux Centos 7 server.

The access interface is optimized and tested for Google Chrome and Mozilla Firefox browsers. This interface has also been optimized for access on Android-based smartphones.

[1] Ship wrecks integrated in port constructions (platforms, quays, dikes, piers, jetties, etc.)

[2] Offshore sites where fishing nets are hooked on unknown objects or structures located on the seabed.

Access to the database is through a closed login system, which means that users cannot make the registration. Instead, a request must be sent to system administrators who will generate passwords and user names, which will grant access to the database.

The access screen consists of a box where the name and the password are inserted. The box also has "Remember me" option, as shown in Fig 1.

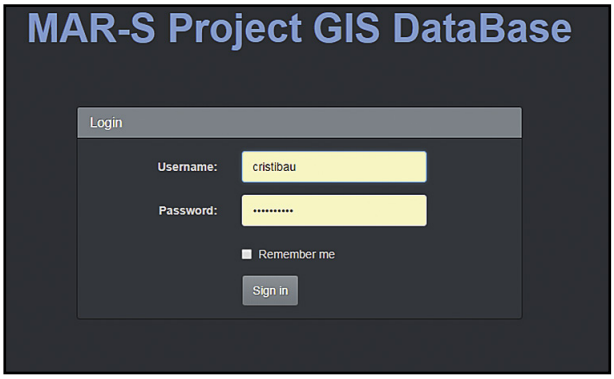


Fig. 1. Login screen to MARS database

The web front end is made from several modules with integrated functionalities as described next in the article.

2.1. Data Listing Module

In this module (Fig. 2), the data are listed and, where appropriate, interpreted through JavaScript scripts. The „Confidence" column in which numbers 1 through 5 are entered is converted into a Star Rating system. The „link" column, where links to image files stored in the database are displayed, is converted into an image preview system with the possibility of viewing them in full size without downloading from the server.

Furthermore, in this module, a rapid search function was developed based on predefined criteria, reporting the number of data sets corresponding to these criteria, as shown in Fig. 3. In addition, interactive features to hide some columns of data or to change the real-time dimensions of some columns are included.

