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Ocean Optics Protocols For Satellite Ocean Color Sensor Validation, Revision 3, Volume 2

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Preface

This document stipulates protocols for measuring bio-optical and radiometric data for the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project activities and algorithm development. This document supersedes the earlier version (Fargion and Mueller 2000) and is organized into four parts:

- *Introductory Background*: The initial part covers perspectives on ocean color research and validation (Chapter 1), fundamental definitions, terminology, relationships and conventions used throughout the protocol document (Chapter 2), and requirements for specific *in situ* observations (Chapter 3).
- *Instrument Characteristics*: This group of chapters begins with a review of instrument performance characteristics required for *in situ* observations to support validation (Chapter 4), and the subsequent chapters cover detailed instrument specifications and underlying rationale (Chapter 5) and protocols for instrument calibration and characterization standards and methods (Chapters 6 through 8).
- *Field Measurements and Data Analysis*: The methods used in the field to make the *in situ* measurements needed for ocean color validation, together with methods of analyzing the data, are briefly, but comprehensively, reviewed in Chapter 9. The remaining chapters of this part provide detailed measurement and data analysis protocols for in-water radiometric profiles (Chapter 10), the Marine Optical Buoy (MOBY) radiometric observatory for vicarious calibration of satellite ocean color sensors (Chapter 11), above water measurements of remote sensing reflectance (Chapter 12), determinations of exact normalized water-leaving radiance (Chapter 13), atmospheric radiometric measurements to determine aerosol optical thickness and sky radiance distributions (Chapter 14), determination of absorption spectra from water samples (Chapter 15), and determination of phytoplankton pigment concentrations using HPLC (Chapter 16) and fluorometric (Chapter 17) methods.
- *Data Reporting and Archival*: Chapter 18 describes the methods and procedures for data archival, data synthesis and merging, and quality control applicable to the SeaWiFS Bio-optical Archive and Storage System (SeaBASS), which is maintained to support ocean color validation for the SeaWiFS, SIMBIOS and other cooperating satellite sensor projects. Current SeaBASS file content and formatting requirements are given in Appendix B.

What is new in Revision 3 to the ocean optics protocol document, as compared to Revision 2 (Fargion and Mueller 2000). The most obvious changes are the insertion of 3 new chapters into the document, and the renumbering of the other chapters to accommodate them. The new chapters are:

1. Chapter 2, *Fundamental Definitions, Relationships and Conventions*, introduces the radiometric quantities, inherent optical properties, fundamental concepts and terminology underlying the *in situ* measurement and analysis protocols discussed throughout the document. The chapter also discusses the scales adopted in these protocols for such quantities as extraterrestrial solar irradiance, and the absorption and scattering coefficients of pure water.
2. Chapter 11, *MOBY, A Radiometric Buoy for Performance Monitoring and Vicarious Calibration of Satellite Ocean Color Sensors: Measurement and Data Analysis Protocols*, documents the specific measurement and data analysis protocols used in the operation of this critical radiometric observatory. The MOBY normalized water-leaving radiance time series has provided the principal, common basis for vicarious calibration of every satellite ocean color sensor in operation since 1996.
3. Chapter 13, *Normalized Water-Leaving Radiance and Remote Sensing Reflectance: Bidirectional Reflectance and Other Factors*, develops the physical basis underlying the bidirectional aspects of the ocean's reflectance, and presents methods for removing this effect to determine *exact normalized water-leaving radiance*, the only form of water-leaving radiance suitable for comparisons between determinations based on satellite and *in situ* measurements.

Aside from renumbering, several of the chapters carried over from Revision 2 have been revisited and significantly revised, while others have been modified only slightly.