

## AUTONOMOUS TECHNOLOGIES – A NEW APPROACH TO THE DEVELOPMENT OF HYDROGRAPHY

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### Abstract:

Through their role, hydrography and oceanography contribute to the safety of civilian and military vessels, by constantly monitoring routes and navigation areas and mapping the body of water's depth, the shape and patterns of the coastline, physical characteristics, and possible navigational hazards posed by submerged bodies. At the same time, it plays an important role in guiding all of the important actors involved in the maritime industry, area management, coastal engineering, commercial fishing, dredging projects, and many other activities. Real-time data from sensors installed in the marine environment or obtained as a result of hydrographic surveys, represent an important support for the specific product development such as navigation charts or different types of forecasts.

In this context, hydrography through national hydrographic offices plays a key role in maritime security and operational oceanography. For the North-Western Black Sea shelf, the Romanian Maritime Hydrographic Directorate (MHD), as a national authority in oceanography and hydrography, follows the implementation of innovative procedures and techniques to increase the regional autonomous capabilities. To comply with the international regulations, MHD is permanently upgrading its infrastructure to perform hydrographic and oceanographic surveys to provide high-resolution data. In addition to the use of these data in specific activities, in most cases, they could also represent a national contribution to major projects developed at the regional or global level.

### INTRODUCTION

The methods and procedures underlying the activity of hydrographic services are characteristic of public service and are different from those of research institutes whose various objectives are generally oriented towards research projects that are usually carried out over a short period. At the same time, it can be said that the relevance of hydrographic and oceanographic data can only increase insofar as they come from surveys that involve their systematic collection in a certain area, over a long period. These requirements are, moreover, specific to operational oceanography whose activities are closely related to the measurements performed over a long period of time in a systematic manner, as well as their rapid interpretation and dissemination.

Furthermore, the quality of the data obtained, depends to a large extent on the accuracy which they are collected, and where the sensor's performance is essential, as well as on the accuracy which these data were georeferenced. The products resulting from the processing of these data will have to show exactly their spatial distribution and, if necessary, their temporal variations.

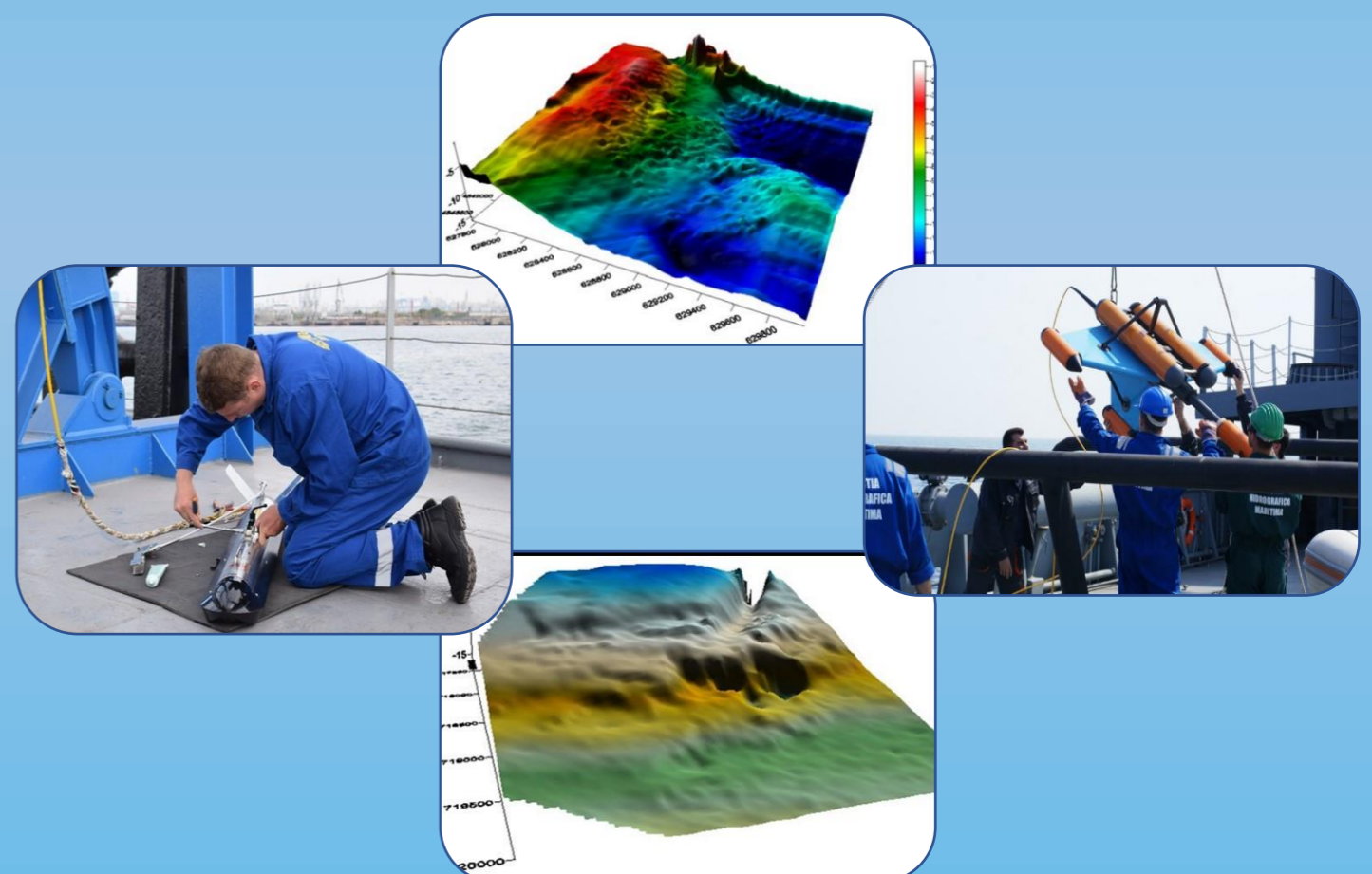
In Romania, the national hydrographic service, known as Maritime Hydrographic Directorate (MHD), supports safe and efficient navigation, fosters national maritime development, facilitates the protection of the marine environment. As the authority in the field of maritime hydrography, MHD also supports national security and maritime defense through hydrographic surveys that support submarine operations or mine clearance.