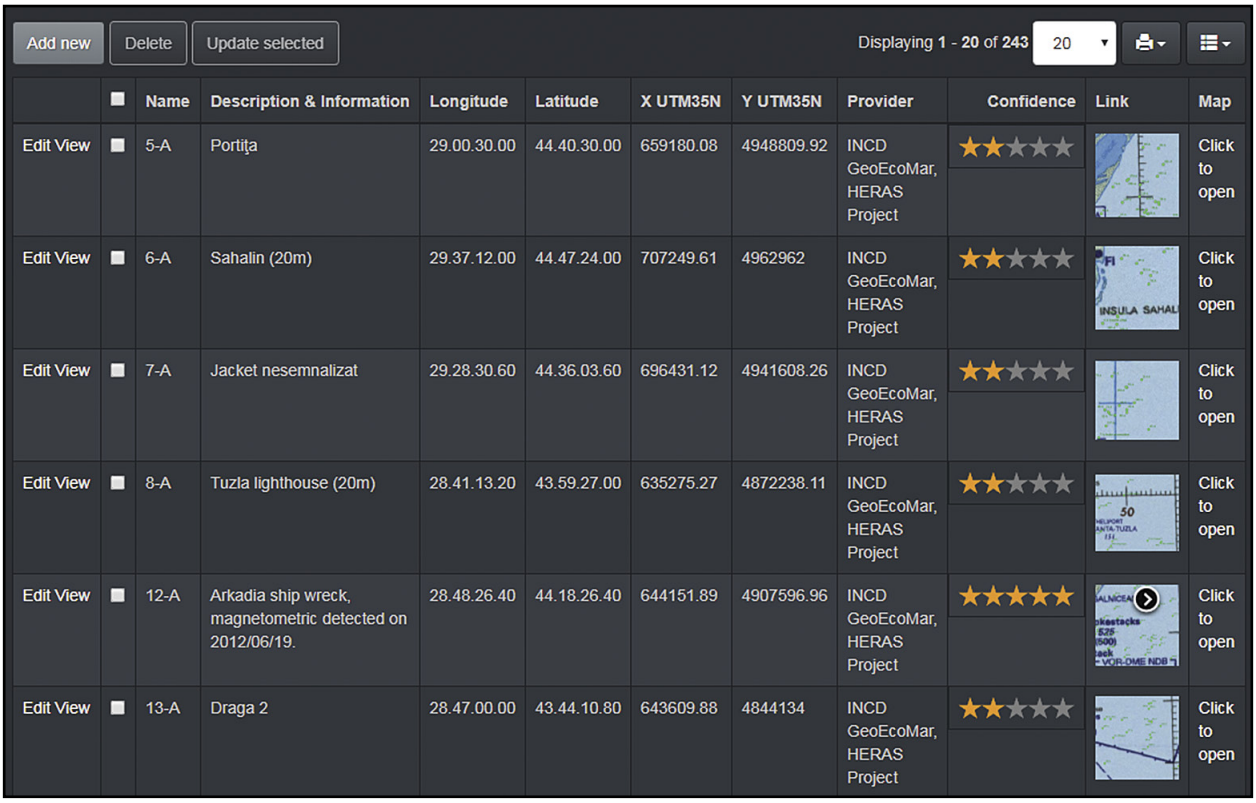
2.2. Adding Data Module

This module is used to insert data to the database, as shown in Fig. 4.

The data input is validated via the type of variable defined in the DB server. You cannot enter letters in fields defined as digits; data must be in a specific format, etc.

2.3. Editing Data Module

With this module, data already entered in the database can be edited. Features such as direct navigation from editing into the viewing window, consecutive data set navigation, have been added, as shown in Fig. 5.



		Name	Description & Information	Longitude	Latitude	X UTM35N	Y UTM35N	Provider	Confidence	Link	Map
Edit View	☐	5-A	Portița	29.00.30.00	44.40.30.00	659180.08	4948809.92	INCD GeoEcoMar, HERAS Project	★★☆☆☆		Click to open
Edit View	☐	6-A	Sahalin (20m)	29.37.12.00	44.47.24.00	707249.61	4962962	INCD GeoEcoMar, HERAS Project	★★☆☆☆		Click to open
Edit View	☐	7-A	Jacket nesemnalizat	29.28.30.60	44.36.03.60	696431.12	4941608.26	INCD GeoEcoMar, HERAS Project	★★☆☆☆		Click to open
Edit View	☐	8-A	Tuzla lighthouse (20m)	28.41.13.20	43.59.27.00	635275.27	4872238.11	INCD GeoEcoMar, HERAS Project	★★☆☆☆		Click to open
Edit View	☐	12-A	Arkadia ship wreck, magnetometric detected on 2012/06/19.	28.48.26.40	44.18.26.40	644151.89	4907596.96	INCD GeoEcoMar, HERAS Project	★★★★★		Click to open
Edit View	☐	13-A	Draga 2	28.47.00.00	43.44.10.80	643609.88	4844134	INCD GeoEcoMar, HERAS Project	★★☆☆☆		Click to open

Fig. 2. Data listing module with rating plugin and thumbnail preview. The add, delete, edit and view functionalities are present in this module

