iFADO Case Study:
ATL2MED mission in Canary Islands

Introduction

ATL2MED is the first mission by two Autonomous Surface Vehicle (USV) from the Atlantic Ocean to the Mediterranean Sea, collecting environmental and carbon data for climate science.

ATL2MED is joined by key European marine research institutions from Germany, France, Italy, Portugal, Belgium, Finland and from Spain with the Balearic Islands Coastal Observing System (SOCIB) and PLOCAN. They provide key technical-scientific infrastructures and reference ocean-observatories, which in the case of PLOCAN includes the test-site facility located in the East coast of Gran Canaria and its ocean-observatory ESTOC.

The mission was taken place during the years 2019-2020: from October 18th 2019, to July 17th 2020, and has been deployed in Canary Islands. This is a public-private partnership between Saildrone (the two USV manufacturer) and 12 oceanographic research institutions and universities from seven countries. The ALT2MED mission needed 679.000 US$ resources and 18 people (scientific and technical profiles).

The mission is part of a European project EuroSea : a European Union Innovation Action funded through the European Commission research funding programme Horizon 2020 under a call supporting the G7

Figure 1: The oceanographic research institutions and universities associated to the mission

Future of Seas and Oceans Flagship Initiative. EuroSea brings together key European actors of ocean observing and forecasting with users of oceanographic products and services and it aims at improving and integrating the European Ocean Observing and Forecasting System. EuroSea had explored the possibility together with Saildrone Inc. to implement this as a service nested in a global ocean observing framework, while developing adequate data dissemination pathways to end-users.

Objectives

There is a growing need to better understand carbon-related processes driven by climate change, and the spatial variability of the CO2 systems in the oceans. This mission was intended to evaluate Saildrone technology as a new autonomous vehicle approach for ocean observation.

The mission was designed to physically approach fixed oceanographic and meteorological observatories along its route, some of which have more than two decades of measurement time series. The Saildrones data will then be compared with those from the fixed measurement stations to assess their quality, with interest in CO2.

The mission was conducted in two phases: Phase 1 was an eddy survey near Cabo Verde led by GEOMAR based in Kiel, Germany. The Phase 2, led by ICOS OTC, focused on cross-calibration of CO2 measurements at nine fixed ocean stations: CVOO (Cabo Verde), ESTOC (Gran Canaria), LION (France), ANTARES (France), DYFAMED (France), W1M3A (Italy), E2M3A (Italy), PALOMA (Italy), and Miramare (Italy).

Mission highlights include the first autonomous passage of the Strait of Gibraltar, the monitoring oceanographic conditions in the area of a tagged sea turtle navigating near the strong anticyclonic eddy south of Ibiza, a saildrone-glider comparison study along the Nice-Calvi Line, and a volcanic impact survey around the Aeolian Islands.

Study area

On July 17, 2020, two Saildrones unmanned surface vehicles (USVs) known as SD 1030 and SD 1053 completed the first-ever Atlantic to Mediterranean mission [Figure2]. This historic nine-month voyage began in Cabo Verde, off the coast of West Africa, entered the Mediterranean Sea through the Strait of Gibraltar, and finished in Trieste, at the top of the Adriatic Sea.

The ATL2MED mission covers 27 810 km of distance sailing for both vehicles combined for a total duration of 274 days [Figure3]. The average speed was 2-3 knots, which corresponds to the average human walking peace. The mission visited 9 ocean stations on its way.

The voyage had to deal with rapid marine growth in tropical waters, crowded shipping lanes in the Strait of Gibraltar, light winds, strong currents, transiting nine different EEZ's and interacting with six different navies. However, despite the challenges, both vehicles arrived in Trieste, having completed all the mission's primary and secondary objectives.

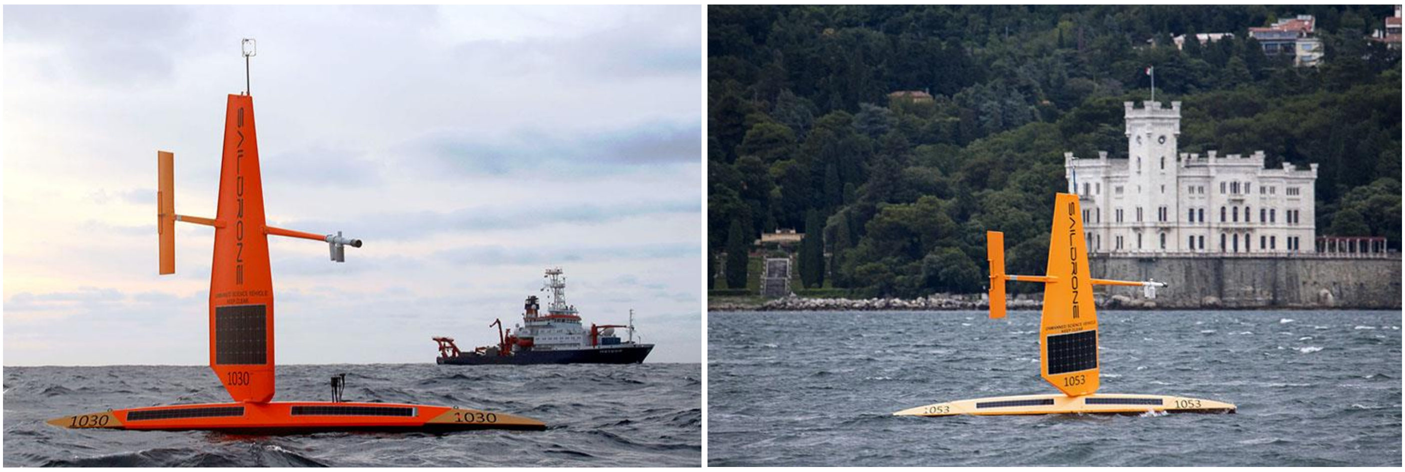

Figure 2: Picture of saildrone SD 1030 in Canary waters (left) and picture of saildrone SD 1053 in Italy waters (right).

