Distributed Biological Observatory (DBO) 2018 Cruise Report
CCGS Sir Wilfrid Laurier
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Polar Science Research Lab
Clark University
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Parameters Measured
Chlorophyll-*a* (chl-*a*) and Pheophytin
Suspended Particulate Matter (SPM)
Chromophoric Dissolved Organic Matter (CDOM)
Dissolved Organic Carbon (DOC)
Compact-Optical Profiling System (C-OPS) deployments

Field Measurements Summary
Sampling onboard the *Sir Wilfrid Laurier* DBO cruise took place in July 2018 this past year, with actual sampling dates from 16–22 July 2018 (Table 1, Figure 1). Sampling efforts on this particular cruise include measurements of chlorophyll-*a*, pheophytin, chromophoric dissolved organic matter (CDOM), dissolved organic carbon (DOC), and compact-optical profiling system (C-OPS) optical deployments. As this cruise ended relatively recently, we are still in the processing and analysis stages of our data collections and will post our results to the Arctic Data Center as soon as they are available. Details regarding sample collection and analysis can be found in the subsections below.

Data Collections
Collections for suspended particulate matter (SPMs), chromophoric dissolved organic matter (CDOM), dissolved organic matter (DOC), chlorophyll-*a* (chl-*a*) and phaeophytin, and measurements for irradiance/radiance through the water column with the compact optical profiling system (C-OPS) instruments were performed over the course of this DBO 2018 cruise. Chl-*a* is used as a biomarker for production to understand the distribution of primary producers in the water column. SPMs additionally allow for quantification of non-algal particles. CDOM refers to the dissolved portion of organic matter that has optical properties. These properties, based on their absorbance at different wavelengths from 800 to 200 nm give insight into DOM quantity and quality as well as their impact on irradiance/radiance in the water column. Optical

observations taken with the C-OPS profiling radiometers measures light penetration from the surface of the water down through the water column. The profiles not only allow for further investigation of biological/biogeochemical processes in the water column, but also aid in validating/calibrating ocean satellite data. This allows for a synoptic understanding of how the biogeochemistry changes in the water column as it will affect light availability and the potential impact on primary production, photodegradation of DOM, and/or ocean water column heating.

Table 1. Summary of sampling stations for the 2018 *Sir Wilfrid Laurier* DBO cruise.

Station	Date (PDT)	Chl-*a*/Pheo	SPM	DOC	CDOM	C-OPS
SLIP-1	7/16/2018	X	X	X	X	
SLIP-2	7/16/2018	X	X	X	X	X
SLIP-2b	7/16/2018					
SLIP-3	7/16/2018	X	X	X	X	X
SLIP-3b	7/16/2018					
SLIP-5	7/16/2018	X	X	X	X	
SLIP-5b	7/17/2018					
SLIP-4	7/17/2018	X	X	X	X	
SLIP-4b	7/17/2018					
SLIP-4c	7/17/2018					
BCL-6a	7/17/2018	X	X	X	X	
BCL-6b	7/17/2018					
BCL-6c	7/17/2018	X	X	X	X	X
DBO2.0a	7/17/2018					
UTBS-5	7/17/2018	X	X	X	X	X
DBO2.1a	7/18/2018					
UTBS-2	7/18/2018	X	X	X	X	
DBO2.2a	7/18/2018					
UTBS-2a	7/18/2018	X	X	X	X	
DBO2.7	7/18/2018	X	X	X	X	
DBO2.6	7/18/2018					
UTBS-1	7/18/2018	X	X	X	X	X
DBO2.4a	7/18/2018					
UTBS-4	7/18/2018	X	X	X	X	X
BRS-2	7/18/2018	X	X	X	X	
BRS-3	7/19/2018	X	X	X	X	
BRS-4	7/19/2018	X	X	X	X	
UTN-1	7/19/2018	X	X	X	X	
UTN-2	7/19/2018	X	X	X	X	X
UTN-3	7/19/2018	X	X	X	X	X
UTN-4	7/19/2018	X	X	X	X	X
SEC-8	7/20/2018	X	X	X	X	
SEC-7	7/20/2018	X	X	X	X	X
SEC-6	7/20/2018	X	X	X	X	X
SEC-5	7/20/2018	X	X	X	X	X
SEC-4	7/20/2018	X	X	X	X	X
SEC-3	7/20/2018	X	X	X	X	X

