High Resolution Time Series Observations and Modeling of Radiance, Optical Properties, and Physical Processes as Part of RaDyO

A Proposal for the ONR Research Initiative: Radiance in a Dynamic Ocean (RaDyO)

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Abstract

The fundamental physics and optics of the ocean's surface boundary layer (SBL) are highly complex and remain to be comprehensively studied. The RaDyO program will be the first concerted effort to attack this challenging problem. As a starting point, it is clear that the temporal variability of the ocean radiance of the surface and upper ocean boundary layers is influenced by a wide variety of oceanic physical and bio-optical processes as well as changing atmospheric conditions. Some key physical and atmospheric processes include: the changing structure of the ocean surface as affected by wind conditions and thus waves, bubbles, surfactants, and foam, small-scale stratification, and highly variable incident light fields. The upper ocean conditions are also affected by variable inherent optical properties (IOPs) and apparent optical properties (AOPs) that are influenced by complex biological and geological processes. Two of the primary goals of the RaDyO program are: 1) to examine subsurface time-dependent radiance distributions in relation to dynamic surface boundary layers (SBLs) and 2) to combine a sufficiently detailed radiance-based transfer model with models of surface boundary layer processes (e.g., surface waves and bubble production) and to investigate the feasibility of inverting the coupled models to yield key conditions within the surface boundary layer. The purpose of our proposed research is to obtain, analyze, and model high temporal resolution time series of radiance, IOPs and other AOPs, and physical processes in the upper oceanic layer and SBL as well as forcing by atmospheric conditions including incident solar radiation. We envision that our project would be a central contribution to RaDyO in that we propose to execute highly interdisciplinary, high temporal resolution, continuous time series field studies in both coastal (optically shallow) and open ocean (optically deep) environments. In addition, we plan to participate in the development of relevant forward and inverse models to address the central RaDyO objectives and goals, which entail both fundamental understanding and important applications including predictions of SBL conditions and image propagation (i.e., imaging above-surface objects from sensors placed beneath the sea surface). Our project would build upon over two decades of related research and RaDyO could leverage several of our recent and current field activities and sampling assets.