The interplay between upwelling and deep convective mixing in determining the seasonal phytoplankton dynamics in the Gulf of Aqaba: Evidence from SeaWiFS and MODIS

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ABSTRACT: In the Gulf of Aqaba, the northeasternmost segment of the Red Sea, phytoplankton blooms are more intense than in other oligotrophic regions (e.g., the Sargasso Sea). In this study, we use multiyear in situ (1988-2000) and Sea viewing Wide Field of View Sensor (SeaWiFS) (1999-2001) chlorophyll *a* (Chl *a*) data to describe the dynamics of phytoplankton biomass throughout the Gulf of Aqaba. The temporal pattern of phytoplankton biomass in the Gulf of Aqaba includes a strong spring bloom and a somewhat weaker autumn bloom, the length, intensity, and timing of which vary from year to year. In addition, highly positive west-to-east (W to E) gradients in Chl a were found throughout the Gulf of Aqaba. A corresponding negative gradient in sea surface temperature (SST) obtained from MODerate resolution Imaging Spectroradiometer (MODIS) in 2001 indicates that the gradient of Chl a across the Gulf of Aqaba is an outcome of an Ekman-driven upwelling along the eastern side. Calculations of the upwelling and convective fluxes that are based on meteorological data from Eilat, Israel, indicate that upwelling is comparable to or exceeds convection during much of the year. We present a conceptual model demonstrating how upwelling and convection can either support or oppose each other, thereby jointly controlling mixed-layer depth and the development of phytoplankton blooms. Coastal upwelling plays a larger role in controlling phytoplankton dynamics than was previously thought, and it explains much of the observed spatial and temporal variability in phytoplankton distributions.