



# Infrastructure for Sustainable Development of Marine Research, Including the Participation of Bulgaria in the European Infrastructure Euro-Argo



Atanas Palazov<sup>(1)</sup>, Snejana Moncheva<sup>(1)</sup>, Elisaveta Peneva<sup>(2)</sup>, Ivan Ivanov<sup>(3)</sup>, Rumen Kishev<sup>(4)</sup>, Elitca Petrova<sup>(5)</sup>, Peycho Kaloyanchev<sup>(6)</sup>, Christo Pirovsky<sup>(7)</sup> and Dimitar Stavrev<sup>(8)</sup>

(1) Institute of Oceanology, Varna, Bulgaria ([palazov@io-bas.bg](mailto:palazov@io-bas.bg)), (2) Sofia University "St. Kliment Ohridski", (3) National Institute of Meteorology and Hydrology, (4) Bulgarian Ship Hydrodynamics Centre at IMSETCHA-BAS, (5) "Nikola Vaptsarov" Naval Academy, (6) Institute of Fishery Resources, Agricultural Academy, (7) Technical University – Varna, (8) Medical University – Varna

## Abstract

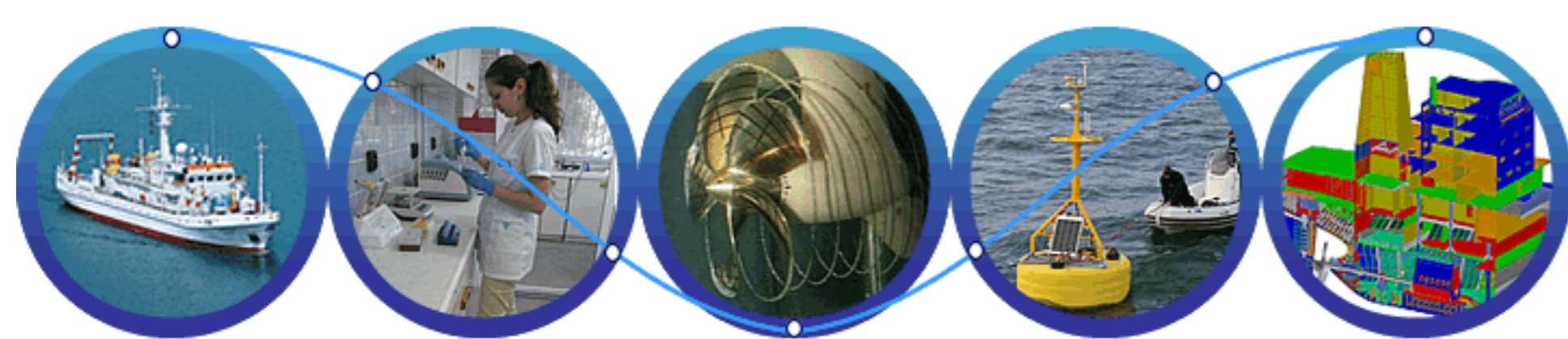
MASRI – Infrastructure for Sustainable Development of Marine Research Including the Participation of Bulgaria in the European Infrastructure Euro-Argo is a project of the National roadmap for scientific Infrastructure (2017-2023) of Bulgaria. The mission of MASRI is to build and utilize a modern research infrastructure which will provide the basis for highly efficient marine and maritime research to expand our knowledge of the marine environment and to support blue growth and implementation of marine policy and maritime spatial planning in order to achieve UN Sustainable Development Goal 14: Conservation and sustainable use of oceans, seas and marine resources for sustainable development.

MASRI activities include modernization of existing unique resources and equipment and establishment of new facilities. The research infrastructure consists of four main modules: Research fleet; National Operational Marine Observing System – NOMOS; Data and information center and Research laboratory complex, each representing a distinct on functional basis part of the scientific infrastructure, and consists of separate components distributed physically in different scientific organizations, in the city of Varna. Thus, MASRI is intended to be a large-scale, interdisciplinary multifunctional (physics, chemistry, biology, geology, aquacultures, medicine, energy, underwater and offshore technologies) marine research infrastructure of scientific significance and will provide unique facilities (including databases and computer network) which will be widely accessible on national, regional and international level for multidisciplinary researches.

Research vessels are intended to provide access to the investigated medium – the sea and they are providing a working platform for conducting research. NOMOS is a system of systems to measure in situ parameters of marine environment and surrounding atmosphere. It is designed to provide information on the state of the marine environment for scientific research, forecasting and marine industry. Data and information center provide a computing environment, communication environment and environment for quality control and reliable storage of data and information within the scientific infrastructure. Research laboratory Complex represents a system of research laboratories for chemical, biological and geological analyzes and for relevant research on marine medicine as well as of laboratories for marine resources and technologies research.

As an important module of MASRI, NOMOS includes several components: BulArgo – a system of profiling floats to measure the profiles of the characteristics of the marine environment in the depth up to 2000m; waves and currents monitoring system; national sea level observing system; moorings network; coast research bases and metrological control laboratory.

MASRI is also intended to support participation of Bulgaria in European research infrastructure consortia Euro-Argo ERIC. At least of three floats are provided and launched in the Black sea every year in the frame of BulArgo project. Thus, BulArgo gives important contribution to Argo program in particular in the Black sea, providing significant volume of very important in-situ data both for climatic research, for assimilation into the models and verification of the forecasts.