UTN-6	7/20/2018	X	X	X	X	X
SEC-2	7/20/2018	X	X	X	X	X
SEC-1	7/21/2018	X	X	X	X	
UTN-7	7/21/2018	X	X	X	X	
DBO4.6n	7/22/2018	X	X	X	X	X
DBO4.5*	7/22/2018	X	X	X	X	X
DBO4.5n*	7/22/2018					X
DBO4.4na	7/22/2018					
DBO4.4n	7/22/2018	X	X	X	X	X
DBO4.3na	7/22/2018					
DBO4.3n	7/22/2018	X	X	X	X	X
DBO4.2na	7/22/2018					
DBO4.2n	7/22/2018	X	X	X	X	

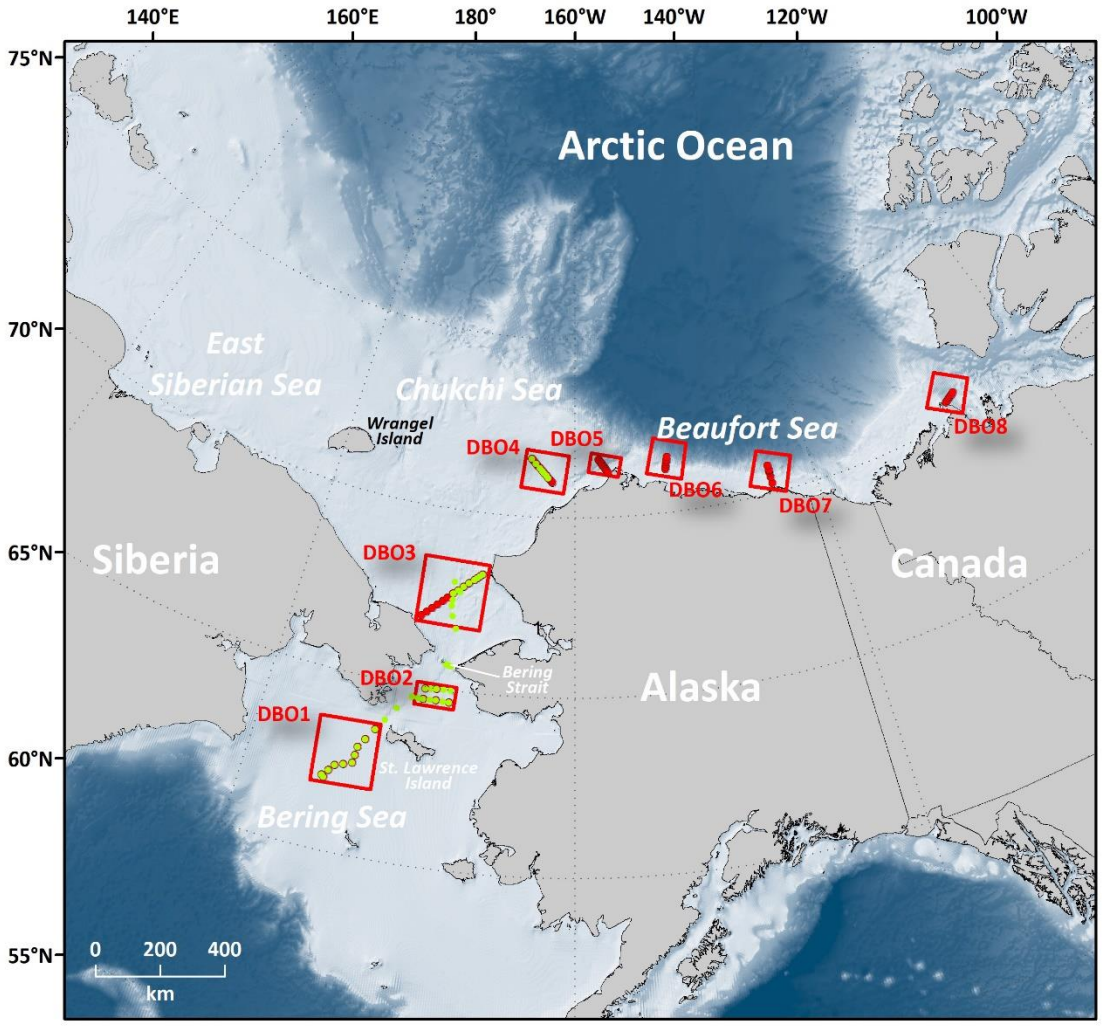

Figure 1. Sampling sites for the *Sir Wilfrid Laurier* cruise in July 2018. All DBO sites are shown in red, those sampled in 2018 are shown in green.

