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Tropical cyclone induced physical and biogeochemical response in the Arabian Sea

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Tropical cyclone moving over a warm ocean is a manifestation of intense air-sea interaction process. Though the destructive power associated with the landfall of a cyclone is well known, its role in enhancing the biological production, and associated biogeochemical fluxes is least understood. In the Arabian Sea, located in the western part of the north Indian Ocean, tropical cyclones occurs regularly during spring (April-May) and fall (October-November) intermonsoons. In this presentation the life cycle of a tropical cyclone Phyan, which occurred during 9-11 November 2009 in the Arabian Sea is analyzed to understand the quantitative response in sea surface temperature (SST), chlorophyll concentration, net primary production (NPP) and CO_2 out-gassing using a variety of remotely sensed as well as in situ data. Associated with the passage of cyclone, SST showed a rapid cooling of 2oC. The cooling was in response to the strong cyclonic wind stress curl and associated upward Ekman-pumping. The chlorophyll biomass as well as net primary productivity showed a 2-fold increase. The biological response mediated by the upward Ekman pumping-driven vertical transport of subsurface nutrient showed a time lag of 3-4 days. During the period of cyclone development, entrainment of CO_2 into the surface ocean by turbulent mixing and Ekman-pumping enhanced the out-gassing from the ocean, which was 0.123 Tg C. This accounted for $\sim$85% of the total out-gassing from the eastern Arabian Sea during November. Thus, if the frequency and intensity of the cyclone increases in future due to warming, the Arabian Sea would become more productive, and also release more CO_2 to the atmosphere than the present. In addition, increased productivity, in turn, will exert increased demand on mid-depth oxygen exerting additional stress on already existing oxygen minimum zone (OMZ).