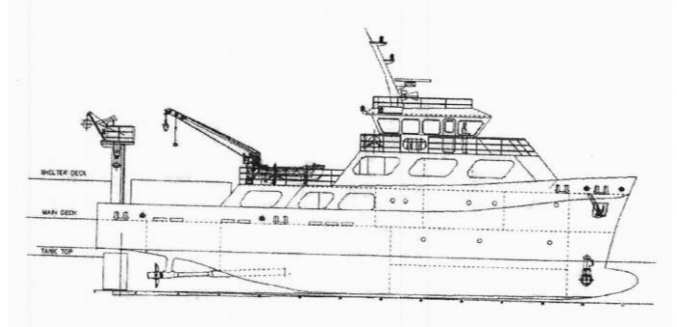


## Four main modules of MASRI

- Research Fleet;
- National Operational Marine Observing System – NOMOS;
- Data and information center;
- Research Laboratory Complex.

## Research Fleet

- **Regional RV "Akademik"** – a regional class research vessel which provides research in the Black Sea. Part of the European research infrastructure EUROFLEETS – Envisaged replacement.
- **Small RV "Izsledovatel"** – modern, highly effective research vessel, optimized for near the coast and shelf zone researches. Part of the European research infrastructure EUROFLEETS – Planned to be built.
- **Vessel for underwater research and technological operations** – support of the scientific research activities in the area of marine science and technology – Envisaged modernization.
- **Research submarine PC-8B** – allows operation of a scientific crew of 3 people to a depth of 250 meters. Part of the European research infrastructure EUROFLEETS – Envisaged modernization.



## National Operational Marine Observing System – NOMOS

NOMOS is a system of systems to measure in situ parameters of marine environment and surrounding atmosphere. It is designed to provide information on the state of the marine environment for scientific research, forecasting and marine industry. NOMOS includes several components:

- **BulArgo** – a system of profiling drifting buoys to measure the profiles of the characteristics of the marine environment in the depth up to 2000m. Part of the European research infrastructure EuroARGO – Envisaged modernization.
- **Waves and currents monitoring system** – Part of the European research infrastructure JERICO – Planned to be built.
- **National sea level observing system** – Part of the European research infrastructure JERICO – Envisaged modernization.
- **Moorings network** – Part of the European research infrastructure JERICO – Envisaged modernization.
- **Coast research bases** – research complexes for marine coastal research and monitoring – Part of the European research infrastructure JERICO – Envisaged modernization.
- **Metrological control laboratory** – provides accurate measurements by metrological control of the used sensors. Part of the European research infrastructure JERICO – Planned to be built.

## Data and information center

Provides a computing environment, communication environment and environment for quality control and reliable storage of data and information within the scientific infrastructure. Includes three components:

- **National Oceanographic Data and Information Center – BGODC** – Provides centralized national storage, processing and presentation of oceanographic data. Provides national and international exchange of oceanographic data. Part of the European research infrastructure SeaDataNet – Envisaged modernization.
- **High Performance Computing Simulation Facility** – provides powerful computational resources of the consortium members in solving complex problems in computational mathematics, hydrodynamics and marine information technology – Planned to be built.
- **High speed communication environment** – provides high-speed communication medium between components and modules of the scientific infrastructure, thereby ensuring its coherence and virtual connectivity in terms of physical distribution – Planned to be built.

## Research Laboratory Complex

Research laboratory Complex represents a system of research laboratories for chemical, biological and geological analyzes and for relevant research on marine medicine as well as of laboratories for marine resources and technologies research. The complex includes the next components:

- [Marine Chemical Laboratory](#)
- [Laboratory of Marine Biology and Ecology](#)
- [Marine Geological Laboratory](#)
- [Marine Genetics Laboratory](#)
- [Laboratory for Marine Living Resources](#)
- [Marine Medicine Laboratory](#)
- [Laboratory for Marine Renewable Energy Resources](#)
- [Underwater Technology Laboratory](#)
- [Diagnostics of Ship Structures and Equipment Laboratory](#)
- [Underwater Cutting and Welding Laboratory](#)

## First activities and results

1. Two Argo floats (one with DO sensor) were delivered and deployed in the western part of the Black Sea in 2019. In 2020 another three floats (two with DO sensor) will be delivered and deployed. For the needs of the MASRI Argo Scientific Program, buoys provide researchers with an irreplaceable data set to study the seasonal and interannual variability of Black Sea water mass characteristics.
2. A Cytosense Flowcytometer was delivered for the needs of marine biology laboratory. This state-of-the-art apparatus will allow the introduction of a methodology for real-time in situ analysis and in the deferred mode of the qualitative structure of phytoplankton communities throughout size spectrum (from picoplankton to microphytoplankton) as a key component of the creation of an Integrated System for Early Diagnosis of Phytoplankton Blooms (HAB) and improvement of the MSFD monitoring programs.

## MASRI PARTNERS

- INSTITUTE OF OCEANOLOGY – Bulgarian Academy of Science (IO-BAS) – Coordinator
- SOFIA UNIVERSITY "St. Kliment Ohridski" (SU)
- NATIONAL INSTITUTE OF METEOROLOGY AND HYDROLOGY (NIMH)
- BULGARIAN SHIP HYDRODYNAMICS CENTRE AT IMSETCHA-BAS (BSHC-BAS)
- INSTITUTE OF FISHERY RESOURCES – AGRICULTURAL ACADEMY (IFR)
- NIKOLA VAPTSAROV NAVAL ACADEMY (NVNA)
- TECHNICAL UNIVERSITY – VARNA (TU – Varna)
- MEDICAL UNIVERSITY – VARNA (MU – Varna)

