INTERDISCIPLINARY MODELLING - PHYSICAL PROCESSES

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Physical processes consist of mixing and advection. The mixing processes can be divided into boundary and interior mixing. The boundary mixing, whether it is on the ocean surface or at the ocean bottom, is relatively well studied. Surface mixed-layer models are routinely used in study of upper-ocean thermal structures, and bottom mixed-layer models are often used in study of tidal mixing in shallow seas. In contrast, the interior mixing remains little understood. Modeling of interior mixing is usually based on simple *ad hoc* assumptions.

Applications of the one-dimensional mixed-layer models to the interdisciplinary modelling are quite common. The upper-ocean temperature and entrainment rate, predicted from surface mixed-layer models, can be used to calculate respectively the biological and chemical reaction rates and upward nutrient flux. Knowledge of the turbulence structure in the mixed layer can be used to calculate the trajectories of planktonic particles. Potential feedback from biology to physical process, such as the attenuation of optical depth by phytoplankton bloom, also has been explored.

While mixed-layer models are realistic, the general ocean circulation (three-dimensional advective processes) models are still quite primitive. The computer power is only marginal and the data base is lacking. Very few regional circulation models had ever been verified. So far, in interdisciplinary regional models, the flow fields usually are derived from simple idealizations. The common approaches use estimations from a well-known circulation pattern (such as the coastal upwelling circulation) or from the geopotential surfaces. The idealized flow patterns nevertheless are useful in providing mean flow trajectories for calculation of, for example, the dissolved and particulate material budget, the sedimentation pattern, and the larvae recruitment.

Embedded in the large-scale regional circulation are the mesoscale activities. These motions are marked by strong flow convergence and divergence. A well-known example is the frontal eddy and filament along a meandering current. The flow convergence and divergence can have major impacts on the biology. Local divergence (upwelling) will bring up nutrients, but, it also may cause larger advective loss. Local convergence will concentrate floating particles (food), but, it also may bring planktons below the photic zone. The complex interaction between frontal circulation and biological system can result in wide varieties of biological and chemical response.

We feel that a major opportunity in the interdisciplinary modeling is the study of biological and chemical system in mesoscale fronts. It is now feasible to describe the general convergence and divergence pattern in a frontal meander. Coupling such advective pattern to a biological model can be a useful tool to examine the observed biological heterogeneity. The model also can be used to explore the larger question of contributions of frontal system to the overall biological budget. Moreover, since the biology is sensitive to flow divergence, the advective processes themselves may also be quantified.