Case Study: Uncrewed Surface Vehicles (USV) for a more efficient and sustainable ocean observing strategy.

A long-range scientific-technical mission to take the pulse of the East-Central North Atlantic region in support to the MSFD strategy and beyond.

Why to observe the ocean? The European Ocean Observing strategy.

The ocean plays a key role in many human activities such coastal protection, tourism, search and rescue, defence and security, shipping, aquaculture and fisheries, offshore industry, and marine renewable energy, among others. Ocean observation enables us to better understand ocean functions and meet societal needs related to these activities.

The Intergovernmental Oceanographic Commission (IOC of UNESCO) developed the Global Ocean Observing System (GOOS) more than two decades ago in order to coordinate different national efforts in terms of sustained ocean observations throughout the world and to maximize the societal benefits of ocean observations.

The GOOS has three observation panels for the development of observing strategies for climate, biogeochemistry and biology/ecosystems and the Observation Coordination Group (OCG) of the World Meteorological Organization (WMO), Intergovernmental Oceanographic Commission (IOC) Joint Commission on Oceanography and Marine Meteorology (JCOMM) for technical coordination of on-going observations.

GOOS also act as the ocean component of the Global Climate Observing system (GCOS) implemented through GOOS Regional Alliances and supported through a wide range of bodies, such as the Committee on Earth Observing Satellites (CEOS), the Partnership for Observation of the Global Ocean (POGO) and the GEO Blue Planet initiative.

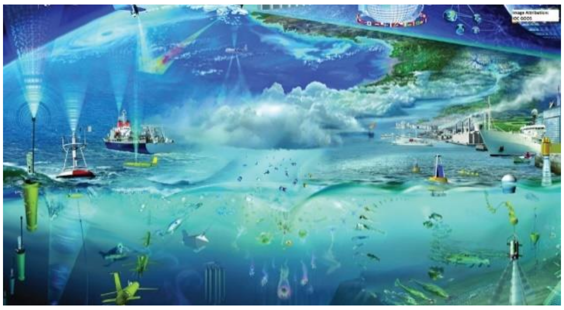

Figure 1 Current conceptual approach of the Ocean-Observing strategy based on autonomous technologies.

In the last two decades, discussions on GOOS highlighted the tremendous potential value for physical, biogeochemical, and biological observations, particularly in the transition between the open-ocean and the coastal environment, which is a key area for societal issues, economical applications and at the same time is a prime area for ocean-glider technology observations.

At EU level, there is currently a strategy managed by EuroGOOS and other agencies and initiatives in order to best coordinate effort through specific programs, research infrastructures and projects at different scales.

Uncrewed Surface Vehicles technology in support to Ocean-Observing strategy

Significant advances in technological disciplines such as electronics, communications, sensors, new materials, etc. have allowed in the last two decades the development of autonomous platforms addressed to progressively replace the exclusive role that research vessels and associated ship-based technologies have undertaken for decades in ocean observing.

Through the last two decades, several Uncrewed Surface Vehicles (USV) developments have been undertaken through public and private initiatives with diverse scope and purpose. After clearly experimental beginnings with limited capabilities in terms autonomy, endurance, payload, power outputs, etc., in recent years significant progress has been made in all USV subsystem components (hull and structural elements, propulsion and power system, GNC, telemetry, payloads, data management and ground station), enabling USV a leading commercial technology solution in several applications and services (some on a routine basis) beyond the military and research.

The initial reference on the path to autonomous ships is technical. The core technologies that enable unmanned vessels has come about largely due to developments in other fields. Improved USV capabilities allow to undertake missions both in coastal and open-ocean areas for long periods of time due to a more efficient power and propulsion systems based in some cases on renewable energy sources (solar, wind, waves).

Figure 2: Main USV commercial technologies for ocean observing.

State-of-the-art broadband telemetry systems enable remote real-time operation and decision-making by the operator. In parallel with the mechanical and electronic system architecture improvements for USVs, software advanced rapidly as well, with special focus on autonomous navigation methods and techniques in compliance and contribution to ocean digitalization and e-navigation framework initiatives.

Many institutions, universities and companies have begun developing and using USVs aiming to cover a wide range of applications and services, evolving rapidly. With growing worldwide interest in commercial, scientific, and military issues associated with both open-ocean and shallow waters, there has been a corresponding growth in demand for the development of more complex USV with advanced guidance, navigation and control functionalities.

An USV is an unmanned mobile that operates on the sea surface without real-time input or control from human operators. The USV is always at the surface, therefore, it can constantly maintain a GPS fix, eliminating the need for dead-reckoning navigation as used by AUVs. ASVs can range from small platforms that carry only one sensor, to large vessels greater than 10 m in length that carry comprehensive sensor suites. Differences in propulsion, as with AUVs, are also seen in different types of ASVs. Some USVs are propelled solely by wind like a sailboat, some use rechargeable batteries, while others are propelled using fuel.

The iFADO mission performance and main derived achievements

As one of the main activities committed by iFADO within the framework of the WP5 (Novel Technologies for Ocean Observing) is the performance of several oceanographic missions using unmanned platforms.

In this context, a long-range scientific mission was conducted to monitor oceanographic and weather parameters between Azores and Canaries. A WaveGlider SV2 USV with a science payload composed by biogeochemical sensors such conductivity, temperature, dissolved oxygen, and physical such passive acoustics, as well as weather sensors (temperature, air pressure, humidity, and wind) was the selected platform.

