Instrument Report for AC-S on Tara Expedition

Instrument Name: AC-S
Instrument Model and S/N: ACS007
Instrument Purchase Date: June 2004
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Introduction

Absorption and attenuation measurements were made using the ac-s instrument, an in situ absorption and attenuation meter utilizing dual-flow tubes, a collimated source lamp, and spectra bandpass filters arranged on a rotating wheel to produce absorption and attenuation spectra at multiple wavelengths in the visible through near-infrared (Slade et al., 2010). Absorption is measured using a reflective tube and a wide-angle detector (with diffuser) and attenuation is measured using a nonreflective tube and collimated detector. The ac-s provides measurements at greater than 80 wavelengths using a linear variable filter, producing complete spectra at 4 Hz, nominal.
Please refer to Slade, et al. (2010) for additional information.

Calibration

We use a calibration independent technique to obtain particular absorption and attenuation by differencing measurements with a 0.2um filter from measurements made with no filter. Filters are exchanged weekly and flowtubes are cleaned about every other day to once a week (flow rate was monitored to insure filters did not clog).
The instrument was refit by the manufacturer with new lamps. We check the wavelength alignment on the instrument by seeing that the water-absorption temperature peak is within +/- 2nm form 739nm.
Please refer to Slade, et al. (2010) for additional information, including calibration procedures.

Deployment/Sample Collection

The ac-s sampling system (Fig. 8 in Slade et al., 2010) was set in the forward bilge of the R/V Tara.
A diaphragm pump (electric, 24VDC) was used to provide flowing seawater to the ac-s and other lab instruments. Seawater was drawn through the forward central seacock, through a coarse filter, then through the pump, a MSRC Vortex debubbler, and finally to instrumentation. Flow rates for the ac-s were maintained at approx. 4 L/min, and monitored using Omega FPR series paddle wheel flow sensors for data QC. Seawater flow was periodically diverted through a 0.2 micron filter (using a computer-controlled, electrically-actuated valve system), giving us measurements of the total and filtered seawater. Particulate optical properties were then calculated by difference. This method removes measurement inaccuracy due to biofouling and

drift in instrument calibration. In coastal regions switching between filtered and unfiltered measurements was done in 30min cycles while in open ocean every 60min (50min total, 10min dissolved). Refer to Slade, et al. (2010) for additional information on the flow-through valve system.
The ac-s was cleaned approximately weekly using alcohol, and the 0.2 micron cartridge filter was replaced and the filter housing was cleaned approximately every two weeks. Flow sensors and other plumbing were cleaned as needed, and Tygon tubing used in the ac-s was replaced when significantly fouled, approximately once per three months. Black tape was used on Tygon tubing near ac-s to prevent introduction of stray light into the sensor.

Data Processing

Data are filtered based on their being >+/-0.005nm and with standard deviation (over 1 min) < 0.03m^-1 at the most (large deviation is indicative of possible contamination by bubbles).
Data provided are minute binned absorption data (dissolved values needed to obtain the particulate values, are linearly interpolated to the time of particulate measurements).
We use the 3rd method of Zaneveld et al., 1994 to correct for scattering with 730nm as the null wavelengths simultaneously performing a residual temperature correction (see Slade et al., 2010). We have left spectra with negative absorption in the blue regions as these values are not significantly different from zero. In extreme cases we replace bad values with -9999. Uncertainty files based on the standard deviation within each min are also provided.

References

Slade, W.H, E. Boss, G. Dall'Olmo, M.R. Langner, J. Loftin, M.J. Behrenfeld, C. Roesler, and T.K. Westberry, 2010. Underway and moored methods for improving accuracy in measurement of spectral particulate absorption and attenuation. Journal of Atmospheric and Oceanic Technology, 27:10, 1733-1746. Download available here: http://misclab.umeoce.maine.edu/documents/Sladeetal2010JTECH.pdf