**Data Processing and Archival in the Marine Optical Buoy Project (MOBY)**

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### Introduction

The primary reference instrument for ocean color satellites, including the U.S. Moderate Resolution Imaging Spectroradiometer (MODIS) and the Sea-Viewing Wide Field-of-View Sensor (SeaWIFS), is the Marine Optical Buoy (MOBY), a radiometric buoy stationed in the waters off Lieni, Hawaii. MOBY uses a hyperspectral instrument known as the Marine Optical System (MOS) to detect radiation over the spectral range from 350 nm to 955 nm. In MOBY, MOS is fiber-optically connected to radiance and irradiance ports on the three MOBY arms (identified Top, Mid, and Bot) that are located at depths of approximately 1.5 m, 5 m, and 9 m, as well as a surface irradiance port.

Data acquisition is autonomous and designed to overlap with the overpass of the sun-synchronous satellites, resulting in daily acquisitions at 20 h, 22 h, and 23 h, corresponding to SeaWIFS, MODIS-Terra and MODIS-Aqua, respectively. In this presentation, we describe the processing of the MOBY data sets, including what is collected, analysis and quality control, and dissemination and archival.

### MOBY Data Processing

The optical measurements (e.g., \(E_u\), \(L_u\) and \(L_w\)) by MOBY are sequential – the inputs from the different optical fibers are coupled to the spectrographs using an optical multiplexer mirror assembly. A complete data set for \(L_u\) at each depth includes multiple scans of \(L_u\), bracketed by a dark scan; the \(L_u\) measurement is bracketed in turn by a set of \(E_u\) scans (which are also bracketed by dark scans). The optical and ancillary data are stored on hard drive until transmitted to a server at MLML via modem and cellular antenna.

Pre-processing of the entire data set includes the incorporation of time stamps for the ancillary data, if necessary, rejection of anomalous radiometric scans, and removal of "spikes" in the radiometric data. Multiple scans are averaged, the data are normalized for integration time and bin factor (a sub-sampling along the slit direction in the CCD spectrographs), and the net counts are determined using the associated dark scans. Corrections are made for instrument temperature, which affects the radiometric responsivity as 0.5%/°C. The temperature correction algorithm is based on laboratory measurements at the MOBY facility in Honolulu, using a temperature controlled bath and stable radiometric sources.

### MOBY Processing Steps

- **MOS in temperature controlled bath**
- **In-water and system response temperatures (ref. is 32°C)**

### MOBY System Responses

- **Lw7 Total-Band (µW/cm²/sr/nm)**
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### MOBY Time Series, 22 Hour for MODIS-Terra

The water-leaving radiances, \(L_w\), are computed by upward extrapolation using the \(K_w\) and \(L_u\) data and propagation through the surface for nadir viewing. A solar-normalized water leaving radiance, \(L_{sw}\), is calculated by correcting for variations in the Earth-Sun distance and atmospheric transmittance (this is a simplified approach, aerosols are not included). Then, using relative spectral responsivity data provided by the satellite teams, band-averaged radiances are determined for \(L_s\) (all depths), \(L_{sw}\) and the \(L_{sw}\) values.

Additional quality control data are available. This includes scans of an internal lamp and two internal LEDs, verification of the stability of the wavelength calibration from observation of Fraunhofer lines, and assessment of the system level responsivity utilizing diver-deployed stable calibration lamps on monthly intervals.

### Distribution and Archival of Data

The satellite band averaged values for \(L_s\), \(E_u\) and \(L_{sw}\) are downloaded automatically to NASA. They are also displayed on the internet, see http://pyscocw.mpml.caltech.edu/moby/ These data are also password-protected and are available to NASA authorized users. Requests for access authorization should be made to NASA.

### Data Submissions

In October of 2006 spectral MOBY data from deployments 2-32 were provided to NASA. This data included upwelled radiance \(L_u\), surface irradiance \(E_s\), downwelled irradiance \(E_d\) and upwelled irradiance \(E_u\). All of the satellite weighted products were also provided. The data are in the Moss Landing database format (MLdbase). Documentation describing the format and ancillary data have been included.

### Summary

The MOBY data consist of a nine year record of in situ radiometric measurements. The values are derived using a robust system of multiple calibration and measurement procedures. Extensive instrument characterizations are the basis for correction of known systematic effects. The data are made available to users according to NASA guidelines.