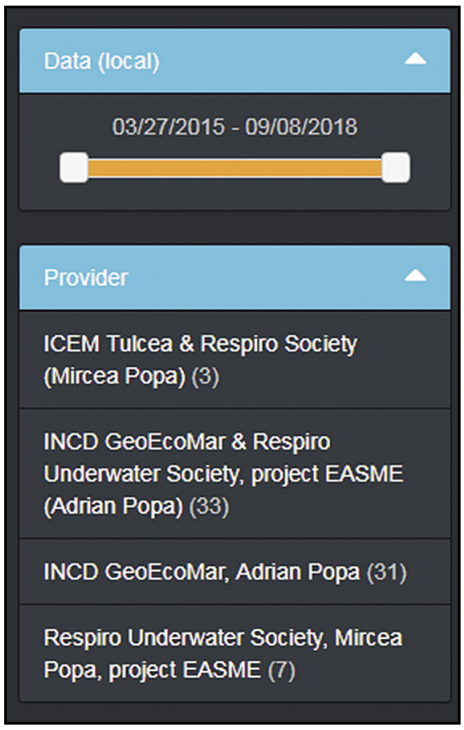


Fig. 3. Rapid search module with predefined criteria

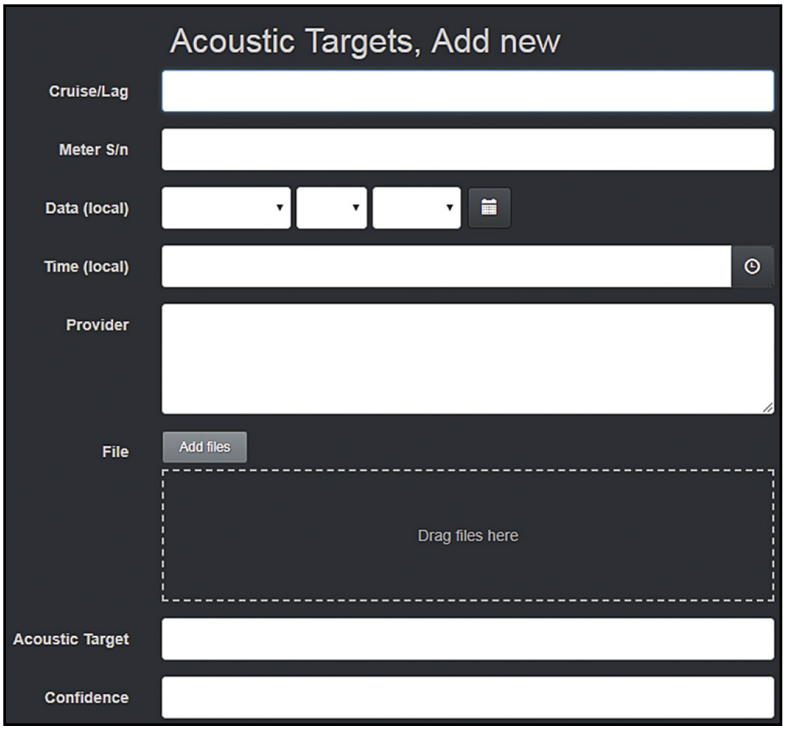


Fig. 4. Data add module with various validation modules

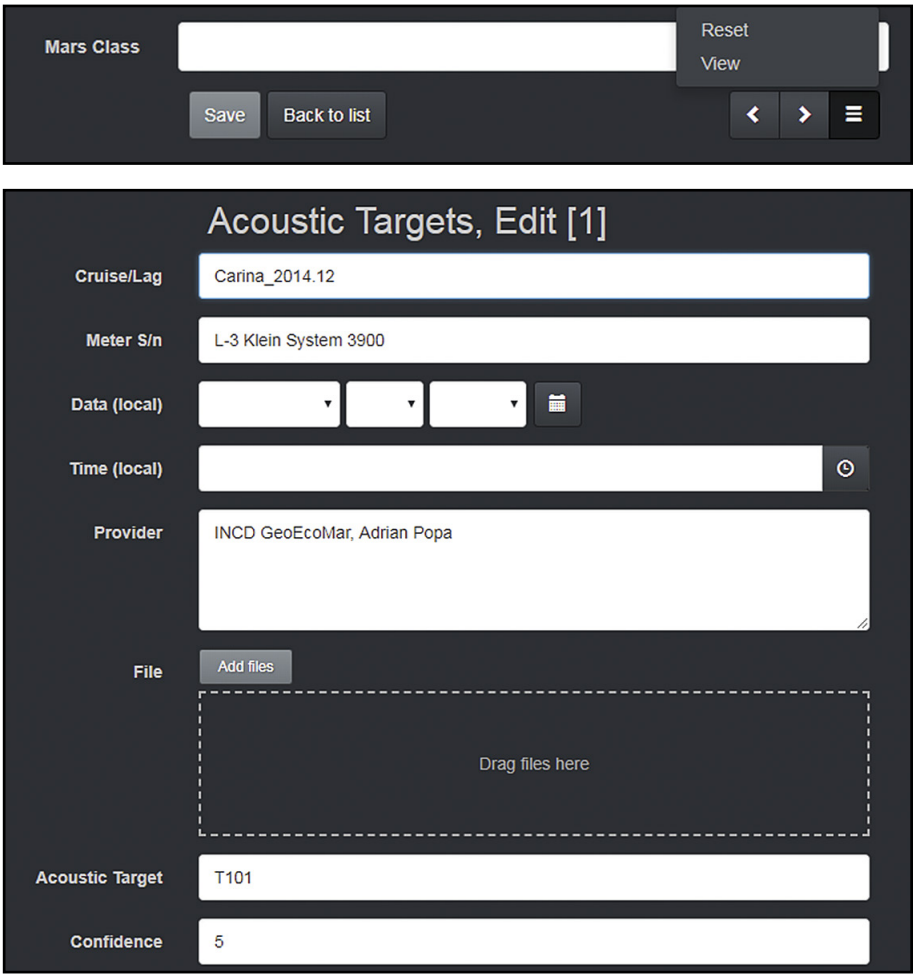


Fig. 5. Editing module with shortcut buttons for viewing data

2.4. Visualizing the Data Module

With this module, data sets entered in the database can be viewed. Features such as fast navigation between consecutive data sets and direct editing of data in the viewing window have been added, as shown in Fig. 6 and Fig. 7.

Fig. 6. Shortcut to editing data module

2.5. Database Query Module

Querying the database can be done in two ways:

- Quick queries through the focus of a window displayed directly in the search suggestion module while entering letters that form the search word, and when displaying the results, the search term is bold and displayed in the red color, as shown in Fig. 8.

