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Integrating SWOT with autonomous platforms: the case of the BioSWOT-Med biogeochemical front

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The BioSWOT-Med cruise was carried out in the northwestern Mediterranean Sea during the fast-sampling phase of the satellite SWOT mission (fixed tracks were revisited every 24h), contributing to the international efforts of studying the oceanic submesoscale to mesoscale (1 to 100 km) dynamics. This region is an ideal natural laboratory for fine-scale biogeochemistry as its dynamics sustains strong contrasts associated with high production in the north (Gulf of Lions) and oligotrophic conditions with moderate energy in the south. The BioSWOT-Med cruise used an adaptive and Lagrangian sampling strategy, determined from near-real time satellite observations analysis, combining in-situ shipborne measurements with drifters, ocean gliders and Biogeochemical (BGC)-Argo floats, to achieve high spatio-temporal resolution multidisciplinary measurements within SWOT swaths. In this work, we present the preliminary outcomes derived by autonomous platforms (BGC-Argo floats, gliders, and surface drifters) with high-frequency sampling. Drifters combined with SWOT observations have been able to disentangle distinct features such as frontal zones, cyclones, anticyclones, and filaments. BGC-Argo floats collected measurements within an anticyclonic eddy visible in SWOT images but unresolved by conventional altimetry, and within a meander of the North Balearic front. The frontal area is influenced by saltier and colder Atlantic origin Water to the north and younger Atlantic Water to the south, resulting in a strong horizontal salinity gradient (~0.4 PSU). Chlorophyll concentrations co-varied with these frontal features and showed remarkable variations both at the surface and in the Deep Chlorophyll Maximum, with strong vertical gradients. As revealed by gliders measurements, the anticyclonic eddy, located south of the front, was characterised by fresher, warmer, and less productive Atlantic Water, and exhibited a distinct horizontal gradient compared with waters north of the front. Using both optical imaging and dual-frequency active acoustics, *Zooglider* revealed a

marked change in the community of grazing zooplankton in the eddy center. The BGC-Argo floats equipped with chlorophyll and backscatter sensors also allowed estimating ocean productivity in terms of Net Community Production (NCP) which provided new insights about the link between ocean production and physical processes.

This study demonstrates the importance of performing a synergic approach combining unprecedented high resolution satellite observations from SWOT and autonomous platforms (BGC-Argo floats, gliders, and drifters) to resolve the biological and physical interactions at fine scales.