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Combining gliders and models to understand mesoscale biogeochemical patterns at the Angola-Benguela front

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The Angola-Benguela frontal region represents an extremely dynamic portion of the ocean located along the south-western African coast, at the northern edge of the South Atlantic gyre. At this boundary, the northern warm and saline waters of the Angola Basin mix with the southern colder and fresher waters carried by the Benguela current through a combination of processes that span a wide range of spatio-temporal scales. This study combines the use of underwater glider data collected between February and June 2018 with a high resolution 3D physical-biogeochemical model to investigate how these lateral exchanges impact the oxygen and organic carbon distributions in the proximity of the front. From the glider data, we identify a set of salinity, oxygen and organic carbon anomalies impacting the first 500 m of the water column during February-June 2018. Using satellite images of physical and biological data and an eddy identification algorithm, we discuss these anomalies in the context of the surrounding physical and biological setting at the time of measurement and identify key processes that may be responsible for the observed tracer patterns. We employ the Regional Ocean Modeling System (ROMS) coupled with the Biogeochemistry Ecosystem Circulation model (BEC) to further explain and upscale our findings. We study the dynamics of cross-frontal exchanges of oxygen and organic carbon in the first 500 m depth. We show how the coupling between long filaments and intense anticyclonic eddies forming at the front generates a complex pattern of recirculation of Angola Basin-derived saline and low-oxygen waters into the oxygenated Benguela region. Finally, we quantify the oxygen lateral transport coupled with these dynamics, and discuss the implications for the biological activity in the region.