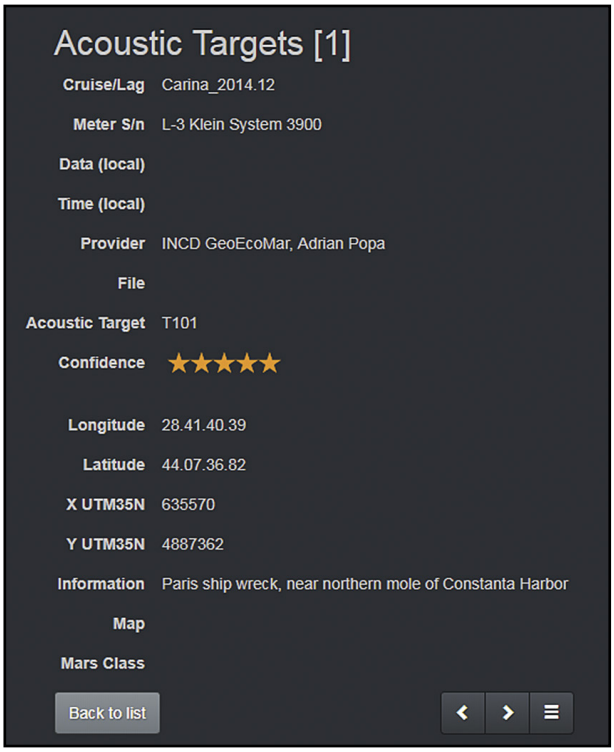


Fig. 7. View data module with rating plugin

		Name	Description & Information	Longitude	Latitude	X UTM35N	Y UTM35N	Provider	Confidence	Link	Map
Edit View		5-A	Portița	29.00.30.00	44.40.30.00	659180.08	4948809.92	INCD GeoEcoMar, HERAS Project	★★☆☆☆		Click to open

Fig. 8. Quick search results with search term visualization

- Advanced query through a separate window. The facilities offered are search by multiple criteria simultaneously and the introduction of a set of logical operators in the query, as shown in Fig. 9.

2.6. Export Data Module

This module (Fig. 10) provides export facilities for a selection of data, all data, individual fields of interest, choice of data separator, and export in various formats: excel, xml, table word, etc.

