# *Chapter 1*

# Introduction to Special Topics in Ocean Optics for Ocean Color Sensor Validation

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The overall purpose of the ocean optics protocols document is to provide the ocean color community with guidance for acquiring *in situ* data needed to develop algorithms and validate the performance of, and biogeochemical data sets derived from, satellite ocean color sensors. The first five volumes of this document first identify necessary and desired oceanic and atmospheric variables and appropriate instruments to measure them. Methods for characterizing and calibrating those instruments are covered next. Finally, detailed methods are described for measuring each category of variables at sea, and for processing and analyzing the data, to derive the essential information needed for all aspects of satellite ocean color validation.

The present volume provides a vehicle for describing important elements of the *in situ* ocean color validation process and infrastructure that don't fit cleanly into the integrated "variable – instrument – calibration – measurement – analysis" structure of the topics presented other volumes. As presently envisioned, appropriate subjects for chapters in this volume fall into 3 categories described below.

***Ocean observatories*** use moored buoys instrumented for radiometric, bio-optical and interdisciplinary time-series measurements, together with supporting programs of survey cruises and/or drifting buoy deployments, to determine time and space scales of biogeochemical and physical variability in selected regional sites. The scientific goal of such observatories may be narrowly focused on acquiring ocean radiometric and optical data for vicarious calibration of satellite ocean color sensors, e.g the MOBY observatory described in ***Chapter 2*** of this volume [carried over unchanged from Chapter 11 of Revision 3 to the protocols (Mueller and Fargion, 2002)]. On the other hand, an interdisciplinary ocean observatory can combine comprehensive *in situ* observations with satellite remotely sensed data to derive synergistic descriptions of regional oceanographic features and their evolution in space and time, and provide validation data as well. Applications of moored and drifting instrumented buoys in the second, more general oceanographic context combined with ocean color validation are described in ***Chapter 3*** of this volume.

**Airborne ocean color** measurements, strictly speaking, are *in situ* observations closely related to shipboard radiometry topics covered elsewhere in the document. However, methods of airborne ocean color measurement also have much in common with satellite ocean color radiometry itself, including atmospheric corrections, and the avoidance and correction of sun and sky glint effects. From that perspective, protocols covering the full breadth of (satellite or aircraft) ocean color remote sensing technology and algorithms are beyond the scope of *Ocean Optics Protocols for Satellite Ocean Color Sensor Validation.* Certain aspects of radiometric and other measurements from aircraft are, nevertheless, relevant and within the scope of this document. These aspects include measurements from low altitude, which are closely akin to shipboard above-water radiance measurements (Vol. III, Ch. 3). Also appropriate are airborne measurements from any altitude to determine spatial variability, at scales ranging from m to 10 Km, in ocean color as a means of relating, *e.g.* shipboard, *in situ* measurements at a single point to concurrent satellite ocean color observations; such "sub-pixel" to small-scale regional bio-optical variability characterizations, using aircraft along-track or image data, become especially critical in Case II waters (Vol. I, Ch. 4). ***Chapter 4*** of this document describes the methods used in one approach to ocean color measurements using relatively simple radiometers mounted on light aircraft flown at low altitude, to detemine water-leaving radiance, and from radiance "spectral curvature" parameters, *Chl* (chlorophyll a concentration). Other important aspects that could form the basis for future chapters in this topic area include using along-track, nadir-viewing, combined measurements of hyperspectral ocean color radiance and oceanographic LIDAR at low altitude (*e.g.* Hoge and Swift 1986a, 1986b), or hyperspectral ocean color images, measured at spatial resolutions ranging less than a few m to 10's of m using imaging sensors flown at higher higher altitudes (*e.g.* Carder *et al*. 2003; Dierssen *et al*. 2003), to determine spatial distributions of water-leaving radiance and derived bio-optical variables.