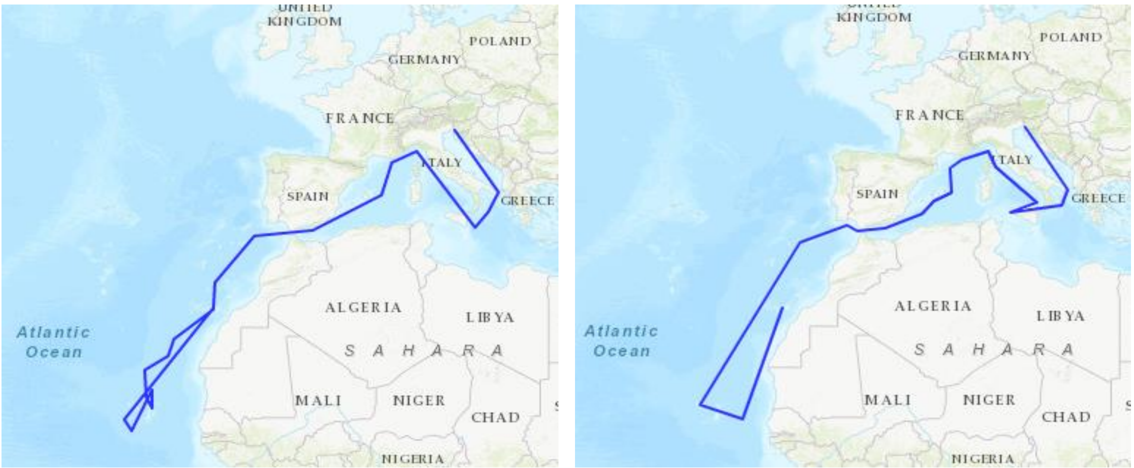

Figure 3: Routes of saildrones SD1030 (leftt) and SD1053 (right)

Data collected

The main aim of the mission was to collect CO2 measurements, but the sensors also recorded acidity, the current velocity and direction, wind speed and direction, relative humidity, barometric pressure, air and sea temperature, salinity, dissolved oxygen, chlorophyll, wave height and period.

In addition to the standard Saildrone sensor suite sold by the enterprise, Saildrone SD-1030 was equipped with a pCO2 sensor suite (ASVCO2, developed by NOAA PMEL) and 300 kHz ADCP (Acoustic Doppler Current Profiler). The Saildrone SD-1053, was equipped with a scientific echo sounder (SIMRAD EK80 WBT mini).

This data set contains Saildrone platform telemetry and near-surface observational data at 1-minute to 1-day resolution in NetCDF format. The data covered a geographical area from Latitude 13.91 to 45.7 and Longitude -25.96 to 18.95.

Lessons learned

STRENGHTS	WEAKNESSES
Scalability of the drone by adding new sensors	High operations cost
Product /service novelty offered	Difficulty with long term durability
Large amount of data retrieved for model's implementation	Technology not available for purchase
Endurance of Dissemination model	

The main difficulties encountered during this mission are related to the length of the route, environmental conditions, other uses of the maritime environment, etc. As related by Saildrone founder and CEO Richard Jenkins: "This voyage has been a great demonstration of the resilience of unmanned systems to continue essential ocean science during troubled times".

This study (or some aspects of it) as being potentially interesting for other regions to learn from, as it has demonstrated:

- → The capabilities and advantages from autonomous mobile platforms for ocean observing applications.
- → The synergies between fix and mobile ocean observing platforms.
- → The engagement and capacity building from international and long-term missions.
- → The key success factors such: mission planning (including permits), data formats, sensor integration, training, new observing network (ASV)

Conclusions

This project participates in the establishment of a true global ocean observation network based on strategic centers. It has allowed, on one side, to connect the maritime countries: Spain (Canary Islands, Andalusia, Balearic Islands), Portugal, Cabo Verde, France and Italy. On the other side it contributed to flagship EU-projects such EuroSea, GROOM II, Mission Atlantic, EUMarineRobots, iFADO, and programs such AtlantOS, EOOS, etc. At this time, the business model approach must be developed for the scientific community and lack of a regulatory framework for operations worldwide makes it difficult to convince large-scale oceanography operations.

ATL2MED mission is a partnership with industry, science community and governmental agencies that offers a significant support to ocean-observing network initiatives, data aggregators and oceans model agencies. By increasing ocean knowledge and derived products for the whole society benefit, it used direct synergies with other ocean-observing technologies/platforms.

Acknowledgements

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Article 3:
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