

EXPORTS NA (May 2021) Eco-bb3 Processing Report V1

Emmanuel Boss, August 2021

Measurements

Spectral backscattering (centered at 475, 532, 650nm w/ Gaussian-fit stdev of ~10nm) was measured continuously on board the R/V Cook during the *EXPORTS NA* expedition in the North Atlantic May 2, 2021, to May 31st, 2021, using a EcoBB2 (serial number 1052). The Eco-bb3 was set after a switching system running 0.2 μ m filtered sea water through the instrument the first 12 minutes of every hour and total (“normal”) seawater was flowing the rest of the time. This setup allows to retrieve particulate backscattering independently from the instrument drift and the biofouling effect (Slade et al., 2010). The data was logged with a home-grown data-logger (Inlinino, <http://inlinino.readthedocs.io/>). The 0.2 μ m filter was changed every 5 days and the EcoBB3 was cleaned daily.

Processing notes

Particulate data:

Data was processed following Boss et al. (2019), using a custom software for in-line optical data processing

(<https://github.com/OceanOptics/InLineAnalysis/commit/e4d90b9fb110f539d428a3b07c39ff8660bc874c>).

All in-line instruments were logged on the same computer which was synchronized with the ship’s GPS date/time and latitude/longitude. Total and filtered data were first separated according to flow data of the in-line data. Automatic QC was applied to the raw data removing a single wavelength measure on a spectrum when the average of the other two wavelength is 3 times lower than the one QCed. For each minute of the total seawater measurement, the signal between the 2.5th and 97.5th percentiles are averaged, and their standard deviation is kept for reporting. The automatic QC and the 2.5th to 97.5th percentiles averaging filters out noisy spikes from bubbles.

The particulate VSF are computed depending on the switch position. They are obtained by subtracting the filtered from the total values (filtered values are linearly interpolated). These differences include the dark and wall effects of the BB-box. The slope coefficient provided by the manufacturer (see table below) is used for all wavelengths. The particulate backscattering coefficient (bb_p) is computed using $\chi=1.12$ (nominal angle 120, Boss and Pegau, 2001).

The flow was sometimes very low and the volume of water in the BB-box did not have time to be completely replaced by filtered water during the 10 minutes of filter events. Following the method in Dall’Olmo et al. (2009), we fitted the following relation (1) to the exponential decay of beta counts of the BB3 sensor after the switch change from total to filtered.

$$bb_p(t) = bb_p(<0.2\mu\text{m}) + bb_p(t_0) \exp[-s(t-t_0)] \quad (1)$$

Where t_0 is the first point of the 0.2- μ m filtered data used for the fit and s is the decay constant that is proportional to the ratio of the seawater flow rate to chamber volume. $bb_p(<0.2\mu\text{m})$ was then used as the ‘true’ backscattering measurement for each filter event and each wavelength.

For calibration values used, see calibration report in Calibration_history_EcoBB3_1052.pdf.

Uncertainties based on variability within a one-minute bin are provided in the file. True uncertainties are, however, higher, about 12% (higher in at 650nm) based on the calibration uncertainty and

procedure to obtain the particulate back-scattering measurement from a measurement from a single angle in the back direction.

The data was not corrected for attenuation along the path, which is the waters we were in would be less than 1%. Will be done in the next version.

References:

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<https://doi.org/10.1016/j.mio.2013.11.002>

Dall'Olmo, G., Westberry, T.K., Behrenfeld, M.J., Boss, E., Slade, W.H., 2009. Direct contribution of phytoplankton-sized particles to optical backscattering in the open ocean. *Biogeosciences Discuss* 6, 291–340. <https://doi.org/10.5194/bgd-6-291-2009>

Slade, W.H., Boss, E., Dall'Olmo, G., Langner, M.R., Loftin, J., Behrenfeld, M.J., Roesler, C., Westberry, T.K., 2010. Underway and Moored Methods for Improving Accuracy in Measurement of Spectral Particulate Absorption and Attenuation. *Journal of Atmospheric and Oceanic Technology* 27, 1733–1746.
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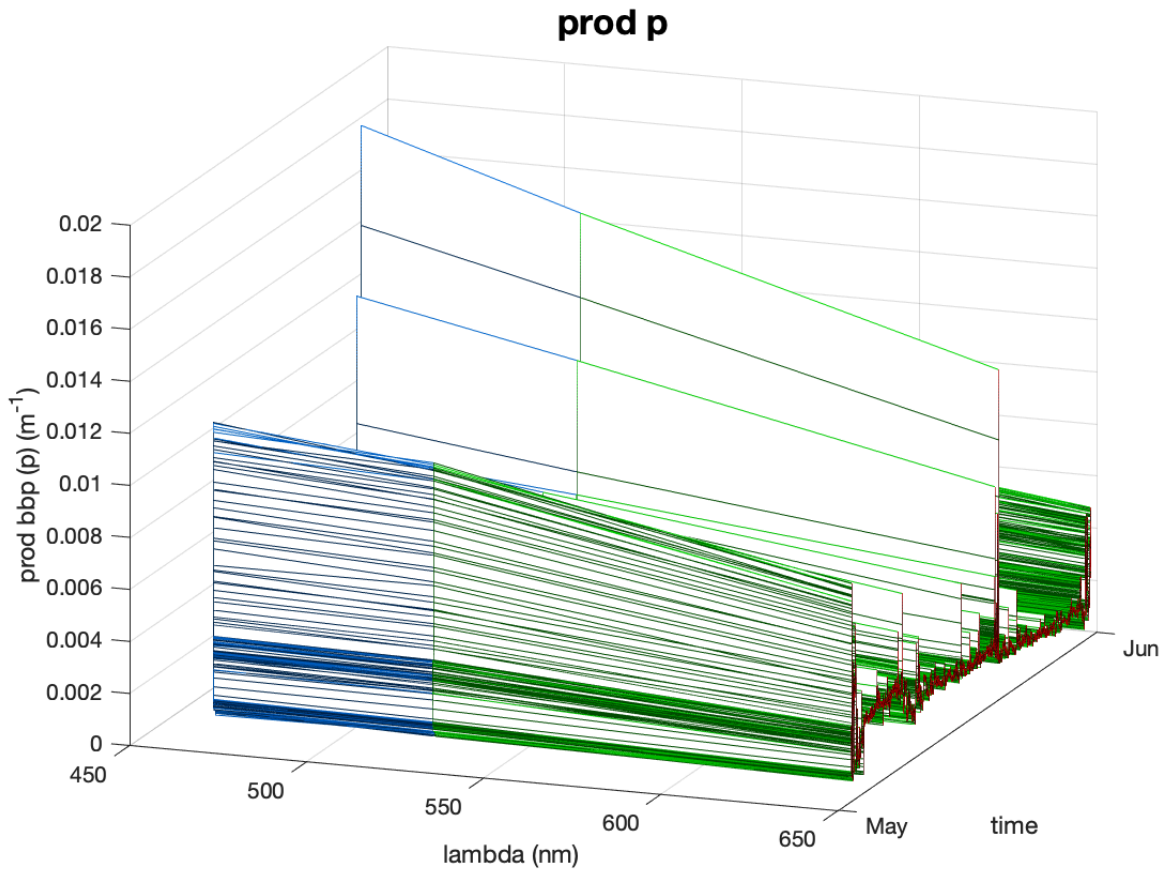


Figure 1. spectra of particulate backscattering for the whole expedition.