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Uncrewed Surface Vehicles Network in support to EOOS: The EuroSea project

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***Abstract* –A wide range of platforms and systems constitute the current Global Ocean Observing System (GOOS) including satellites, research vessels, floats, underwater gliders, fixed-point observatories, sea level stations, high frequency radar and uncrewed surface vehicles. The European Ocean Observing System (EOOS) is designed to align and integrate Europe's ocean observing capacity, promote a systematic and collaborative approach to collecting information on the state and variability of our seas, and underpin sustainable management of the marine environment and its resources. EOOS attempts to link the currently disparate observing system components and promote novel technology and infrastructure development, standardization, open access to data, and capacity building. Within the framework of EOOS is the EU-funded EuroSea project, with the overall goal to consolidate an integrated interdisciplinary ocean-observing-system to deliver essential information for the wellbeing, blue growth and sustainable management of the ocean, based on the implementation and coordination of the different observing networks above-mentioned, being the Uncrewed Surface Vehicles (USV) technology one of the novelties in terms of network initiative attempting to engage existing and forthcoming actors from public and private sectors, to consolidate an international USV network under common standard operational procedures and regulatory framework in support to EOOS strategy.**

***Keywords* –** *USV, ASV, network, EOOS, ocean, EuroSea.*

I. THE EOOS FRAMEWORK

The Ocean Observing System includes different networks, integrating their data output in assimilation centers that feeds into the assimilation and forecast systems. A wide range of platforms and systems constitute the current global ocean observing infrastructure, including satellite observations, research vessels, autonomous floats, underwater gliders, fixed-point observatories, sea level stations, high frequency radar and autonomous surface vehicles [1]. Currently the ocean observing system remain largely immature and is composed of a large and diverse set of actors, such as research institutes, governmental agencies and the private sector [2]. The European Ocean Observing System (EOOS) is a coordinating framework designed to align and integrate Europe's ocean-observing capacity, promote a systematic and collaborative approach to collecting information on the state and variability of our seas, and underpin sustainable management of the marine environment and its resources. An overarching strategy across all measurement platforms is required to ensure that best use is made of limited resources in Member States and at European level [3]. EOOS attempts to link the currently disparate components of the observing system in Europe and promote novel technology and infrastructure development, standardization, open access to data, and capacity building.

Fig. 1. Conceptual approach of the Global Ocean Observing System based on existing monitoring technologies.

Within the framework of EOOS is the EU-funded EuroSea project, with an overall goal about to consolidate a more integrated interdisciplinary ocean observing system able to deliver essential information for the wellbeing, blue growth and sustainable management of the ocean, based on the implementation and coordination of the different observing networks above-mentioned. The USV technology is one of the main novelties in terms of network initiative that attempts to engage existing and forthcoming actors from public and private sectors, to set and coordinate current and upcoming efforts in order to establish and consolidate a recognized international network under common Best Practices and Standard Procedures in support to EOOS strategy.

II. USV TECHNOLOGY

Transition from research concept to commercial product and related services has not always been easy in most cases due to technology, business and policy framework constrains. Unmanned Surface Vehicles (USV) is one of the right domains to illustrate this evolution [4] [5]. Starting as small custom-prototypes operating near shore for survey and research applications to evolve a more complex and capable platforms able to operate also in highly demanding specific-scenarios or open-ocean areas for long periods in routine-fully-autonomous mode as single unit or fleet configuration [6] [7] [8]. This has enabled to pave the way to release a first approach on small and large-scale autonomous ships implementation as ultimate step in maritime autonomy.

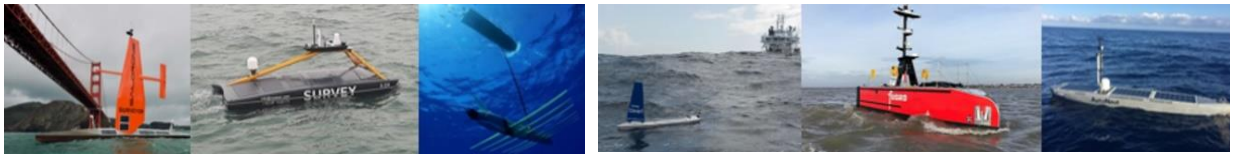

Fig 2. Some of the USV technologies currently available for ocean-observing.

Technology developments enabling USV include a multidisciplinary set of cutting-edge sensors and systems for guidance, navigation, control, telemetry, propulsion, path planning, as well as specific tools for oversight operations and situational awareness, being key the inclusion of machine/deep learning and artificial intelligence techniques. USV capabilities and applications include nowadays a wide range of operations and services addressed to cover specific needs from marine and maritime sectors. The policy and regulatory environment of USV is being developed at high and global level by IMO for MASS implementation [9] [10]. We are nowadays facing a step further towards a new paradigm associated with cyber-physical systems, big data and autonomy as part of Shipping 4.0 and Digital Ocean international trends and strategies. Efforts in transport cost reduction, the global need of minimize emissions and the demand for improving safety at sea are three base reasons on why autonomous shipping is under consideration and early stages of implementation. The development and future implementation of vessels as MASS (Maritime Autonomous Surface Ship) will represent an inflexion point for the paradigm shift in the industry and maritime shipping system as a whole. Industries related to high specialized technology base sectors such autonomy and automation, unmanned operations, big data, artificial intelligence, machine learning, enterprise-grade connectivity and analytics will be essential. As ultimate regulator responsible for the COLREGs, the International Maritime Organization (IMO) in 2017 agreed to include marine autonomous surface ships (MASS) in agenda and started with a scoping exercise to determine how the safe, secure and environmentally sound operation of MASS might be introduced in IMO policies and rules.

III. ACKNOWLEDGEMENTS

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