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NUMERICAL MODELLING OF THE SEASONAL VARIABILITY OF PLANKTON AND FORAGE FISH IN THE GULF OF KHAMBHAT

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Marine ecological modelling has to deal with a cascade of scales associated with physical and biological oceanographic processes. The range of space and time scales over which marine organisms exist is large and these scales overlap with a variety of physical scales. Representing the interaction of these processes at different spatial and temporal scales is of main concern towards the development of a model. Coupling circulation and biological processes in a single model could be quite challenging due to stiffness of the coupled system. The governing system of partial differential equations represents the interaction of the physical, biological and chemical processes in a marine environment.

Numerical modeling of marine ecology exploits several assumptions and it is indeed quite challenging to include marine ecological phenomena in to a mathematical framework. The key concern in the development of a numerical model is the categorization of compartment of species. It is nevertheless assumed that one particular model compartment contains the same type of marine species. In the present formulation, a five-compartment NPZDF (Nutrient, Phytoplankton, Zooplankton, Detritus, Forage Fish) model is formulated using advection-diffusion-biological equations in order to understand the ecological dynamics in the marine environment.

For the development and exploration of the model's behavior we have concentrated on the modeling of seasonal cycle in the Gulf of Khambhat ($19^o48'$N - $22^o20'$N, 65^oE - $72^o40'$E). It has rich bio-diversity and a high productive area due to elevated turbidity and geographical location. The varying geography of Gulf of Khambhat is projected to a rectangular domain through co-ordinate transformations. The model validation with the available ecological data in the study area is discussed.

Chlorophyll is the main fundamental factor for optical observation of phytoplankton. Area averaged monthly mean of satellite (SeaWiFs and MODIS Aqua) observed data of chlorophyll-a with 9 and 4 km resolution are available at http://daac.gsfc.nasa.gov/giovanni. The observed data have two peaks, one in February and the other in August. Model simulated results agree well qualitatively with SeaWiFs and MODIS Aqua Chlorophyll data, pattern of peaks being nearly the same.