

The 2018 EXPORTS Pacific Experiment

Calibration of Chlorophyll on Lagrangian Float #92

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Summary

Chlorophyll fluorescence measured on the EXPORTS Lagrangian float (#92) spanning 16 August 2018 to 01 December 2018 was calibrated to chlorophyll concentration based on calibration casts made from the *R/V Sally Ride*. One additional cast at recovery shows significant deviations from this calibration suggesting that the calibration, or community, shifted during the deployment. The adjusted data is released as *EXPORTS-EXPORTSNP_Ch1_Seabird_float_20180814_R1.sb*

1. Sensors & Mission

Float 92 was the only Lagrangian float deployed in EXPORTS 2018. It carried SBE-41-CT sensors on the top (Fig 1a) and bottom (Fig. 1b) endcaps with the entrances to the sensors separated vertically by 1.69 m. Pressure was measured with sensors attached to the inside of the top and bottom endcaps, separated vertically by ~1.15 m. A Wetlabs FLNTU backscatter and chlorophyll sensor (SN 4992, Fig. 1b) was attached to the bottom endcap with the sensing volume at the same level as the input to the bottom CTD. This report describes the chlorophyll data from that sensor.

Float 92 was deployed on 14-Aug-2018 07:15Z from the *R/V Sally Ride*, sampled for 109.3 days with the last data taken on 01-Dec-2018 14:34 Z. The float was recovered shortly thereafter by *R/V Sikuliaq*. The FLNTU sampled 101198 data points, with an average separation of ~93 seconds. The float also successfully measured nitrate, oxygen, temperature, salinity and pressure. The accuracies of these sensors are described in other data reports.

Calibration casts for Chlorophyll used here were made from the *R/V Sally Ride* during the main experimental period and from the *R/V Sikuliaq* at recovery. Cast times are listed on plots in Appendix A. Additional information on ship CTD casts is available in EXPORTS ship data reports.

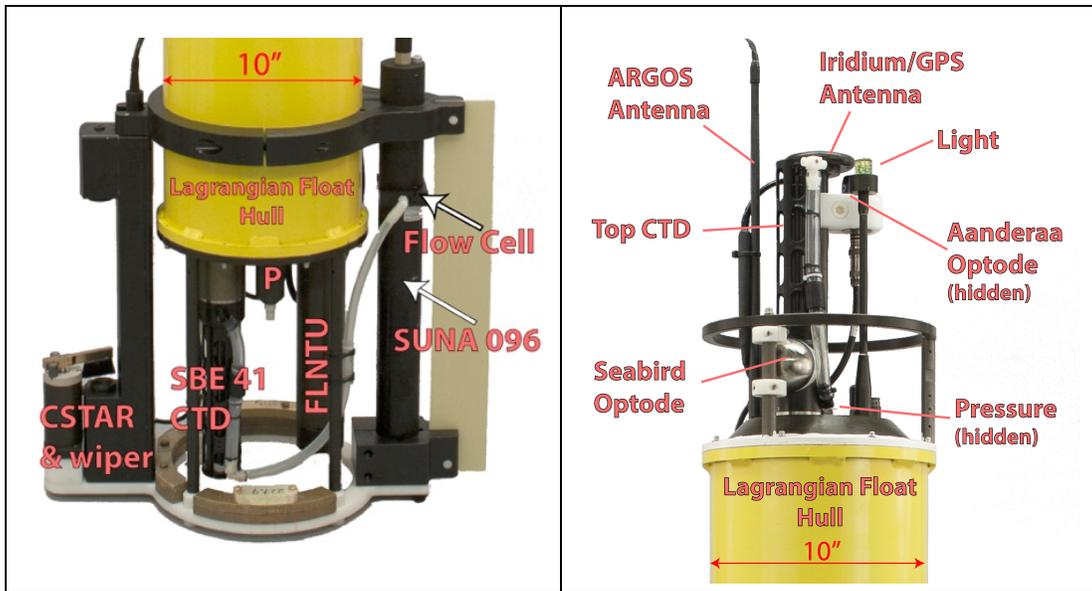


Figure 1. Sensors at a) bottom and b) top of EXPORTS float 92. A flag was attached to the top, endcap but not shown here.

