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Improve our understanding of coupled bio-optical and physical processes in the coastal zone and of the variability and predictability of the coastal ocean's optical properties on time scales of one to five days. Investigate the coupled dynamics of ocean bio-optical, physical, and atmospheric models. Provide a foundation for the development of scientifically valid, dynamically coupled atmospher••ocean models.

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Title: Dynamics of Coupled Models
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Research Objective: Improve our understanding of coupled bio-optical and physical processes in the coastal zone and of the variability and predictability of the coastal ocean's optical properties on time scales of one to five days. Investigate the coupled dynamics of ocean bio-optical, physical, and atmospheric models. Provide a foundation for the development of scientifically valid, dynamically coupled atmosphere-ocean models.

Methodology: The approach is based on using nested, coupled physical-bio-optical models of the coastal region together with bio-optical and physical in-situ and remotely sensed observations. Data assimilation techniques for both physical and bio-optical fields are used to examine project research issues and objectives. Approach is also based on joint studies of the bioluminescence (BL) potential and inherent optical properties (IOPs) over relevant time and space scales. Dynamical, biochemical, physical and BL potential models are combined into a methodology for estimating BL potential and night-time water leaving radiance (BLw).

Results: We published results from the first (to our knowledge) observational and modeling studies of bioluminescence (BL) potential dynamics in the Delaware Bay area to evaluate BL potential at the interface of an estuary-shelf system. We published results describing the impact that errors in model surface Photosynthetically Available Radiation (PAR) and vertical attenuation of PAR have on the upper ocean model heat content. Sensitivities derived in this study provide a capability to understand and control the impact of errors in PAR and its attenuation on the upper ocean model heat content predictions. We submitted for publication a paper describing a novel, ensemble based approach to specify observational error covariance in the data assimilation of satellite bio-optical properties. The observational error covariance is derived from statistical properties of the generated ensemble of satellite images, and it is used in the reduced-order Kalman filter for the assimilation of satellite derived bio-optical observations.

DoD Impact/Significance: Emerging Navy Electro-Optical (EO) systems under development and Special Operations missions require an improved understanding of the ocean optical environment. This is critical for operations and weapon deployment, especially in the coastal and littoral zones. Improved basin scale to mesoscale forecast skill is critical to both military and civilian use of the oceans, particularly on the continental margins.

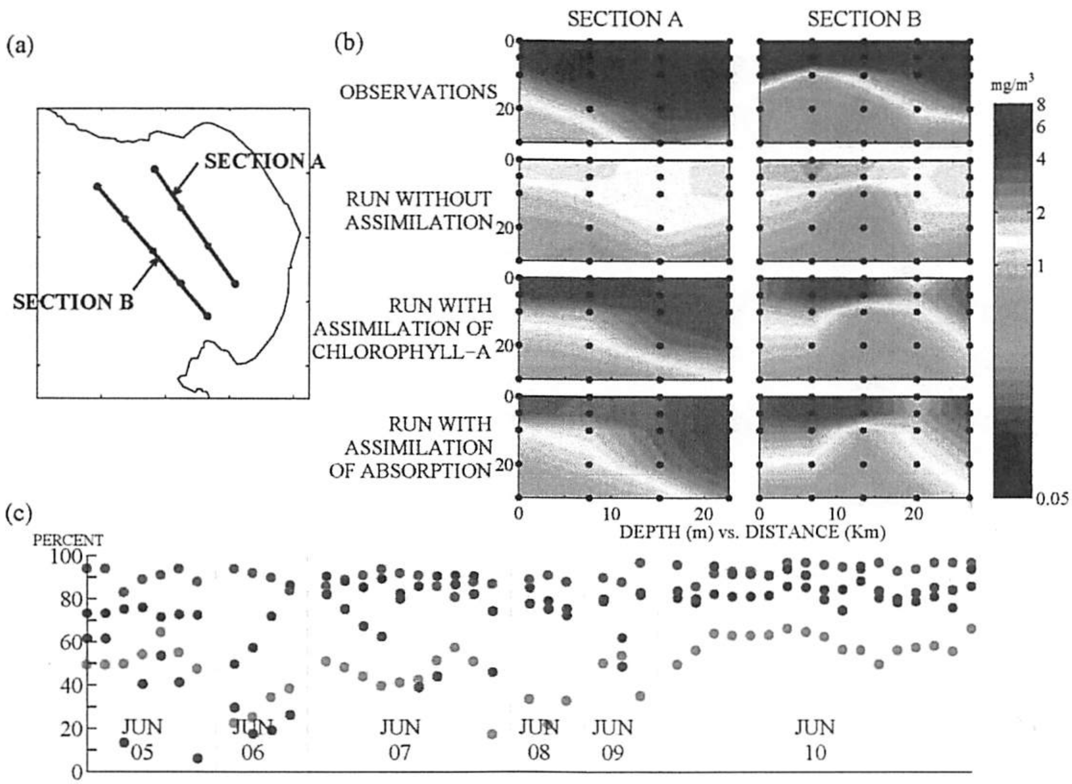

Figure 1. The assimilation of MODIS-Aqua derived optical properties (chlorophyll or absorption due to phytoplankton) into coupled biochemical, physical model of the Monterey Bay. The data assimilation improved surface and subsurface agreement between the model and observations. (a) – locations of water samples stations A and B; (b) Comparisons of observed (sections A and B) and model predicted subsurface chlorophyll distributions at water sample locations; (c) Observed and model-predicted fractions of diatoms to the whole phytoplankton populations at water samples locations: green – observed fractions, blue light – run without assimilation of bio-optical properties, brown – run with assimilation of satellite chlorophyll data; red- run with assimilation of absorption due to phytoplankton.