The mission started in Faial waters and covered a distance of approximately 1980 kilometres connecting Azores, Madeira and Canary Islands. The WaveGlider was piloted 24/7 through WGMS graphic interface by PLOCAN staff and got the support in terms of aids to navigation by real-time information derived by forecasting models provided by some iFADO partners. In addition to this, launching and recovery manoeuvres involved several iFADO partners under PLOCAN coordination as owner of the WaveGlider and WP5 leader.

Figure 3: The WaveGlider SV2 just leaving Faial coast after a successful deployment conducted by iFADO partners.

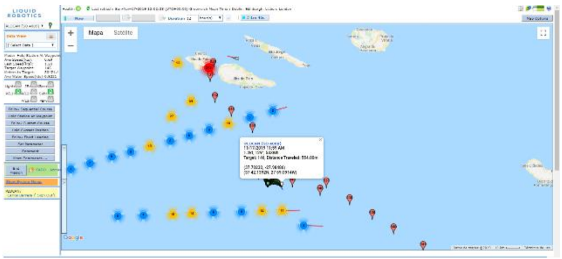

Figure 4: WGMS piloting graphic interface with the real-time location and navigation status of the WaveGlider SV2

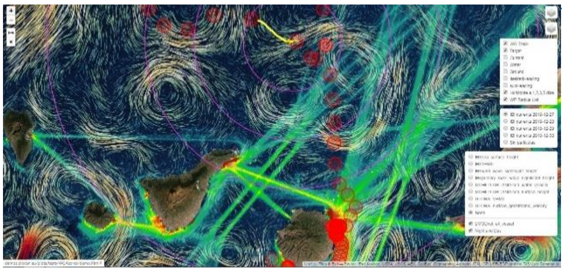

Figure 5: Graphic interface with added information layers such marine traffic, geostrophy, ocean currents, etc.

The mission performance and derived preliminary results were available through the PLOCAN Glider portal http://obsplatforms.plocan.eu/vehicle/USV/71/

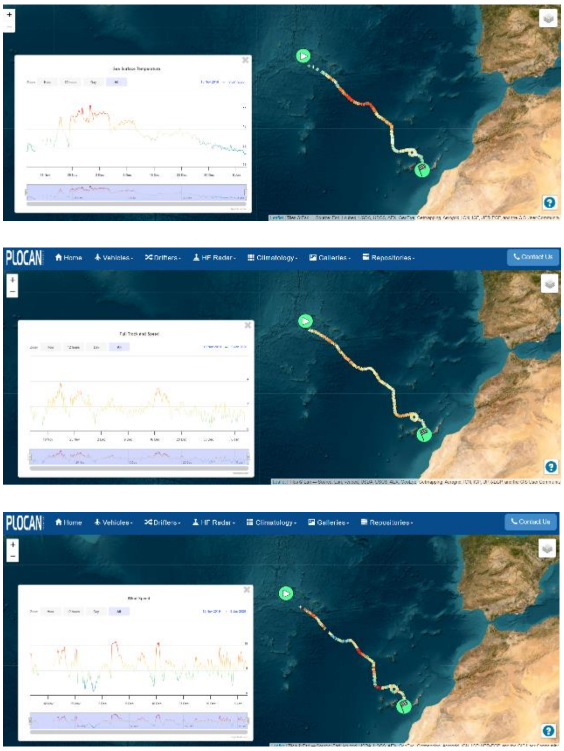

Figure 6: Some of the derived plots in real time from the WaveGlider during the iFADO mission performance

The mission provided a particular partnership framework between iFADO and the JONAS (Joint Framework for Ocean Noise in the Atlantic Seas) project, in terms of passive acoustic monitoring (PAM). A second PAM module provided by University of Algarve was installed in self-contained mode on the WaveGlider and conducted measurements along the whole transect.

After 57 days, the WaveGlider was successfully recovered in waters of the test-site facility of PLOCAN in Gran Canaria. Data were processed and several articles and scientific work have been published.

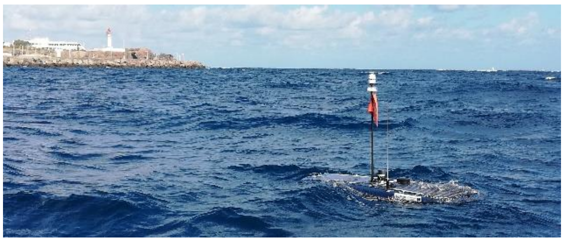

Figure 7: WaveGlider in the surroundings of PLOCAN facilities in Taliarte (Gran Canaria) just before to be recovered after almost two months mission across the Macaronesia region.

Conclusions

The iFADO project has provided an ideal and very fruitful partnership framework in which to use and showcase the benefits of autonomous mobile platforms (in particular, USV technology) aiming to improve the European ocean-observing capabilities in benefit to MSFD.

In addition to this, the conducted mission has brought a great example at EU and international level to identify gaps and weaknesses related on how to design and support long-term programs with this type of novel and cutting-edge technologies, considering the requested multidisciplinary requirements-context.

iFADO Project (EAPA_165/2016)

https://www.atlanticarea.eu/project/14