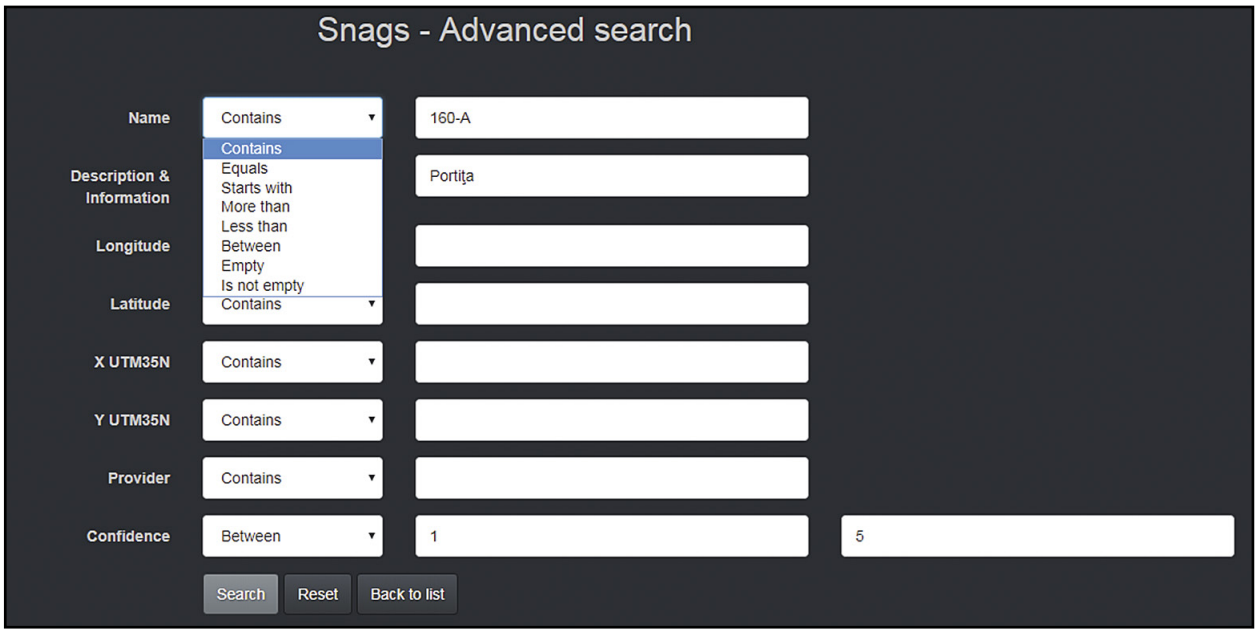


Fig. 9. Advanced search interrogation window

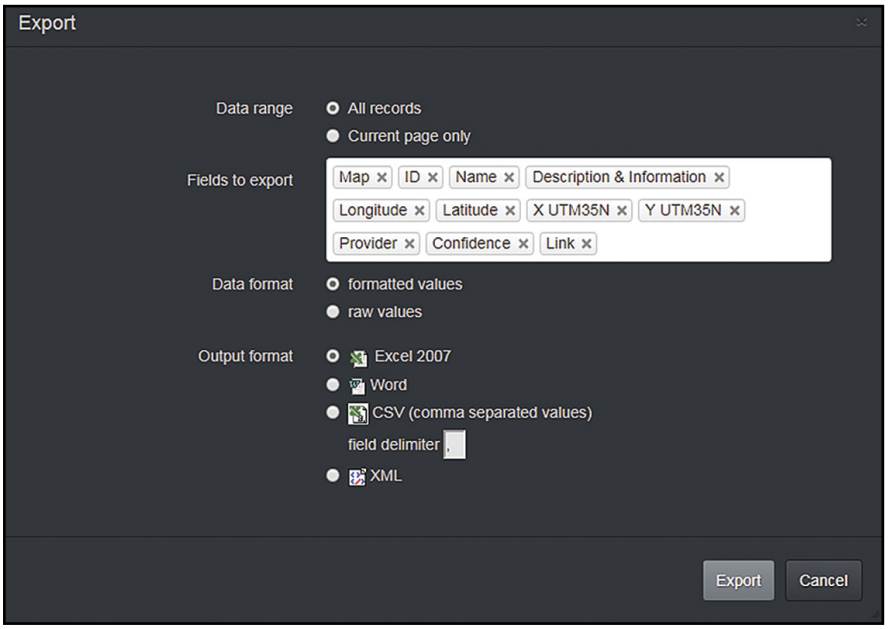


Fig. 10. Export data module with various export data options

2.7. Import Data Module

With this module (Fig. 11), it is possible to import already existing datasets into the database with respect to the tabletop structure existing in the database and data formats agreed by the database. Import can be done directly from excel and csv files or copy / paste.

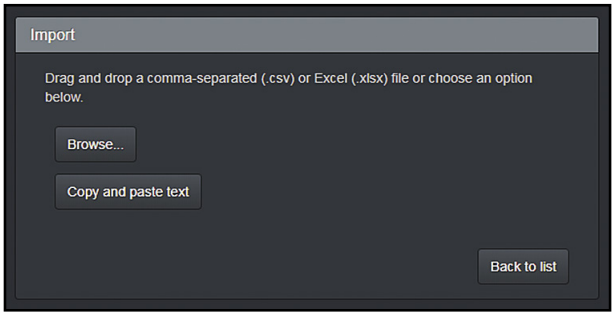


Fig. 11. Import Data Module with various options

2.8. Printing Data Module

This module (Fig. 12) provides a printer-friendly functionality of data sets by printing without background colors, buttons, etc.

