Kudela Lab HS6 Data Acquisition and Processing Protocols

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HS6 Data Acquisition

During a given cast, HydroScat-6P Spectral Backscattering Sensor & Fluorometer (HS6), manufactured by HOBI Laboratories, is deployed using a mechanized wench on an ocean-going vessel. It is first lowered 5-7m into the water column to dispel bubbles in the flow chambers, and is then raised and lowered through the water column in succession for a time period of 5-10 minutes (typically three cycles). HS6 measures optical backscattering and fluorescence in the visible at six channels and two channels respectively. It also has a pressure sensor, with which to measure depth. During casts, HS6 is typically deployed in conjunction with the ac-s (see kudelalab_ACS_readme.pdf for details).

HS6 Data Processing

Processing of HS6 optical backscattering data is minimal to allow the user flexibility in applying his/her own sigma-correction. First, optical backscattering is converted into particulate backscattering (b_{bp}) by subtracting the backscattering coefficient of pure water (b_w), estimated using methods described in Morel et al. (1974) (Eq. 1). We then perform on b_{bp}, QA/QC, discarding all particulate backscattering spectra containing one or more values less than 0 or greater than 0.5. Fluorescence data were not processed. However, fluorescence values were discarded if their corresponding backscattering spectra did not pass QA/QC standards. As with ac-s, we display HS6 data using two formats: 1. Individual b_{bp}spectra and fluorescence values, along with corresponding depths and time stamps are displayed in sequential order, and 2. Depth-binned b_{bp} and fluorescence averages are also calculated different depth bin sizes, as specified by user.

b_{bp}Sigma Correction

To correct for photon absorption along HS6's optical pathlength, we perform sigma-corrections on b_{bp}spectra prior to depth binning. Here we follow methods outlined in Doxaran et al. (2016). This entails using ac-s measured absorption values in order to calculate sigma, a wavelength-dependent correction coefficient by which particulate backscattering values are multiplied (Eq. 2-3). Whenever possible, we use binned absorption spectra sampled concurrently with HS6. When sigma-correcting b_{bp}, we select ac-s depth-binned at the same bin size at which we plan to depth-bin b_{bp} spectra. For each individual b_{bp} spectrum, we select the appropriate depth-binned absorption spectrum using nearest neighbor approach.

$$b_w(\lambda) = b_w(\lambda_o)\left(\frac{\lambda_o}{\lambda}\right)^{\gamma}$$

Eq. 1: Wavelength-dependent equation for pure water backscattering coefficient using wavelength ratios. The equation assumes knowledge of pure water backscattering at an initial wavelength (λ_o). We calculate $b_w(\lambda)$ using the settings suggested by Hydrosoft (HS6 processing software): λ_o= 525 nm, $b_w(\lambda_o)$ = 4.5x10-4 m-1, and γ = 4.32.

$$\sigma = k_1 \exp\left(K_{exp} K_{bb}\right)$$

Eq. 2: Sigma correction (σ). k_1 and K_{exp} are instrument-dependent coefficients. K_{bb} is an absorption- and backscattering-dependent coefficient (see below).

$$K_{bb} = a(\lambda) + 4.34 b_{bp}(\lambda)$$

Eq. 3: Absorption (a) and particulate backscattering (b_{bp})-dependent coefficient used to calculate σ.

Bibliography

Doxaran, D., E. Leymarie, B. Nechad, A. Dogliotti, K. Ruddick, P. Gernex, and E. Knaeps, *Improved correction methods for field measurements of particulate light backscattering in turbid waters.* Optics express, 2016. **24**: p. 3615-3637.

Morel, A, *Optical Aspects of Oceanography.* in *Optical Aspects of Oceanography*, M. G. Jerlov, and E. S. Nielsen, eds. (Academic Press Inc, 1977).