Submesoscale physical-biogeochemical coupling across the Ligurian current (northwestern Mediterranean) using a bio-optical glider

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ABSTRACT: A bio-optical autonomous underwater gliding vehicle, equipped with a conductivity, temperature, depth (CTD) sensor, an oxygen sensor, backscatter meters, chromophoric dissolved organic matter (CDOM) and chlorophyll fluorometers, and upwelling and downwelling radiometers was developed to characterize the biogeochemical response to physical forcing at the submesoscale (1-10 km). Winter data obtained in the northwestern Mediterranean basin in a 50-km transect that crossed the permanent, along-coast Ligurian Current show tight physical-biogeochemical coupling across the Ligurian Current, not observed using other sampling strategies. At the scale of the transect, the various biogeochemical parameters displayed independent behaviors, while at the submesoscale, there was a coherent covariance of these variables, especially in the frontal zone. Nearisopycnal tongues of elevated fluorescence and oxygen concentration were recorded down to a depth of 180 m and are the likely signature of a converging horizontal and downwelled water flow. Local anomalies in a horizontal section well below the mixed-layer depth are likely representative of downwelled waters from the euphotic layer. Intrusions of elevated CDOM concentrations together with signatures of smaller particles are the likely features of a local divergence and upwelled waters from subjacent aphotic layers. These are particularly apparent in the form of local anomalies in a horizontal section within the mixed layer. Similar tongues were observed in data from subsequent glider deployments. Such biogeochemical signatures enable the identification of upward and downward physical motions not observed by other technologies, reinforcing the need for coupled high-resolution physical-biogeochemical studies, not only for investigating biogeochemical processes themselves but also for resolving physical processes at these scales.

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