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Biological response to local and remote forcing in the bay of Bengal

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The permanently stratified water column in the Bay of Bengal and a strong halocline, resulting from a heavy influx of freshwater from river runoff and precipitation is an impediment to mixing processes that can inject new nutrients into the bay. Consequently, unlike the monsoonal blooms of the Arabian Sea with rates of primary productivity exceptional in magnitude among offshore ocean regions, phytoplankton productivity in the Bay of Bengal is modest and largely dependent on processes that can erode the halocline and entrain nutrients into the euphotic zone.

Although considerable advances have been made in understanding the physical mechanisms that are particularly unique to the Bay of Bengal such as the Sri Lanka and Bay of Bengal Domes during the Southwest monsoon, mixing induced by tropical cyclones and cyclonic eddies, all of which can bring new nutrients into the euphotic zone, there seems to be little understanding of the biological response. This is a consequence of sparse shipboard biological measurements of phytoplankton biomass and productivity and inadequate coverage of ocean color satellite measurements because of persistent cloud cover. In view of these limitations, ecosystem models are more advantageous as they offer large scale coverage even under cloudy conditions as well as over the euphotic depth an important aspect for studying the deep chlorophyll maxima.

In this study we use outputs from a Naval Coastal Ocean Model (NCOM) coupled to a 13-component ecosystem model to describe some of the unique physical forcing features of the Bay of Bengal which enhance phytoplankton productivity in an otherwise low productivity environment. Model results are compared and evaluated against in-situ and remotely sensed observations. We focus on three physically and biologically active regions viz. the Sri Lanka Dome during the Southwest monsoon followed by the Bay of Bengal Dome to its north and the winter bloom in the southwest of the bay. Using the model outputs we investigate the causes for phytoplankton enhancement and the effects of two climate modes, the Indian Ocean Dipole and the El Nino/Southern Oscillation in these regions.