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Internal wave–eddy interactions, turbulence and mixing during the 2023 BioSWOT-MED cruise

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The BioSWOT-MED cruise (https://doi.org/10.17600/18002392) was designed to study the bio-physical coupling in the region of the North Balearic Front in the Western Mediterranean Sea, an area of moderate fine scale energy level. The cruise took place during the SWOT fast-sampling phase in April-May 2023 thus providing a unique opportunity to study the daily evolution of mesoscale eddies and fine scale structures as inferred from SWOT in combination with high frequency in-situ measurements.

In-situ measurements were focused on a fine scale front identified from SWOT altimetry data and Chl-a gradient from remote sensing (Sentinel-3). The front was located at the northern margin of a small mesoscale anticyclonic eddy (~30 km of diameter, too small to be detected by conventional altimetry maps), from a cyclonic area. Preliminary results revealed strong wave-eddy interactions. Two triplets of 24-h Lagrangian stations (the boat is passively advected by the current to follow the water mass sampled) were performed during the cruise with one station at the front and two on both sides. At the end of the cruise, a third 24-h station was conducted in the anticyclonic eddy.

Two consecutive wind events (~25–30 kn) before the second and third sets of stations allowed us to observe and characterise the generation of near-inertial waves (NIWs) and their propagation at depth. Whereas NIWs amplitude was uniformly small during the first triplet of stations, contrasted NIWs amplitudes were observed after the wind events. A remarkable intensification of NIWs in the anticyclonic eddy was observed at the last station with amplitudes reaching up to ~0.4 m/s down to ~300 m, in strong contrast with weak NIW amplitudes in the frontal and the cyclonic area. An inertial chimney trapping NIWs can be evidenced within the anticyclonic eddy. Vertical Microstructure Profiler measurements showed that those trapped NIWs significantly enhanced turbulence and mixing activity in the anticyclonic eddy through intense shear generation. Contrasts in vertical nutrients fluxes between the inertial chimney in the anticyclonic eddy, the

front and the cyclonic area are finally discussed.