### RESEARCH

To expand its database and obtain a sufficient amount of data, for improving the process of designing and providing hydrographic and oceanographic products, MHD follows the requirements of national and international standards and has set as the main objective, the development of a new efficient method of obtaining relevant data. Regarding today's conditions and associated risks, autonomous technologies are of high interest, so that a reconsideration of how some missions are carried out, including those of hydrographic surveys, is necessary.

Autonomous and unmanned surface or underwater platforms (Autonomous Surface Vehicle – ASV, Unmanned Surface Vehicle – USV, Autonomous Underwater Vehicle – AUV) offer a variety of design solutions in the construction of the hull and propulsion: single hull, double hull with a screw or screwless propulsion with a small draft (Romano e Duranti, 2012). Modern technologies have allowed for the development of small-size vehicles with a lower build cost, allowing the deployment of more units for a single mission, in a relatively short period.

Bathymetric surveys being part of hydrographic measurements, that aim at measuring the seabed topography, require a high positioning accuracy (\*\*IHO, 2008). Hence the use of unmanned boats in hydrography can now be regarded as the beginning of a new era in this field (C. Specht et al., 2017). In this regard, the International Hydrographic Bureau - IHO suggests that hydrography will provide tests for the proper use of these technologies, as well as increase the coverage of properly supervised areas.



MHD's hydrographic products and data acquisition systems



RHV "Cpt. Cdor Al. Cătuneanu" and hydrographic boats

Taking into account the advantages deriving from the use of autonomous technologies, MHD will develop a new autonomous operative component by adopting the following directions:

- Supplying the departments in charge of survey planning and data collection, with autonomous equipment, to expand the research areas and to acquire a large volume of relevant data. So, for the next two years, at the MHD level, the implementation of an extensive endowment plan has started, which includes the following elements: underwater gliders, unmanned hydrographic survey boat systems, autonomous underwater vehicles (AUV), and combined sonar systems. A complex training program for MHD specialists will also be considered since the autonomous systems require skilled personnel. Also, a great advantage in the operation of these systems is the fact that MHD has its capabilities to produce high-resolution electronic charts. As a result, the acquired data will benefit from a high-quality reference. The deployment and operation of the autonomous systems will be done onboard the Research Hydrographic Vessel "Cpt. Cdor. Al. Cătuneanu" and the other three hydrographic boats;
- Development of autonomous boats, that will later be equipped with hydrographic and oceanographic sensors, together with partner universities and research centres. Thus, through its Research - Development and Innovation Center, MHD in partnership with universities and research centers will initiate research projects that will aim to develop USV and AUV marine platforms with improved characteristics;
- Involvement at the national level, in joint projects and missions, of the institutions that have such technologies, to carry out activities that impose a high degree of risk. Here, it is taken into consideration: discovery, identification, and classification of submerged objects, that constitute potential dangers for navigation.

Simultaneously with the implementation of new autonomous technologies, MHD will go through the stages of harmonization and development of its own hydrographic and oceanographic database, to achieve WEB-GIS operational services to improve METOC, ASW, and MCM products, necessary for Navy specific missions.

### CONCLUSIONS

Autonomous systems have a great potential to improve the efficiency of hydrographic surveying, also, the low costs required to carry out hydrographic surveys in certain hard-to-reach areas (shallow depths or with navigation obstructions), are an important criterion to take into account.

Likewise, obtaining a large volume of data in the conditions of using a small number of specialists is the main goal of using autonomous technologies. Starting with the clear definition of the elements involving specific procedures and risk management, it is expected that the activities of oceanographic and hydrographic data collection will be done in the most efficient way possible.

At the same time, the corresponding structure of the database, in which the collected data will be found, will allow the efficiency of obtaining specific products even in the conditions of exceptional cases.