Data Collection and Processing

Chlorophyll-a/Pheophytin
Chorophyll-a samples were filtered using 200 mL of seawater through 0.7 μm GF/F glass fiber filters. Filters were frozen (-20°C), stored, and shipped on ice to Clark University where they will be subsequently measured on a Turner Designs Trilogy Fluorometer following a 48-hour dark incubation with 90% acetone using the acidification method. Fluorescence values for chl-*a* and pheopigments will then transferred with a lab-standard corrected algorithm into units of μg/L.

Suspended Particulate Matter (SPM)
To measure SPM, 0.7 μm GF/F glass fiber filters were rinsed with 500 mL Milli-Q (18 Ω) water, dried, combusted (4–6 hours at 450°C, and pre-weighed. SPM samples were then filtered using ~1000 mL of seawater (occasionally smaller volumes at high concentration sites/depths) and rinsed with ~60 mL Milli-Q water to reduce salt accumulation. Samples were then dried at 55°C for at least an hour before being sealed with parafilm, frozen at -20°C, and shipped to Clark University to be re-weighed (Figure 2).

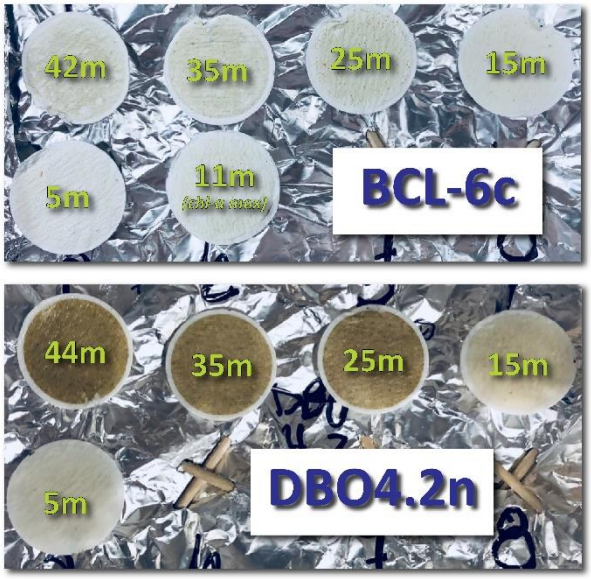

Figure 2. Examples of SPM filters from July 2018 showing variability between stations (e.g., BCL-6c vs. DBO4.2n) as well as variability with depth.

Chromophoric Dissolved Organic Matter (CDOM)
Water samples for CDOM analyses were filtered using pre-rinsed (10% HCl and then Milli-Q (18 Ω water) 0.2 μm Whatman nuclepore polycarbonate track-etched membranes immediately after rosette sampling. CDOM samples were stored in the dark at 4°C in acid-washed (10% HCl), pre-combusted (450°C for 6 hours) foil-covered Qorpak clear glass bottles and analyzed immediately shipboard on a Shimadzu UV-1800 UV-Vis spectrophotometer (800–200 nm at 1 nm intervals) using a 10 cm quartz cuvette. All sample spectra were blank corrected and referenced against Milli-Q water. Measurements were made after samples had equilibrated to laboratory temperature in order to minimize temperature effects. CDOM absorbance was treated

as zero above 750 nm (i.e., the average absorbance between 750 nm and 800 nm was subtracted from the spectra to correct for offsets owing to instrument baseline drift, scattering, and/or refractive effects. CDOM absorption coefficients were calculated from:

$$a(\lambda) = 2.303A(\lambda)/l$$

where a is the Naperian absorbance at the wavelength, and l is the cell-path length in meters. The detection limit is approximately ± 0.05 m^{-1}, based upon instrument specifications and characteristics. The spectral slope (*S*) of each CDOM absorbance spectrum is calculated using a non-linear fit of an exponential function:

$$a(\lambda) = a(\lambda_0)e^{-S(\lambda-\lambda_0)}$$

where $a(\lambda)$ is the absorption coefficient of CDOM (m^{-1}) at wavelength λ, and λ_0 is the reference wavelength (in this case 250 nm). Example CDOM sections from 2017 are shown in Figure 3.