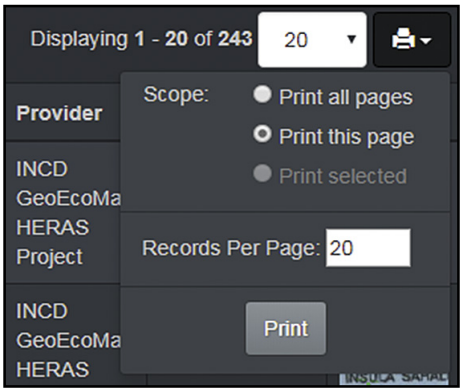


Fig. 12. Printing data module

2.9. Access Menus

The application has two types of menus:

- a "dashboard" type that also represents the point of entry into the interaction with the database, as shown in Fig. 13:
- a horizontally classic one, as shown in Fig. 14 below:

2.10. Access Rights Managing Module

This module allows creating users, allocate users to access groups, and give group access rights for each section, as shown in Fig. 15 below:

Access rights can be given globally or individually and individuals can belong to many than one group inheriting the access rights of this group (deny rule in one group precede access right in another group)

2.11. Entering Data for being processed by Users Module

Through this module, users can enter data into a special database storage section, data to be processed by those with associated access rights - they are notified by email when users enter data sets for processing. Each user can see all datasets entered, and those who process the data can see all the data sets introduced by all users, as shown in Fig. 16:

2.12. Audit Module

Through this module, all of the actions taken on the database are logged: logging / deleting users, action taken on the database. The IP, date, user name and action taken are logged, as shown in Fig. 17.

The application database is common to the OpenGeo server that renders the maps based on the data. The web interface provides a very easy way for operators to add, edit and search data that will be displayed in the OpenGeo server. The database is unique in this approach because no specialized help is needed in populating the database.

