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Ocean Optics Protocols For Satellite Ocean Color Sensor Validation, Revision 3, Volume 1

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Chapter 3

Data Requirements for Ocean Color Algorithms and Validation

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3.1 INTRODUCTION

The principal *in situ* variables to be measured, or derived from measurements, for satellite ocean color sensor validation, and algorithm development and validation, are listed in Table 3.1. The variables are grouped, in Table 3.1, into four related groups: Radiometric Quantities (both oceanic and atmospheric), Inherent Optical Properties (IOP) of sea water, Biogeochemical and Bio-Optical Properties of sea water, and Ancillary Data and Metadata required to support the use, analysis, interpretation, and quality assessment of the other data. Those *in situ* variables that are measured are classified into three categories of descending priority.

The first category of measurements, flagged "Required" in Table 3.1, is the minimum subset required for validating a satellite sensor's radiometric performance, exact normalized water-leaving radiances (Chapter 13), and fundamental derived products, including chlorophyll a concentration, aerosol optical thickness, and K(490), and for associated algorithm development and validation.

The second category, flagged "Highly Desired" in Table 3.1, are measurements that supplement the minimum subset and are needed for investigations focused on atmospheric correction algorithms and aerosols, relationships between IOP and remote sensing reflectance, and/or Case 3 algorithms.

The third category, flagged "Specialized Measurement" in Table 3.1, are measurements which either address aspects of ocean bio-optics that are secondary to satellite remote sensing, or require highly specialized equipment that is not readily available to the community at large.

A fourth category, flagged as "Derived", comprises key quantities that are either calculated from the *in situ* measurements, or are derived from models. The above set of variables is also listed in Table 3.2, to identify the satellite ocean color sensor application for which each measurement is needed. Table 3.2 also provides an index of the protocol chapters addressing each *in situ* measurement.

3.2 RADIOMETRIC QUANTITIES

Surface incident spectral irradiance in air, $E_S(\lambda) \equiv E_d(0^+,\lambda)$, downwelled spectral irradiance, $E_d(z,\lambda)$, and upwelled spectral radiance, $L_u(z,\lambda)$, are the fundamental measurable quantities needed to derive normalized water-leaving radiances (or equivalently remote sensing reflectance) in most circumstances. Other radiometric properties listed in Table 3.1, including sky radiance and normal solar irradiance, are also important *in situ* measurements in the SIMBIOS ocean color validation program. Also listed are critical radiometric quantities that are calculated, or derived, from *in situ* measurements. In some cases, listed radiometric quantities may be derived, wholly or in part, from other non-radiometric measurements listed in the table. For example, remote sensing reflectance may either be calculated directly as the ratio of water-leaving radiance $L_W(\lambda)$ to incident irradiance, $L_W(\lambda) : E_S(\lambda)$, or it may be modeled as a function of the IOP ratio of the backscattering to absorption coefficients, $b_b(\lambda) : a(\lambda)$, and the Bidirectional Reflectance Distribution Function (BRDF) (Chapter 13).