The float executed a simple mission (Fig. 2) alternating between daily profiles to 200m and a Lagrangian drift at approximately 100 m. More precisely, during the drift the float targeted the 25.85 kg m^{-3} isopycnal maintaining this isopycnal between the top and bottom CTDs as it moved vertically $\pm 10\text{m}$ due to internal waves and tides and mesoscale eddies (Fig. 3). Profiles occurred once per day, timed to approximating 0130Z during the cruises so as to facilitate calibration casts, and to approximately 1300Z thereafter, so as to facilitate nighttime air calibrations of the oxygen probe.

The CTD sensors on the float were sampled every 100s during the drift and 15-75s during profiles depending on other activities. Other sensors were sampled less frequently, mostly to save energy.

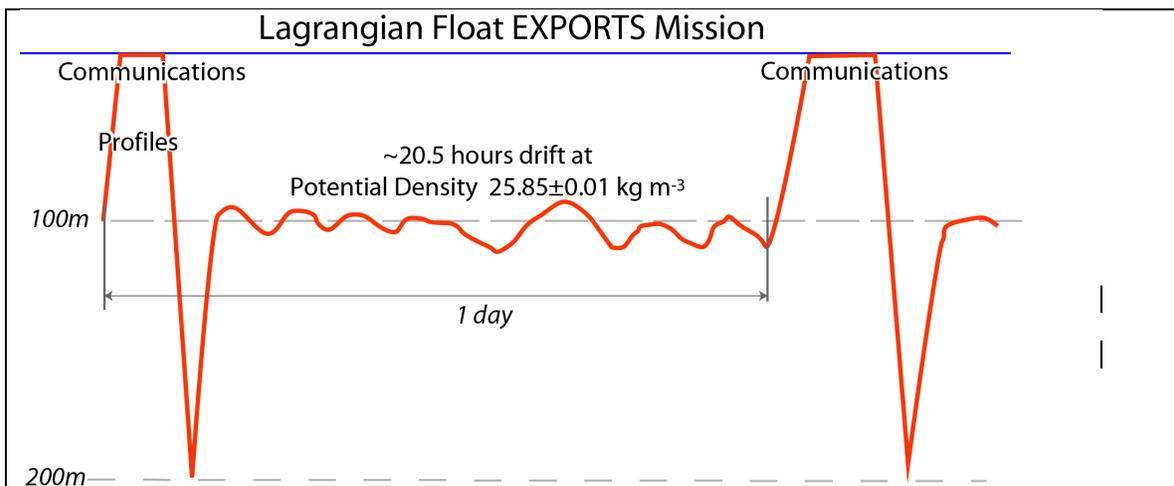
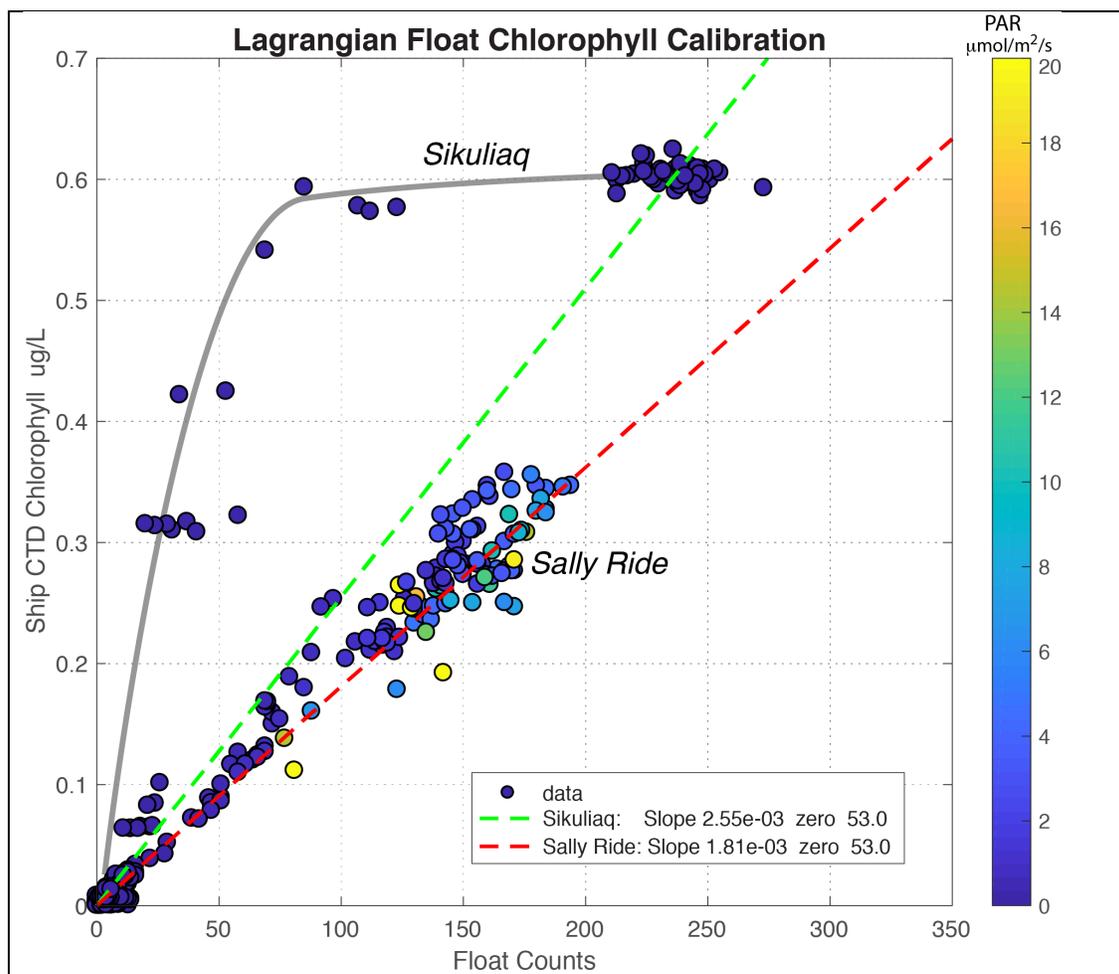
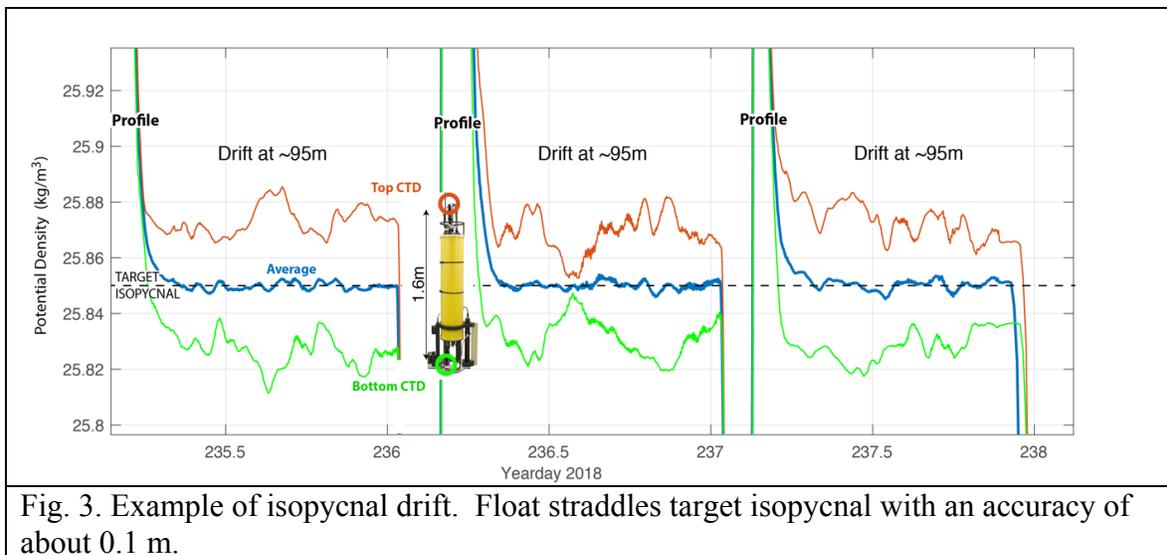


Fig. 2. Float mission. Float alternated between daily profiles from 200m to the surface and a Lagrangian drift at approximately 100m.