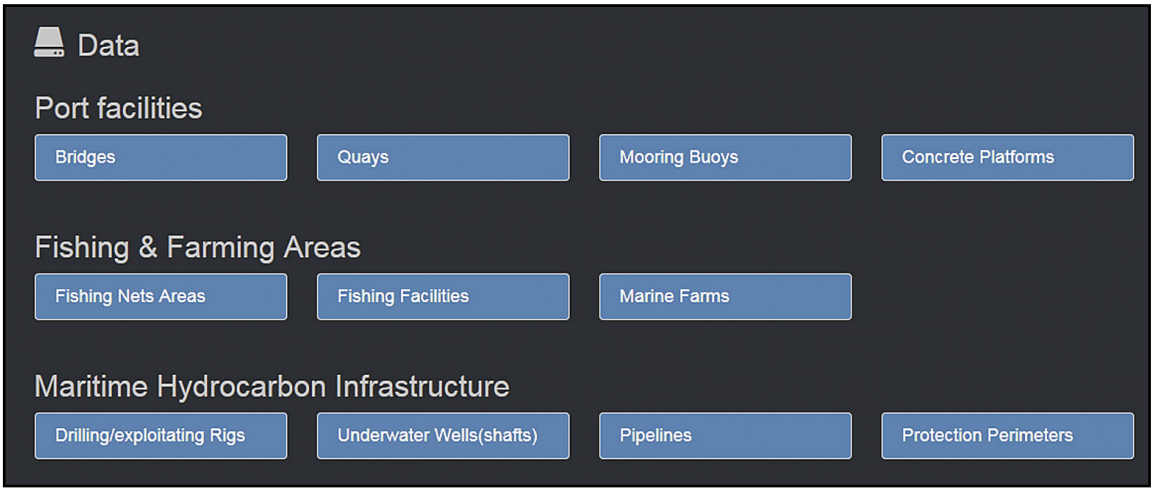


Fig. 13. Dashboard menu with access to database sections

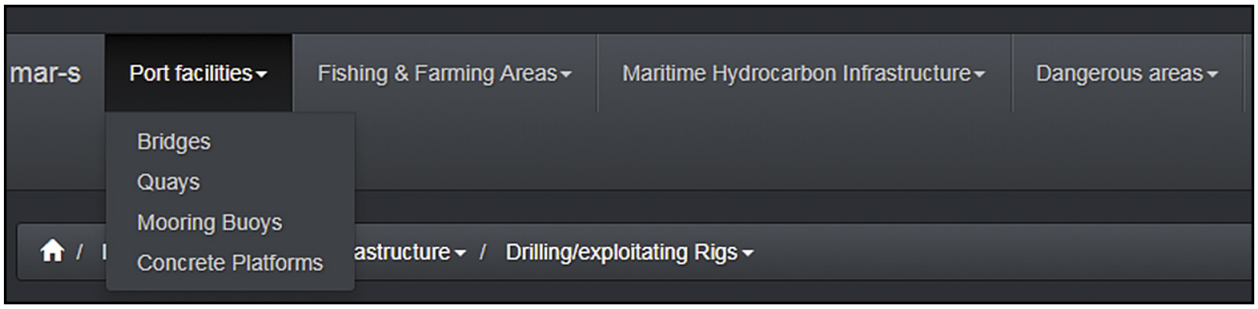


Fig. 14. Horizontal menu with access to database sections

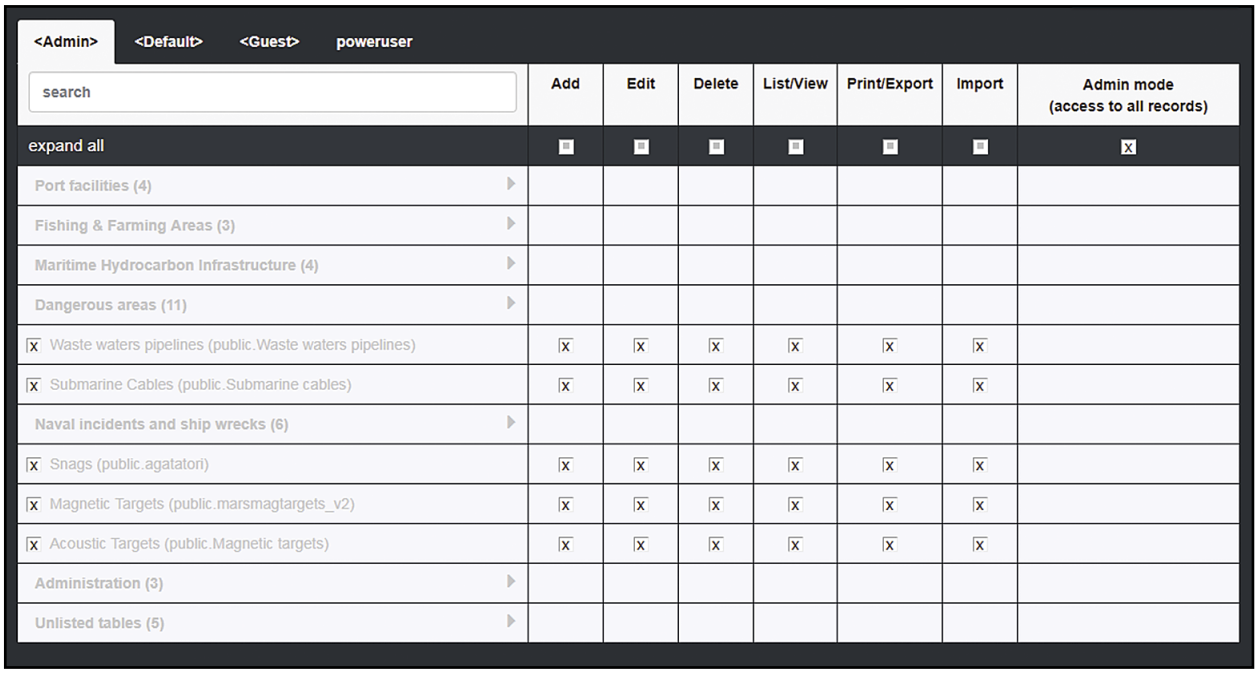


Fig. 15. Access rights module

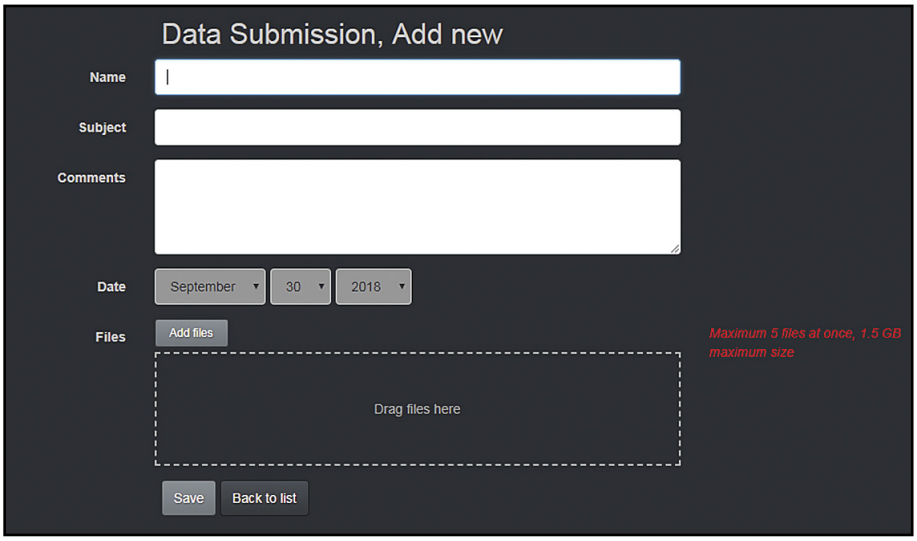


Fig. 16. Data submission module

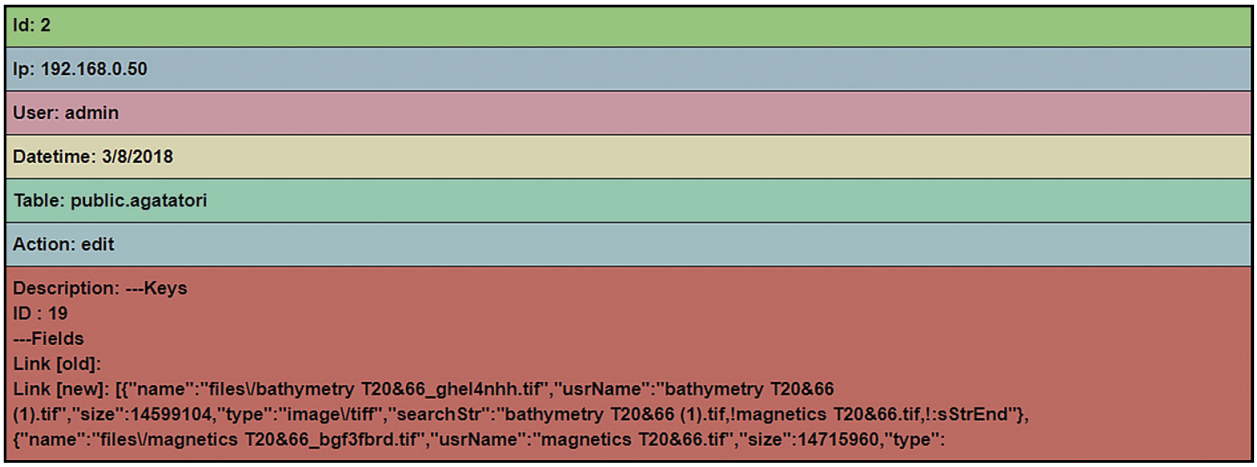


Fig. 17. Access and actions login screen

The access interface, programmed in the most modern web technologies, provides convenient access to data sets and, in addition, can be used as a quick and easy method for entering / modifying the data sets needed for map rendering. After minimal training, any person with average PC knowledge can work with the data sets needed to generate maps within the MARS project.

3. CONCLUSION

The main results of the MAR-S project, including the access to the GIS database, which is hosted on one of NIRD GeoEcoMar's servers, are now available via internet (https://gis.geoecomar.ro/marss/). The access to selected information is widely granted for any interested user, while the access to sensitive information is only open to well pre-defined users who valorize it for the enhancement of the maritime space security.

The database is unique in its purpose by gathering data from various military and civilian sources providing a unifying framework to display Black Sea Romanian shore hazards that otherwise would have to be searched in different institutional databases.

In the event that someone is interested in its activities about the hazards to the Black Sea shores they can ask access to the data relevant to them and see where this hazards are located based on the geographical coordinates (approximate or precise based on security protocols)

An innovative element related to this database is its presentation like a web based application that can be very easily (with basic training) interrogated by any user that wants access to the database.

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