

## A new glider facility in the SE Bay of Biscay: an opportunity for integrated science

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**Abstract** – The transformative influence of gliders on ocean exploration is already evident. Glider missions silently cover extensive distances and depths with a wide temporal coverage (from week to months of endurance). They employ a unique propulsion system with buoyancy adjustments and battery linear movement-based navigation to perform scientific observations and collect high-resolution multidisciplinary ocean data. The acquisition of a small fleet of gliders at AZTI strengthens the existing coastal observatory, promoting interdisciplinary studies. With the focus of promoting integrated science, several missions have been performed, involving traditional sensors for hydrography and environmental monitoring and some other innovative solutions like an Imagenex 853 echosounder and a SUNA sensor for real-time nitrates monitoring. Efficient and autonomous operations make gliders suitable for enduring research initiatives over long durations and they are expected to play an important role in the coming times in both science and society in the framework of the Pasaia Glider Port.

**Keywords** – Glider, AUV, ocean exploration, high-resolution data, ocean observing system.

### I. INTRODUCTION

Gliders have revolutionized ocean exploration with their unique propulsion system, relying on changes in buoyancy and battery displacement-based navigation for silent and efficient movement. This distinctive capability allows gliders to cover extensive distances and provide high-resolution data on various hydrographic and environmental parameters. They exhibit a minimal carbon footprint in the ocean, becoming environmentally friendly contributors to scientific research and monitoring efforts. Gliders can operate in relatively shallow waters, making them suitable for monitoring coastal regions where traditional platforms (e.g.: research vessels) may have limitations. Therefore, they clearly contribute to the challenge of implementing future Integrated Ocean Observing Systems for coastal monitoring. Perfectly integrating into these systems, gliders enhance data collection, offering real-time insights into coastal dynamics and processes.

Two gliders complete today the capacity of the coastal ocean observatory EuskOOS (<https://www.euskoos.eus/en/>) in the SE Bay of Biscay. Equipped with multidisciplinary sensors, these gliders facilitate studies that integrate different disciplines such as physical oceanography, marine ecosystems, climate change, marine environmental management and sustainable fisheries. The first campaigns performed in the framework of the #ebegi project (<https://www.azti.es/en/proyectos/ebegi/>) have been designed in view of enhancing the integration between the different components of the ocean observation of the Bay of Biscay and the coastal zone for the Basque Country for the development of an optimized observatory. Both gliders (SeaExplorer model, ALSEAMAR), are equipped with a set of multidisciplinary sensors, housed in three different payloads (noses) that can be easily interchanged between the two gliders depending on the aim of the mission. One payload is equipped with a CTD sensor and an echosounder. The second payload is equipped with CTD, biogeochemical and SUNA (nitrates) sensors. The third one is equipped with CTD and BGC sensors.

### II. MISSIONS AND PRELIMINARY RESULTS

The inaugural mission, conducted from September 23 to October 13, 2022, focused on monitoring the migration patterns of European anchovy juveniles in the Bay of Biscay. This mission showcased the capacity for integrating physical oceanography and pelagic fish ecology by combining traditional fishery acoustic methods with glider data. The glider, equipped with the nose housing a CTD and echosounder, executed a transect perpendicular to the Basque coast. This route coincided with concurrent acoustical monitoring carried out by the JUVENA survey [1], an annual ship-based initiative primarily aimed at determining the distribution and abundance of anchovy juveniles.

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In the weeks following the JUVENA survey, the glider continued to collect acoustic data on the water column, providing a temporal and spatial perspective on the migration patterns of anchovy and other fish species. An intense storm occurred during the first days of the glider mission, and the consequent development (and relaxation) of a downwelling event could be monitored in real time. The salinity and temperature profiles showed a marked downlift of the isopycnals of around 20 m in the near-surface water masses at the shelf-break, showing a downwelling event which was also monitored by the HF radar and the coastal upwelling index described in [2]. This collaborative approach between glider technology, the EuskOOS observatory and traditional surveys enhance our understanding of the dynamic movements of marine life in the studied region [3].

The second mission was conducted between November 23 and December 4, 2023, using the payload housing CTD, BGC and SUNA. This mission aimed to assess the glider's performance in sampling the stations routinely covered by in-situ sampling (CTD and water samples for nutrients) by AZTI's *¿?* Climate Change Observatory team [4]. For this mission, two additional Argos tags were appended to the glider antenna in an experiment to compare and calibrate the environmental parameters measured by these tags used to mark, monitor and model upper predators behaviour. Preliminary data showed the influence of an anomalously extended Adour river plume along the Basque continental shelf which depicted high nitrate surface concentrations and map for the first time, at such spatio-temporal resolution and up to 1000m depth, the physical and biogeochemical conditions along the Basque coast.

### III. FUTURE LINES

The establishment of the Pasaia Glider Port has been possible thanks to the HUB Oarsoaldea Urdina project (<https://www.azti.es/en/blue-economy-to-boost-oarsoaldea/>), part of the PAA (Preferential Action Areas) strategy of the Basque Government. The Pasaia Glider Port is a cornerstone of a strategy involving the development of the blue economy in the region by boosting high tech and innovative activities related to coastal ocean operational observation, marine robotics and electrification and decarbonization of ports. In this framework a surface autonomous vehicle equipped with acoustic sensors is expected to be fully operational in 2024.

Thanks to the completion of these two missions, the anticipated advantages of glider technology have been further solidified in the SE Bay of Biscay. Efficient data collection, quick battery recharge, and swift relaunch capabilities enable the establishment of a new Glider Port, which is ready to offer observational services to external users under demand. The plan for a sustained endurance line which will monitor the along shelf-slope seasonal dynamics in the area, related to the Iberian Poleward Current and its variability, is also being delineated.

### REFERENCES

- [1] U. Cotano, M. Santos, X. Irigoien, A. Uriarte, G. Boyra, and U. Marti, "and Spatial Distribution Patterns," vol. 70, pp. 1354–1368, 2013.
- [2] P. Lorente *et al.*, "High-frequency radar-derived coastal upwelling index," *State of the Planet*, vol. 1-osr7, p. 8, 2023, [Online]. Available: <https://sp.copernicus.org/articles/1-osr7/8/2023/>
- [3] I. M. Narvarte, G. Boyra, A. Nieto, B. Sobradillo, U. Martínez, and A. Rubio, "Integrating oceanography and pelagic fish distribution in the Bay of Biscay using a glider JUVENILE FISH DISTRIBUTION : DEPARTING HYPOTHESIS Objectives :," vol. 25, p. 2016, 2016.
- [4] G. Chust *et al.*, "Climate regime shifts and biodiversity redistribution in the Bay of Biscay," *Sci. Total Environ.*, vol. 803, 2022, doi: 10.1016/j.scitotenv.2021.149622.