

NAAMES 3 ACS data processing

Nils Haëntjens and Emmanuel Boss

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Updated: March 21, 2019

Cruise: NAAMES 3

Region: North Atlantic

Dates: August 30 – September 25, 2017

Project website: <https://naames.larc.nasa.gov>

PROCESSING UPDATE FROM March 21, 2019:

Switch relationship used to derive chlorophyll a, from particulate absorption line height, from a global algorithm the NAAMES specific relation derived from HPLC.

PROCESSING UPDATE FROM Nov 6, 2018:

The wavelength registration of the absorption and attenuation spectrum was shifted by a few nanometers. This issue is corrected in the updated processing. For consistency with other NAAMES campaigns, the interpolation between two periods filtered is now linear instead of following the trend of the CDOM fluorometer.

A few products are also computed from the particulate spectrums:

- Chlorophyll a (chl) is computed using the particulate absorption line height at 676 nm and the global relationship from Tara Ocean (Boss et al. 2013):
 - $line_height = a_p(676) - (39/65 \times a_p(650) + 26/65 \times a_p(715))$
 - $chl_regional = 95 \times line_height^{1.06}$ (relationship applied here, specific to NAAMES)
 - $chl = 157 \times line_height^{1.22}$ (relationship not applied here, from Tara Ocean)
- The particulate organic carbon (POC) is computed using the particulate attenuation at 660 nm Using the global relationship from Gardner et al. (2006):
 - $POC = 380 \times c_p(660)$
- Gamma is computed using the method of Boss et al. 2001.

ORIGINAL PROCESSING DESCRIPTION (October 10, 2017)

We use a calibration independent technique (Slade et al., 2010) to obtain particulate absorption and attenuation by differencing measurements with a 0.2um filter from measurements made with no filter. Dissolved absorption and attenuation are obtained by subtracting daily MilliQ run from .2um filtered measurements. Filters are exchanged weekly and flow-tubes are cleaned about every other day to once a week. Switching between filtered and unfiltered measurements is done every 60min (50min total, 10min dissolved).

Bad spectrums are removed manually and arise, generally due to bubbles going through the ACS. The software automatically removed suspect minute of data which fail the following test:

$$\frac{bin_{95} - bin_5}{2\sqrt{n}} > \max(0.0025, 0.02 \times bin_{median}) \text{ or } \frac{bin_{std}}{\sqrt{n}} > \max(0.0025, 0.02 \times bin_{median})$$

Where bin_{95} and bin_5 are 95th and 5th percentile of the bin respectively, bin_{std} is the standard deviation of the bin, n is the number of measurements in the bin, bin_{median} is the median of the bin.

For each minute, the remaining data between 15th and 75th percentiles are binned-averaged and their standard deviation is kept for reporting. The particulate bins are processed by subtracting the filtered measurements from the unfiltered measurements. Filtered values needed to obtain the particulate values are interpolated to the time of particulate measurements using the CDOM fluorometer signal. Dissolved

bins are computed by differencing MilliQ and filtered data. The MilliQ values are linearly interpolated to match the filtered periods.

The mismatch in spectral band positions between absorption and attenuation are corrected using interpolation. 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 (Slade et al., 2010). Attenuation is also corrected for residual temperature effect. Then, we perform a spectral unsmoothing based on the method in Chase, A., et al., 2013. We have left spectra with negative absorption in the blue regions, as these values are not significantly different from zero.

The processing is independent from the calibration found in the device file provided here (acs015.dev). The device file was used to read the wavelength and indicate the last service of the instrument (3/6/17), as well as to provide the temperature compensation table used.

Please refer to the following document for additional information, including calibration procedures:

Boss, E., W.S. Pegau, W.D. Gardner, J.R.V. Zaneveld, A.H. Barnard., M.S. Twardowski, G.C. Chang, and T.D. Dickey, 2001. Spectral particulate attenuation and particle size distribution in the bottom boundary layer of a continental shelf. *Journal of Geophysical Research*, 106, 9509-9516.

Emmanuel Boss, Marc Picheral, Thomas Leeuw, Alison Chase, Eric Karsenti, Gabriel Gorsky, Lisa Taylor, Wayne Slade, Josephine Ras, Herve Claustre, 2013. The characteristics of particulate absorption, scattering and attenuation coefficients in the surface ocean; Contribution of the Tara Oceans expedition, *Methods in Oceanography*.

Chase, A., et al., 2013. Decomposition of in situ particulate absorption spectra. *Methods in Oceanography* 7, 110-124.

Gardner, W.D., Mishonov, A., Richardson, M.J., 2006. Global POC concentrations from in-situ and satellite data. *Deep Sea Res. II* 53, 718–740.

Slade, W.H, E. Boss, G. Dall'Olmo, M.R. Langner, J. Loftin, M.J. Behrenfeld, and C. Roesler, 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.

Zaneveld, J. R. V., J. C. Kitchen, and C. Moore, “The scattering error correction of reflecting-tube absorption meters,” in *Ocean Optics XII*, S. G. Ackleson ed., Proc. SPIE 2258, 44-55 (1994).