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Bio-optical properties during the winter-summer transition in the central Red Sea

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The Central Red Sea (CRS) located between two distinct hydrographic and atmospheric regimes. In the southern Red Sea, seasonal monsoon reversal modulates the water masses exchange between the Red Sea and the Indian Ocean. In the northern Red Sea, intermediate and occasionally deep water are formed during the winter to sustain the basin's overturning circulation. Until recently, satellite-derived ocean color observations have been the only means to evaluate the spatial and temporal variability of phytoplankton biomass and optical characteristics of the Red Sea. Autonomous underwater vehicles (AUVs) are efficient and low-cost platforms that provide sustained, spatially resolved vertical profiles of physical, chemical and optical parameters in the water column so that we can understand biological, chemical, and optical responses to physical dynamics. The spatially and temporally resolved glider observations complement remotely sensed ocean color, which derives its signal from the first optical depth ($\sim$20m). The work presented here examines glider-based bio-optical properties from the CRS that include optical backscatter at 700 nm, chlorophyll-a and colored dissolved organic matter (CDOM) fluorescence. This study also discusses the relationship between optical backscatter and chlorophyll in both deep and shallow water environments. During our observations, northward transport occurred via an eastern boundary current (EBC). Both anticyclonic and cyclonic eddies were present during the 4-month observational period. Relatively fresh waters, originating from the Gulf of Aden, advected from the south into the CRS by the EBC. The interplay between eddy activity and the EBC modulates the dispersion of the Gulf of Aden Surface Water (GASW) in the CRS. Biogeochemical properties are affected by this interaction as well because the Gulf of Aden water has unique biogeochemical properties. Our results indicate that the optical signals not only inform us regarding spatial and temporal variability of phytoplankton chlorophyll, suspended particles and CDOM, but serve as tracers for important subsurface physical processes associated with the eddy field, that are not apparent in remote-sensed ocean color observations. Additional inputs from the coastal zone and coral reefs contribute to the ocean color signature. Entrainment of these near-surface optical signatures from the coastal and reef systems suggests that the surface ocean color signals are decoupled from the subsurface chlorophyll maxima that characterize this oligotrophic region. Mechanical stirring at the eddy interfaces enhances the vertically integrated phytoplankton biomass via overlapping subsurface chlorophyll maxima from adjacent eddies. Sustained observations may provide us with sufficient statistical results facilitate inference of these interactions from remotely sensed ocean color and associated remotely sensed physical variables.