2. Chlorophyll Calibration

EXPORTS Chlorophyll calibration is described in detail in the Report “Chlorophyll Fluorescence Calibration to HPLC Chlorophyll a” attached to the data release.

The Lagrangian float was calibrated using 5 calibration casts from the *R/V Sally Ride* during the main experimental period and 1 cast from the *R/V Sikuliaq* near float recovery. The *Sally Ride* casts were all made within 1 km and 30 minutes of a float downcast. The *Sikuliaq* cast was made within 1 km of the final float position, but 36 hours before the float profile. The casts are plotted in Appendix A.

A dark count for the sensor was determined from the median counts below 170 dbar. The deepest data is at 232 dbar; deeper data might produce a smaller dark count. A value of 53 counts was used.

Fluorescence counts, with the dark value subtracted, were converted to Chl-a units by comparing with the calibrated Chl-a values from the ship’s CTD. Ship CTD Chl data were linearly interpolated to the potential density of the float measurements and plotted in Figure 4. Only data with PAR values less than 20 were used in the calibrations.

Two groups of data are apparent in Fig. 4. The lower group is from the Sally Ride calibration casts. A linear fit (red dashed line) yields the slopes used in the Lagrangian float Chl-a calibrations.

The upper group is from the Sikuliaq calibration cast. These lie above the Sally Ride and are nonlinear with a much steeper slope in the pycnocline than in the mixed layer. This may represent different phytoplankton communities in the two depth ranges, or from the large time between the calibration cast and float profiles or from the different shapes of the density and chlorophyll profiles. The suggested calibration (green dashed line) runs through the zero and the mixed layer values and ignores the pycnocline data. These data suggest that may be a change in the chlorophyll calibration during the 109 days of the Lagrangian float deployment, but do not specify how, when or at what depth the calibration changed. Since this calibration is of low quality, it is not applied to the released Lagrangian float data.

Based on this, the conversion from Lagrangian Float 92 chlorophyll fluorescence counts to Chl-a concentrations (mg m^{-3}) from the start of the record through September 8, 2018 is:

$$\text{Chl-a (mg m}^{-3}\text{)} = (\text{counts} - 53) * 0.00181$$

At the end of the record (December 2, 2018), a second calibration was found

$$\text{Chl-a (mg m}^{-3}\text{)} = (\text{counts} - 53) * 0.00255$$

3. Data variables

Chlorophyll data from the FLNTU sensors on the bottom of the EXPORTS Lagrangian float was calibrated with data from the *R/V Sally Ride* CTD during the 2018 EXPORTS field campaign. The adjusted data is released in

EXPORTS-EXPORTSNP_Ch1_Seabird_float_20180814_R1.sb

All variables are on the same timebase. Bottom CTD intake is at the same level as the FLNTU sensing volume.

Name	Description	Accuracy
Date and time		1 sec
lat, lon	Position interpolated from GPS fix	10m at GPS fix time.
wt	Temperature ITS-90 degrees C at bottom CTD intake	±0.002 C
sal	Practical salinity EOS-80 psu at bottom S CTD intakes	±0.002 psu between sensors ±0.01 psu absolute
pressure	Pressure dbar relative to sea surface at bottom PP CTD intake	Relative difference is fixed. ±0.4 dbar absolute
stimf counts	Raw chlorophyll counts	
chl	Calibrated Chlorophyll mg/m ³	±0.05 during cruises ±0.1 afterwards

APPENDIX A - Calibration Casts