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Study of fine-scale dynamics in the Balearic Sea through high-resolution observations and SWOT satellite data

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***Abstract* – The Surface Water and Ocean Topography (SWOT) satellite mission was launched in December 2022 by NASA/CNES and is considered a major breakthrough in ocean observation from space. It is expected to measure the elevation of the Earth's surface water with a spatial resolution one order of magnitude higher than present altimeters (between 15 and 30 km), providing an unprecedented view of mesoscale dynamics [1, 2, 3]. The FaSt-SWOT project is the Spanish contribution to the validation of SWOT data. The main goal of FaSt-SWOT is to integrate SWOT measurements with in-situ observations from two high-resolution multi-platform experiments and advanced data-assimilative models to characterize fine-scale (10-100 km) dynamics and quantify the associated horizontal and vertical transports [4].**

During the initial fast-sampling phase from January to July 2023, the Balearic Islands region in the Western Mediterranean Sea was chosen for SWOT validation. SWOT gathered high-resolution sea surface height (SSH) measurements on a daily basis as part of this validation effort [3]. The two FaSt-SWOT experiments were specifically designed to collect multi-platform in-situ observations within the swath of the SWOT satellite, focusing on the area around the Balearic Sea during the validation phase.

Both campaigns (Figure 1) took place in April and May 2023 and involved the simultaneous use of various ship-based instruments (CTD, Moving Vessel Profiler (MVP), thermosalinograph, Acoustic Doppler Current Profiler (ADCP), GoPros), autonomous platforms (surface drifters and gliders), and satellite observations (SST, ocean color, altimetry). These campaigns brought together a unique multidisciplinary expertise in physical oceanography, satellite remote sensing, in-situ monitoring, numerical modelling and deep learning methods.

Satellite observations were used to identify the structures of interest to be sampled during the FaSt-SWOT experiments [5]. Within the domain of the swaths of the SWOT, the location of the sampling was defined based on the presence of a remarkable small-scale eddy detected in SST imagery just before the start of the first campaign (Figure 2). Therefore, the context was ideal to analyze SWOT capability to detect such small structures.

This presentation will provide an analysis of the multi-platform data collected during the FaSt-SWOT experiments, including ship-based observations, and measurements from autonomous platforms such as the drifters and gliders. Moreover, a first glance at SWOT data in the region of the Balearic Sea, as well as a preliminary analysis of the dynamics of the area of study and of the eddy, will be provided.

***Keywords* -** *Ocean currents, mesoscale, fine-scale, remote-sensing, SWOT satellite, in-situ observations, operational oceanography*

I. FIGURES

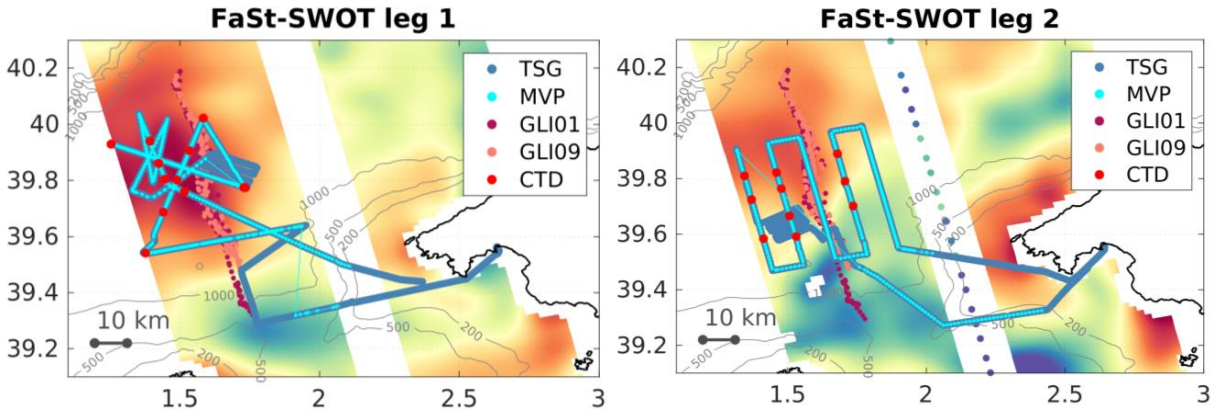

Fig 1. FaSt-SWOT1 (left) and FaSt-SWOT2 (right) sampling strategies. The vessel's trajectory is depicted in blue. The turquoise transects were continuously sampled by the MVP, while the red dots represent CTD profiles. In the background, maps of filtered SSHA from SWOT L3 beta product for 24/04/2023 (FaSt-SWOT1) and 10/05/2023 (FaSt-SWOT2).

