Abstract
Satellite observations have brought a new vantage for characterizing open ocean ecosystems on local to global spatial scales and from intraseasonal to interannual time scales. These satellite observations are most often used to assess the time/space distribution of the chlorophyll concentration, the primary photosynthetic pigment found in all phytoplankton. However, there are additional optically active constituents regulating the color of the open ocean besides chlorophyll. Here, we use novel satellite retrieval algorithms to partition the ocean color spectrum into three primary optically active constituents – the phytoplankton chlorophyll concentration (Chl), the absorption due to chromophoric dissolved organic matter (CDOM) and the particulate backscatter coefficient (BBP). We assess the variability and co-variability of these three optical properties on regional to global scales and evaluate the ecological, biogeochemical and physiological processes controlling these variations. We conclude that the chlorophyll concentration is inappropriate for characterizing ocean ecosystems alone. This is because of the extreme plastic nature of cellular chlorophyll concentrations in response to light and nutrient conditions and the difficulty in separating light absorption in phytoplankton Chl concentrations from CDOM. We suggest that future satellite missions consider the primary optically active constituents in the open ocean and provide a path for their robust determination. In this way we can maximize the scientific returns from these immense infrastructure investments.

Bio
David A. Siegel is a Professor of Marine Science in the Geography Department and Director of the Institute for Computational Earth System Science at the University of California, Santa Barbara. He joined the faculty of the University of California, Santa Barbara in 1990 after a year as a postdoctoral fellow at the Woods Hole Oceanographic Institution. Dr. Siegel is an interdisciplinary marine scientist. His research focuses on the assessment and functioning of aquatic ecosystems using the tools of an applied physicist: namely radiative transfer and fluid mechanics. He has published over 100 refereed works in satellite ocean color remote sensing, marine bio-optics, and the coupling of ecological and ocean physical processes from basin- to micro-scales with application in problems ranging from biogeochemical cycles, plankton ecology and fisheries oceanography. Dr. Siegel is a fellow of both the American Association for the Advancement of Science (AAAS) and the American Geophysical Union (AGU). Dr. Siegel is a member of the Earth Science Subcommittee of the NASA Advisory Committee and has been a member of several NASA Earth Science research teams including Science Working Groups for the Aerosol-Cloud-Ecosystem (ACE) and Hyperspectral Infrared Imager (HypIIR) decadal survey missions. Dr. Siegel received his undergraduate degrees from the University of California, San Diego in 1982 and his doctoral degree from the University of Southern California in 1988.