Implementation of Multi-Disciplinary Sustained Ocean Observations (IMSOO)

Demonstration Theme 1: Plankton Community Changes (including ocean color)

Background/Motivation:
Plankton communities constitute the base of the marine food web and comprise viruses, bacteria, phytoplankton, and zooplankton. Zooplankton includes single-celled (protozoans), multi-cellular (metazoans), and the larval stages of many benthic organisms and fish (ichthyoplankton). Ocean physical, biogeochemical, and biological processes all affect the abundance, composition, patchiness, and distribution of plankton assemblages. Plankton plays a key role in the global chemical cycles, and also provides essential ecosystem services such as carbon fixation, oxygen production, nutrient cycling, and food provisioning to higher trophic levels, many of which are important commercial species for humans. The abundance and distribution of many fish species, sea birds, and marine mammals are tied to fluctuations in the abundance of planktonic organisms. These are driven by and in turn affect physical and biogeochemical processes. Bottom-up changes such as grazing pressure and other biological interactions also have a marked influence on the diversity, abundance, and productivity of the phytoplankton. Thus the plankton community interacts with its physical, chemical, biological, and geological environment across a range of temporal and spatial scales. These changes have direct impacts on ecosystem function.

Indirect and direct human pressures also have significant impacts on plankton communities. These pressures can affect fishery catch potential, patterns of harmful algal and bacterial bloom occurrence, the dispersal of invasive or introduced species, and cause further shifts in marine habitats around the world. Changes in the plankton community provide valuable insights on the effects of both bottom-up pressures like climate-induced and other changes on the rest of the marine ecosystem, including the carbon cycle and all other marine organisms up to the top of the food chain, and top-down pressures that cascade through the food web (e.g. increasing pressure on certain types such as large copepods and krill, for omega-3s and aquaculture).

A combination of in-situ and remotely sensed observations are vital to understanding changes in planktonic communities and assess the impacts of those changes. At present, it is still impractical to sustain the collection of such observations over large areas. Much of our understanding of global plankton distribution, composition and biological rates comes from conceptual models and newer coupled biological–physical oceanographic and earth system simulations.

One of the challenges that will be addressed at the workshop is to design a multi-disciplinary observing system that will enable us to monitor plankton community and change, and improve our understanding of the drivers of this change.
Aims:

1. Identify opportunities for collaboration that will facilitate in-situ and satellite observations (physical, biogeochemical and biological) required to understand the drivers of plankton community change. This should include consideration of innovative observation networks and novel sensors.
2. Identify opportunities and mechanisms to integrate the disparate data types and resolutions related to understanding plankton community changes. This should include consideration of the requirements of modelers (from Regional Oceanographic Models to global scale Earth Systems Models).

To succeed, this will require a coordinated international effort that brings together the multidisciplinary expertise of the ocean modeling and observational communities. Focus of the workshop discussions could be based on: 1) a specific topic of societal relevance (e.g. fisheries, water quality, HABs), 2) a specific geographical case study in which a long-term study and extensive monitoring data has shown changes or shifts in the planktonic community (e.g. CalCOFI, CARIACO), and/or 3) a geographic region in which there is insufficient data but perhaps existing algorithms for satellite observations suggest that shifts may be happening (the coastal zone).

Workshop Outcomes:
Recommendation for a multi disciplinary demonstration project(s) based on the focal discussion areas described above that will:

1. Articulate requirements for plankton community observations within an integrated, multi-disciplinary approach (i.e. including necessary physical, biogeochemical and biological observations).
2. Articulate the role and synergies of the range of networks and technologies in plankton community observations, including (but not limited to), Satellite observations, CPR surveys, Imaging FlowCytoBots, Deep and Shelf Moorings, Gliders, HF Radar.
3. Envision technological developments to facilitate and automate multi-disciplinary observations of plankton communities.