Modelling and Simulation of Marine Biogeochemical Cycles with Emphasis on Iron Fertilization

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Mathematical modeling and computer simulation provide tools to identify and understand fundamental interactions between biogeochemical cycles and ecosystems in the euphotic zone, and between euphotic zone and deep ocean. The key issues addressed at C-MMACS, are the transformation of organic matter in the foodwebs and transfers of matter across the ocean interfaces, by studying the important physical, biological and chemical processes like role of light and multiple nutrients including micronutrients on the photosynthesis, community structure of phytoplankton and zooplankton, fertilization using micronutrients, remineralization, upwelling, mixing etc., which influence the sources and sinks of carbon in the euphotic zone.

A marine ecosystem model with multinutrient kinetics is formulated with iron as a limiting nutrient, to understand the effect of iron fertilization in the high nutrient low chlorophyll (HNLC) region. This model is embedded in the one dimensional physical framework and the results of one dimensional coupled physical-biological model are analysed and evaluated using the US JGOFS Cruise data and buoy data in central Arabian Sea, to identify the significant biological variables and processes, and to estimate model parameters. The same model will be embedded in the three dimensional Ocean General Circulation Model to study the effect of iron fertilization in the Southern Ocean on primary productivity and carbon flux. This study provides tools for making reliable estimates of primary productivity and carbon flux in the ocean.