SWOT satellite sea level observations: a game-changer for high-resolution ocean prediction? Insights from a Western Mediterranean Sea experiment

Launched in late 2022, the SWOT (Surface Water and Ocean Topography) satellite mission has been providing sea level observations at an unprecedented resolution since March 2023, monitoring for the first time the sea level signature of small mesoscale ocean features in two dimensions. SWOT first took measurements with a daily repetitivity over specific areas during its initial 3-month fast-sampling phase, before moving to its final orbit providing global coverage with a 21-day repetitivity. In the presentation we will discuss the contribution of these new observations for high-resolution (kilometric) regional ocean prediction based on the results of a field experiment carried out in the Western Mediterranean Sea during the initial SWOT fast-sampling phase. The FaSt-SWOT sea trial experiments, conducted in the Balearic Sea in April-May 2023, aimed at collecting multi-platform in-situ observations of small mesoscale ocean structures in the area covered by SWOT, using both ship-based instruments (CTD, Moving Vessel Profiler, thermosalinograph, ADCP) and autonomous platforms (surface drifters and gliders). The 2-km resolution data-assimilative predictive model WMOP was used to support the cruise planning and data analysis. In addition, 650m-resolution nested simulations were also produced to provide a complementary view of the small-scale ocean variability. The sampling focused on a ~25km-diameter anticyclonic eddy detected under the swath of the satellite. Several cross-sections of the MVP and underwater gliders provided insights into the vertical structure of temperature and salinity fields, revealing an intrathermocline eddy type. A total of 45 surface drifters were also deployed to evaluate in-situ surface currents and their associated convergence and divergence in the vicinity of the eddy. This dataset provides very valuable ground truth observations for the asssessment of the spatio-temporal variability represented in SWOT data and high-resolution model simulations. SWOT is found to properly represent the signature of this small-scale eddy, both in terms of sea level and associated geostrophic currents, providing a significant improvement with respect to conventional altimetry. It also reveals a significant temporal variability at a daily timescale. The predictive model is able to represent a small-scale eddy in the study area, with some common characteristics with the observed eddy in tems of dimension and vertical structure, but with a 25km spatial offset. This good agreement between SWOT and in-situ observations opens the door for the integration of these data into numerical models, with potential significant improvements in the representation and predictive capability of small scale ocean features by high-resolution data-assimilative ocean models.

Baptiste Mourre 1,2 , Elisabet Verger-Miralles 1 , Laura Gómez-Navarro 1 , Máximo Garcia-Jove 2, Bàrbara Barceló-Llull 1 , Benjamín Casas 2 , Vincent Combes 1 , Eugenio Cutolo 1,3 , Lara Diaz-Barroso 2 , Irene Lizarán 2 , Emma Reyes 2 , Daniel R. Tarry 1,4 , Nikolaos Zarokanellos 2 and Ananda Pascual 1 1 Mediterranean Institute for Advanced Studies, IMEDEA (CSIC-UIB), Esporles, Spain 2 Balearic Islands Coastal Observing and Forecasting System, SOCIB, Palma, Spain 3 IMT-Atlantique, Brest, France 4 University of Washington, Seattle, USA