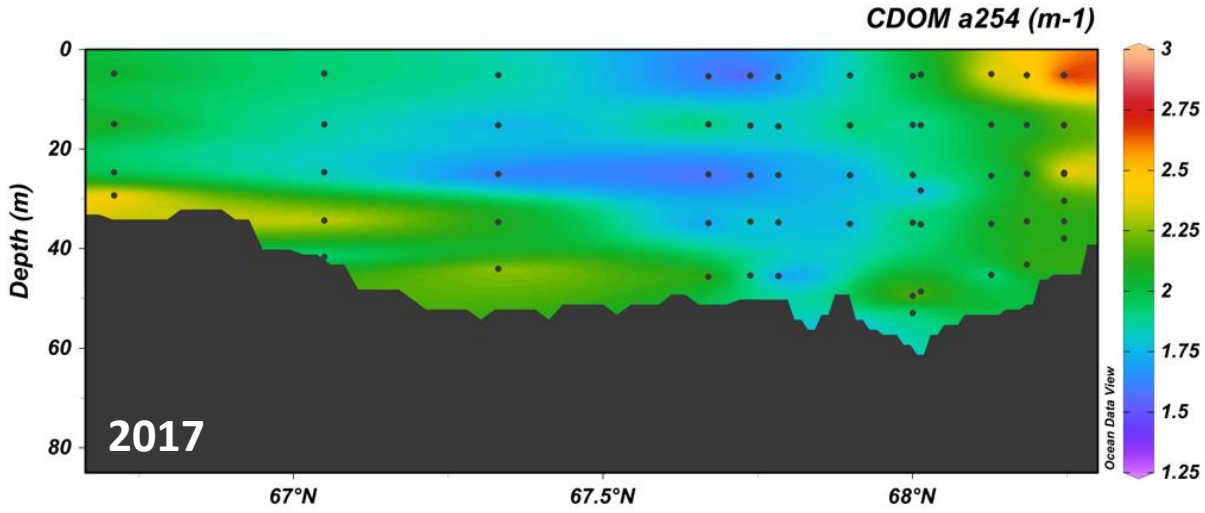

Figure 3. Example transect of chromophoric dissolved organic matter (CDOM) (a_{254}) absorbance (m^{-1}) across DBO3 based on field measurements collected on the *Sir Wilfrid Laurier* in 2017. Data from samples analyzed in 2018 are currently being calculated and compiled.

Dissolved Organic Carbon (DOC)

Samples for DOC were filtered and treated identically as CDOM samples (see above). After filtration and bottling, samples were placed in a -20°C freezer and will be shipped to the University of Maryland Chesapeake Biological Laboratory for analysis on a Shimadzu Total Organic Carbon (TOC) Analyzer.

Compact Optical Profiling System (C-OPS)

Optical measurements taken with the C-OPS profiling radiometers measures light penetration from the surface of the water down through the water column. Optical profiles (downwelling

irradiance and upwelling radiance) were collected at 19 channels (320, 340, 380, 395, 412, 443, 465, 490, 510, 532, 555, 560, 625, 665, 670, 683, 710, 780 nm, and photosynthetically active radation (PAR, 400–700 nm)) at 20 total stations (Figure 4, Table 1). The profiles not only allow for further investigation of biological/biogeochemical processes in the water column, but also aid in validating/calibrating ocean satellite data. In particular, the optical data can ultimately be used in concert with water column biological/biogeochemical measurements collected to calculate normalized water leaving radiance values (via the radiative transfer modeling software Hydrolight, which has recently been purchased by Frey) to directly compare with satellite-derived values of normalized water leaving radiance values. Examples of a variety of downwelling irradiance profiles collected in July 2018 can be seen in Figure 5.

