M5 UNMANNED OCEAN VEHICLES: IMPROVING THE MARINE MONITORING STRATEGY IN THE MACARONESIAN REGION

M. Marqués[139], C. Franco[140], J. Viera[141], A. Lorenzo[142], T. Morales[143], D. Vega[144], C. Barrera[145], M. J. Rueda[146] and O. LLinás[147]

Abstract

Current advances on key marine technology fields provide nowadays a broad range of autonomous unmanned platforms addressed for an efficient and cost-effective monitoring in both coastal and open-ocean areas, with a suitable level of success in terms of endurance, reliability and useful gathered information. Recent examples in this way are the unmanned ocean vehicles able to monitor autonomously the oceans for extended periods of time fitted with different payload sensor configurations to be used for a wide variety of applications. PLOCAN carried out in partnership with international companies, different testing missions in the Macaronesian area with successful and very promising scientific, technical and operational results from these cutting-edge technologies in subtropical areas as they are the surrounding waters of the ESTOC site observatory in Canary Islands archipelago.

Keywords - ASV, glider, ocean observatory, R3M, marine technology, ESTOC.

INTRODUCTION

Ocean observatories play a crucial role in relevant aspects of the climate system on longer time-scales, including among others, global heat budget, sea level rise, potential variations in the meridional overturning circulation, and long-term storage of climatically relevant compounds such as CO2. Expanding the ocean observing system towards being truly global will require an increased commitment to the design and implementation of technologies for collecting offshore and deep ocean data and transmitting them to shore in a useful and cost effective manner.

By definition, ocean observatories [1] usually include a broad and multidisciplinary range of fix and mobile autonomous platforms, from underwater vehicles to sea-bottom seismic networks, including moored surface and subsurface buoys, floats or drifters. Most of them are designed to provide continuous, or at least periodic, field data over a long-time period in near-real time.

The European Station for Time-Series in the OCean -ESTOC- is currently joining the global ocean monitoring strategy as site-partner of baseline initiatives such as EuroSites, ICOS, ESONET or EMSO. Placed sixty nautical miles off Northwards Gran Canaria island at 29º 10' N, 15º 30' W with a depth of 3685 m., is still operational since 1994 through a permanent observing program addressed to monitor biochemical seawater parameters variability over time using a wide in-situ sampling methodologies and instruments i.e. research vessels, VOOP, moorings, turtles, drifters, underwater gliders, among others.

ESTOC is located in the North Atlantic Sub-tropical Gyre and exhibits oligotrophic characteristics. The circulation is driven by the southward-flowing Canary Current and the NE Trade Winds. A clear seasonality is recognizable when upper layer temperature reveals warming during summer season and cooling during winter. Nowadays the site is managed by the Oceanic Platform of the Canary Islands -PLOCAN- through a multidisciplinary set of in-situ monitoring autonomous platforms, where unmanned surface and underwater vehicles develop a special role.

PLOCAN is a multi-purpose public consortium infrastructure engaged for research, technology development and innovation in the marine and maritime sectors. Its main goal is to promote long-term and sustainable ocean observations, providing a cost-effective bend of services as test site, observatory, underwater vehicles base, as well as training and innovation hub.

In this regards, PLOCAN focuses on international and interdisciplinary networking and partnership activities with key-baseline research institutions and companies in the field of marine and maritime technology. Christian Michelsen Research -CMR- Instrumentation and Teledyne Webb Research –TWR- represents suitable examples in this sense. Both are highly specialized company for the design and development of groundbreaking ocean instrumentation specially addressed for harsh environments, being one of its products the autonomous unmanned ocean vessel, SailBuoy and Slocum G2 glider respectively.

PERFORMED MISSIONS

During the last months, some of the newest unmanned glider vehicle technologies have been tested within the context of PLOCAN in varied operational scenarios, aiming different technical and scientific purposes, all of them joined in direct partnership with the company provider and other R&D institutions in some cases. Among others, representative examples in this way are the missions under the name Challenger One and SB02 missions with surface and underwater gliding vehicles, performed mostly in the surrounding subtropical waters of the ESTOC site observatory in the Canary Islands archipelago. The main gathered operational and scientific results from these missions are presented in this work as a sign of new ocean observing technologies within the framework of the Macaronesian Marine and Maritime Observation Strategy (R3M) and linked with the current European programs and projects rules in this field.

Underwater gliders [2] are unmanned autonomous vehicles able to support different payload sensor configurations, addressed for in-situ ocean monitoring within spatial and temporal ranges unable previously in a sustainable way. Base on density concept, no propellers or jets are installed as motion system. The overall vehicle hull allocates navigation, telemetry, board processor, science bay and power as main subsystems components. Commercially available, gliders are able to sample the water column up to 1000 m depth at 25 cm/sec. as mean motion velocity. Though a bidirectional satellite telemetry modem on board, they can be remotely piloted when surfacing for new navigation and sampling commands as well as to provide the gathered data sets. This new ocean monitoring technology offers a wide range of applications, where oceanography, marine pollution and border security are nowadays the main ones. Within this context, the present paper provides a general overview of the the main operational aspects and some "raw" scientific results from a transatlantic partnership mission lead by Teledyne Webb Research, under the name of "Challenger One" with a Slocum G2 glider. The mission started in Reykjavik in June 201 to reach Gran Canaria Island (Spain) in May 2012 for refurbishment tasks and start the second leg ending in Brazil (expected) in July 2013.

Surface vehicles and particularly the SailBuoy, is a small unmanned wind-driven ocean vessel able to travelling across the oceans for extended periods of time. It navigates autonomously, controlled by Iridium satellite link communications, transmitting data in real time underway. Since Iridium is a 2-way communication system, commands such as new waypoints, tracks and sensor parameters can be easily sent to the vessel underway. The SailBuoy can be fitted in a highly modular way with a wide variety of instrumentation payloads able to be used for a broad number of ocean applications. It can easily keep station or travel from point to point. The mission's goal focused on testing and evaluating technical aspects of the navigation and sampling site from the SailBuoy technology for a first time in subtropical areas as it is the Canary Islands archipelago, while to improve the ESTOC's monitoring program strategy. The mission was performed through the surrounding waters of ESTOC site and the channel between Gran Canaria and Fuerteventura Islands with the SailBuoy unit SB02 in November 2012 with a total endurance of 22 days, 406 nautical miles sailed with 0.85 knots as average speed.

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Fig. 1. The unmanned ocean vehicles described: Slocum G2 (left) and Sailbuoy (right)