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Understanding the Role of Nutrient Limitation on Plankton Biomass over Arabian Sea via 1-D Coupled Biogeochemical Model and Bio-Argo Observations

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Arabian Sea (AS) is known to have seasonal phytoplankton blooms during winter and summer driven by distinctive physical forcing mechanisms and associated nutrient dynamics. A 1-D coupled physical-biogeochemical model based on North Pacific Ecosystem Model for Understanding Regional Oceanography (NEMURO) with nitrogen and silicon cycles is adapted for Arabian Sea environment. The model is implemented to investigate the role of nitrate versus silicate limitation on plankton biomass. The seasonal cycle of plankton biomass is well simulated by the model along bio-Argo and ship cruise tracks during the period from 2009 to 2016. Further, three sensitivity simulations are conducted by suppressing (1) nitrate availability (representing new production), (2) ammonium availability (representing regenerated production) and (3) silicate availability (for diatom production). The new production represents 80% of the total primary production in the AS and implicitly controls 70% of total zooplankton production annually. The regenerated production augments small phytoplankton (by ~50%; e.g., flagellates) and small zooplankton (by ~20%; e.g., ciliates) growth with negligible effects on large phytoplankton (e.g., diatom) and predatory zooplankton (e.g., copepods). The diatom production remains within the observed range due to silicate limitation which is fundamental in the model for realistic simulation of chlorophyll. Silicate is the primary limiting nutrient in diatom bloom in the subsurface chlorophyll maxima (SCM) with maximum limitation occurring during the winter season, due to the deeper silicicline as compared to shallower nitracline. At the surface, both nitrate and silicate co-limit the total production; however, nitrate is a strong limiter than silicate from March to May. The study highlights the relative role of silicate versus total nitrogen (nitrate+ ammonium) in primary production in the AS.

Biography

Anju Mallissery currently works at the Department of Ocean Model Development and Data Assimilation, Indian Institute of Tropical Meteorology. Anju Mallissery research focuses on Marine Biology.