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Fronts and eddies: Engines for biogeochemical variability of the Central Red Sea during winter-spring periods

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The central Red Sea (CRS) has been shown to be characterized by significant eddy activity throughout the year. In winter, weakened stratification may lead to enhanced vertical exchange contributing to physical and biogeochemical processes. In winter 2014-2015 we began an extended glider time series to monitor a region in the northern CRS where eddy activity is significant. Remote sensing and glider observations that include CTD, oxygen, CDOM and chlorophyll fluorescence, and multi-wavelength optical backscatter, have been used to characterize the effects of winter mixing and eddy activity in this region. During winter, deep mixing driven by surface cooling and strong winds combined with eddy features, can supply nutrients into the upper layer dramatically modifies the environment from its typically stratified conditions. These mixing events disperse the phytoplankton from the deep chlorophyll maximum throughout the upper mixed layer, and increase the chlorophyll signature detected by ocean color imagery. In addition to the mixing, cyclonic eddies in the region can enhance the vertical displacement of deeper, nutrient containing water toward the euphotic zone contributing to increased chlorophyll concentration and biological productivity. Remote sensing analyses indicate that these eddies also contribute to significant horizontal dispersion including the exchange between the open sea and coastal coral reef ecosystems. During the winter mixing periods, diel fluctuations in phytoplankton biomass have been observed indicative of solar driven plankton dynamics. The biogeochemical response to the subsurface physical processes provides a sensitive indicator to the processes that result from the mixing and eddy dynamics – processes that are not necessarily detectable via remote sensing. In order to understand the seasonal responses, but also the interannual influences on these processes, sustained in situ autonomous platform measurements are essential.