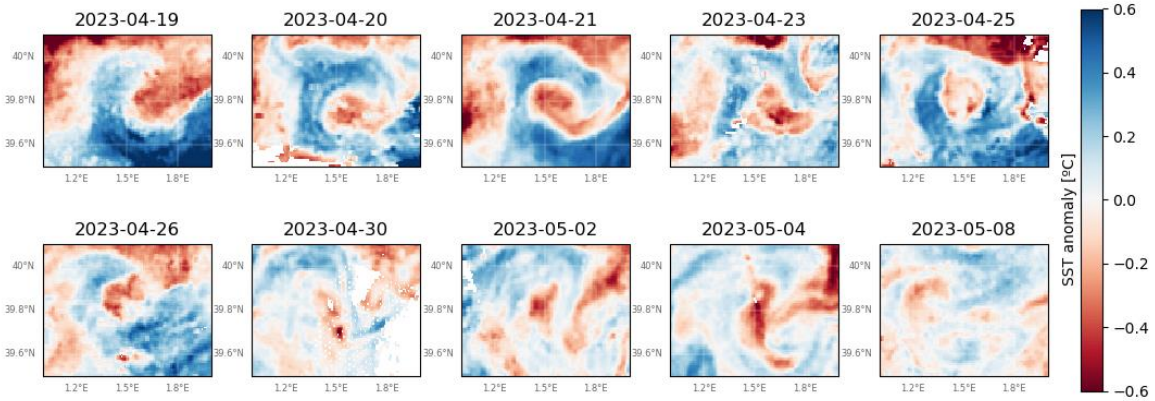

Fig 2. Evolution of the small-scale eddy detected in SST imagery (from Copernicus Marine Service) in the area of study just before the start of the first FaSt-SWOT campaign until the start of the second one.

REFERENCES

[1] Fu, L.-L., & Ubelmann, C. (2014). On the Transition from Profile Altimeter to Swath Altimeter for Observing Global Ocean Surface Topography. Journal of Atmospheric and Oceanic Technology, 31 (2), 560–568. https://doi.org/10.1175/JTECH-D-13-00109.1

[2] Morrow, R., Fu, L.-L., Ardhuin, F., Benkiran, M., Chapron, B., Cosme, E., d'Ovidio, F., Farrar, J. T., Gille, S. T., Lapeyre, G., Le Traon, P.-Y., Pascual, A., Ponte, A., Qiu, B., Rascle, N., Ubelmann, C., Wang, J., & Zaron, E. D. (2019). Global Observations of Fine-Scale Ocean Surface Topography With the Surface Water and Ocean Topography (SWOT) Mission. Frontiers in Marine Science, 6, 232. https://doi.org/10.3389/fmars.2019.00232

[3] d'Ovidio, F., Pascual, A., Wang, J., Doglioli, A. M., Jing, Z., Moreau, S., Grégori, G., Swart, S., Speich, S., Cyr, F., Legresy, B., Chao, Y., Fu, L., & Morrow, R. A. (2019). Frontiers in Fine-Scale in situ Studies: Opportunities During the SWOT Fast Sampling Phase. Frontiers in Marine Science, 6, 168. https://doi.org/10.3389/fmars.2019.00168

[4] Pascual, A., Mourre, B., Balaguer, P., Barceló-Llull, B., Calafat, N., Casas, B., Combes, V., Cutolo, E., Díaz-Barroso, L., Fernández, J. G., Gomez-Navarro, L., Juzà, M., Lizarán, I., Miralles, A., Reyes, E., Rivera, P., Rodríguez-Tarry, D., Roselló, P., Rubio, M.,Sánchez-Román, A., Tintoré, J., Verger-Miralles, E., Viloria, J.M., Wirth, N.,. Zarokanellos, N. (2023). Fine-Scale Ocean currents from integrated multi-platform experiments and numerical simulations: contribution to the new SWOT satellite mission. Cruise Plan (FaSt-SWOT, PID2021-122417NB-I00) (tech. rep.). https://doi.org/https://doi.org/10.20350/digitalCSIC/15276

[5] Verger Miralles, E. (2023). Mesoscale ocean structure reconstruction through data collection and analysis in the framework of the fast swot project (Master thesis).