Calibration and data processing for the WET Labs FL3 for the 2013 field season

Instrument: WET Labs FL3
Model/SN: FL3/2925
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Contact: Colleen Mouw, cmouw@uri.edu
Author: Audrey Ciochetto, audreyciochetto@uri.edu
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I. Description

The WET Labs FL3 measures fluorescence for chl *a*, phcocyanin and colored dissolved organic matter (CDOM). Excitation and emission wavebands are shown in Table 1. The instrument illuminates a volume of water using LEDs and detects fluoresced light at an acceptance angle of 124°. Data are measured at 1 Hz. A more detailed description of specific instrument design and optics can be found in the user's guide (WET Labs 2011a).

The FL3 was mounted on a package that also included a CTD (Sea-Bird, 37SI-100m), an ACS (WET Labs, ACS) and a BB9 (WET Labs, BB9). This allowed for concurrent measurements of temperature, salinity, depth, absorption/attenuation, and scattering coefficients. These ancillary data are not used during data processing. All instruments were connected through a data handling system (WET Labs, DH4) and controlled with the manufacturer's software (WET Labs, WL Logger Host, v7.09). Further information on set up and usage of data handling and software can be found in the user's guide (WET Labs 2011a). Collectively, this suite of instrumentation was called the Bio-Optical Package (BOP).

II. Calibration and Maintenance

The FL3 comes with an instrument-specific device file (FL3-2925.dev) that contains a dark count and scaling factor (units in Table 1) for each excitation/emission (EX/EM) pair. The factory calibration was performed on 2012-11-26 (Table 1).

Table 1. Sensor specifications and factory calibration values for the FL3.

Sensor	EX (nm)	EM (nm)	Scaling factor	Dark count
chl *a*	470	695	0.0122 (μg L^{-1}) $count^{-1}$	52
phycocyanin	630	680	0.0426 ppt $count^{-1}$	50
CDOM	370	460	0.0907 ppb $count^{-1}$	50

A post-season calibration of discrete extracted chl vs. concurrent fluorometer counts was performed and applied to FL3 profiles. For 2013, calibration slope was 0.0208 (μg chl L^{-1}) $count^{-1}$.

Dark offsets measured in the field during the 2013 season were not different from factory calibrations. Dark counts shown in Table 1 were applied.

Data from the phycocyanin and CDOM sensors were excluded from the dataset. Phycocyanin data were all close to the dark value and below a nominal detection limit of 80 counts. This is not surprising given the phytoplankton species typically found in Lake Superior. Also, data from the CDOM sensor were close to the dark value, suggesting the sensitivity of this sensor was set far too low for the Lake Superior system.

III. Sample collection and processing

The FL3 was mounted at the base of the BOP package such that the cage and other instrumentation would not interfere with the sensor. The ACS and BB9 were also mounted such that all measurements were at the same depth. The package was lowered at 0.2 m s^{-1} or as slow as possible to provide the maximum number of replicates for future binning. All casts were to ~50 m or to within 10-15 m of the bottom for shallower stations.

IV. Data Processing

FL3 data were first extracted using the manufacturer's software (WET Labs, WAP) from binary data to raw text and then engineering units by applying the device file discussed in Section II. Only raw text files were used during data processing as the post-season calibration was applied. Detailed instructions on using WAP software can be found in the user's guide (WET Labs 2011b). All further data processing was carried out using a custom set of MATLAB scripts. Data processing steps follow.

1) The post-season calibration was applied to raw counts to retrieve the concentration of chl *a* (µg chl L^{-1}):

$$[x] = S(C_m - C_d)$$

where S is the scaling factor, C_m is the measured instrument count and C_d is the dark offset. Data were excluded where $C_m \leq 80$ counts.

2) Data were binned to 1m. The median value for each bin is reported.

VI. References

WET Labs (2011a) *ECO 3-Measurement Sensor (Triplet) User's Guide*.

WET Labs (2011b) *WET Labs Archive File Processing (WAP) User's Guide*.