Backscatter sensors, SG219

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This document describes how measurements of optical backscatter at 470 and 700 nm from Seaglider (SG) 219 during EXPORTS North Pacific 2018 were processed for submission to the SeaBASS dataset. This processing involved 5 steps, as enumerated below.

Step 1. Re-calibrate data

Internal Seaglider processing converts changes in counts into scattering measurements, in units of m^{-1} sr^{-1}, from a calibration sheet. The calibration involves a multiplicative coefficient to convert between counts and scattering, and a scalar offset to account for non-zero dark counts. Due to an error in the initial calibration files, these values needed to be updated. The user should note that earlier versions of this dataset (not published in SeaBASS) may have the incorrect calibration parameters applied. The correct calibration parameters are attached at the end of this document.

Step 2. Subtract seawater scattering

Seawater scattering contributes to the total signal and can be a substantial fraction of the total in oligotrophic areas. We estimated seawater scattering at 470 and 700 nm and a 124 deg scattering angle using the method of Hu, Zhang, and Perry (2019), which includes temperature, salinity, and pressure effects. These variables were taken from the Seaglider CTD. Seawater scattering was subtracted from the measured value. Python code to calculate this seawater scattering is included in this data submission.

Step 3. Filter to isolate scattering spikes

Spikes in backscatter data can be common, and are often thought to result from large particulates such as phytoplankton aggregates. We followed the published method of Briggs et al. (2011) by using subsequent 7-point (about 7 m, but greater at depth) minimum and maximum filters to describe the baseline, or de-spiked, backscatter signal. The spikes were then isolated as the difference between the full and de-spiked data.

Step 4. Convert from scattering to backscattering

Measurements of scattering were taken at 470 and 700 nm at a scattering angle of 124 degrees. We report backscattering, or the total signal scattered in the backwards direction (>90 degrees). The conversion between backscatter (b_{bp}; m^{-1}) and side scattering (β; m^{-1} sr^{-1}) is:

$$b_{bp} = 2\pi\chi\beta$$

where χ at 124 degrees was estimated to be 1.02 for this location (see the README file for the EXPORTS 2018 North Pacific CTD processing at https://seabass.gsfc.nasa.gov/archive/UCSB/CRSEO/EXPORTS/EXPORTSNP/documents/README_EXPORTSNP_CTD_R2.pdf). As that analysis demonstrates, this value has very narrow confidence intervals (80% of data are within 0.01 of this value) and there is no significant deviation with depth or wavelength.

Step 5. Interpolate to a regular grid

The final particulate, de-spiked backscatter data were interpolated onto a regular grid with depth in the same manner as the other parameters in this data submission.

References:

Briggs, N., Perry, M. J., Cetinić, I., Lee, C., D'Asaro, E., Gray, A. M., & Rehm, E. (2011). High-resolution observations of aggregate flux during a sub-polar North Atlantic spring bloom. *Deep Sea Research Part I: Oceanographic Research Papers*, *58*(10), 1031-1039.

Hu, L., Zhang, X., & Perry, M. J. (2019). Light scattering by pure seawater: effect of pressure. *Deep Sea Research Part I: Oceanographic Research Papers*, *146*, 103-109.

$\bar{\theta}$

$\Delta\theta$

$\bar{\theta}$ $\circ$

$\Delta\theta$ $\circ$

$\bar{\lambda}$

β(θ **–**