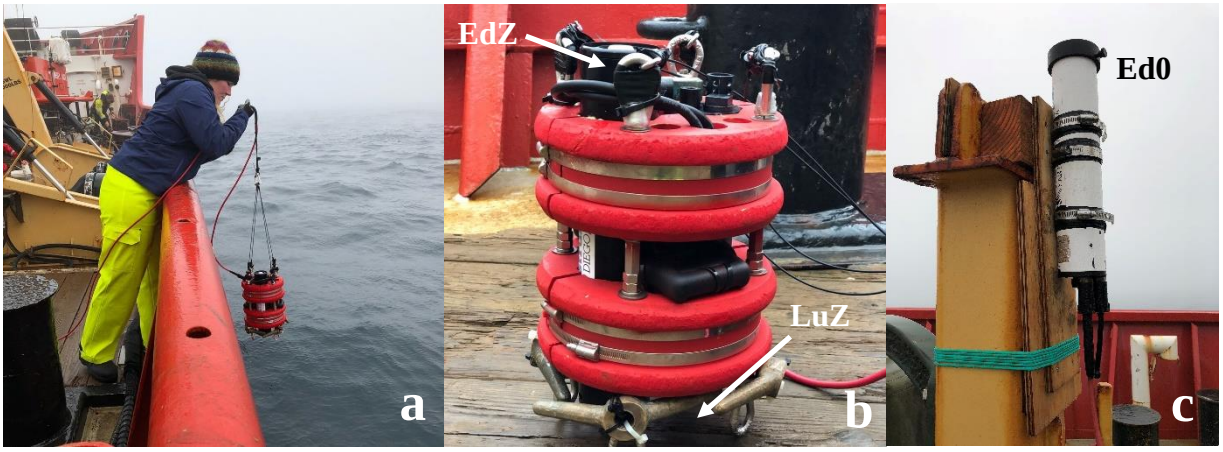

Fig 4. Setup of the C-OPS system, showing (a) a typical deployment off the bow and the three radiometers that simultaneously collect data: (b) the EdZ profiling radiometer measuring downwelling radiance and the LuZ profiling radiometer measuring upwelling radiance, as well as (c) the Ed0/surface reference radiometer.

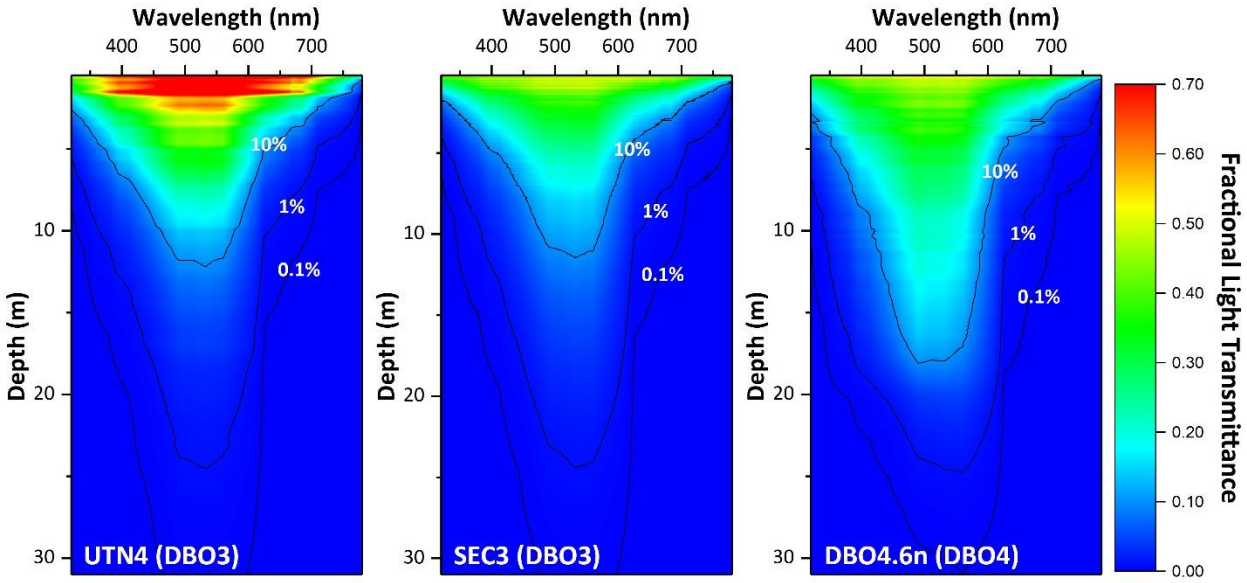

Fig 5. Example optical profile data from the C-OPS instrument for stations UTN4, SEC3, and DBO4.6n collected in July 2018.