Pure water calibration of AC-S data at the Irminger Array

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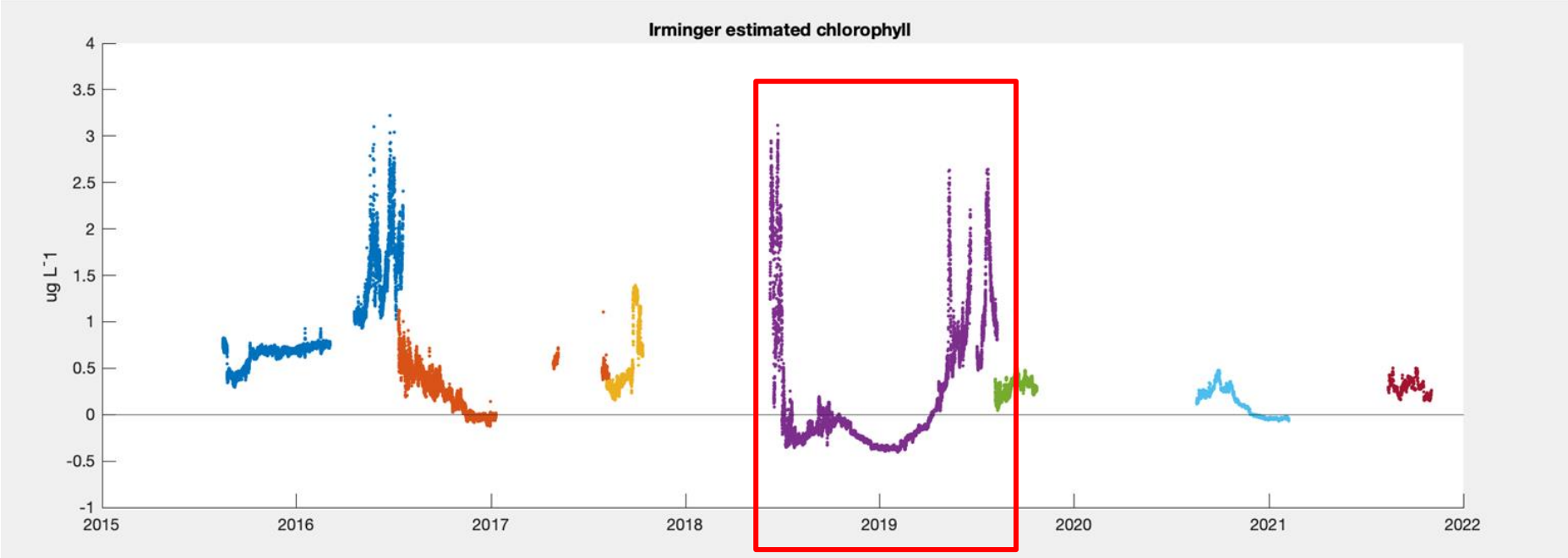
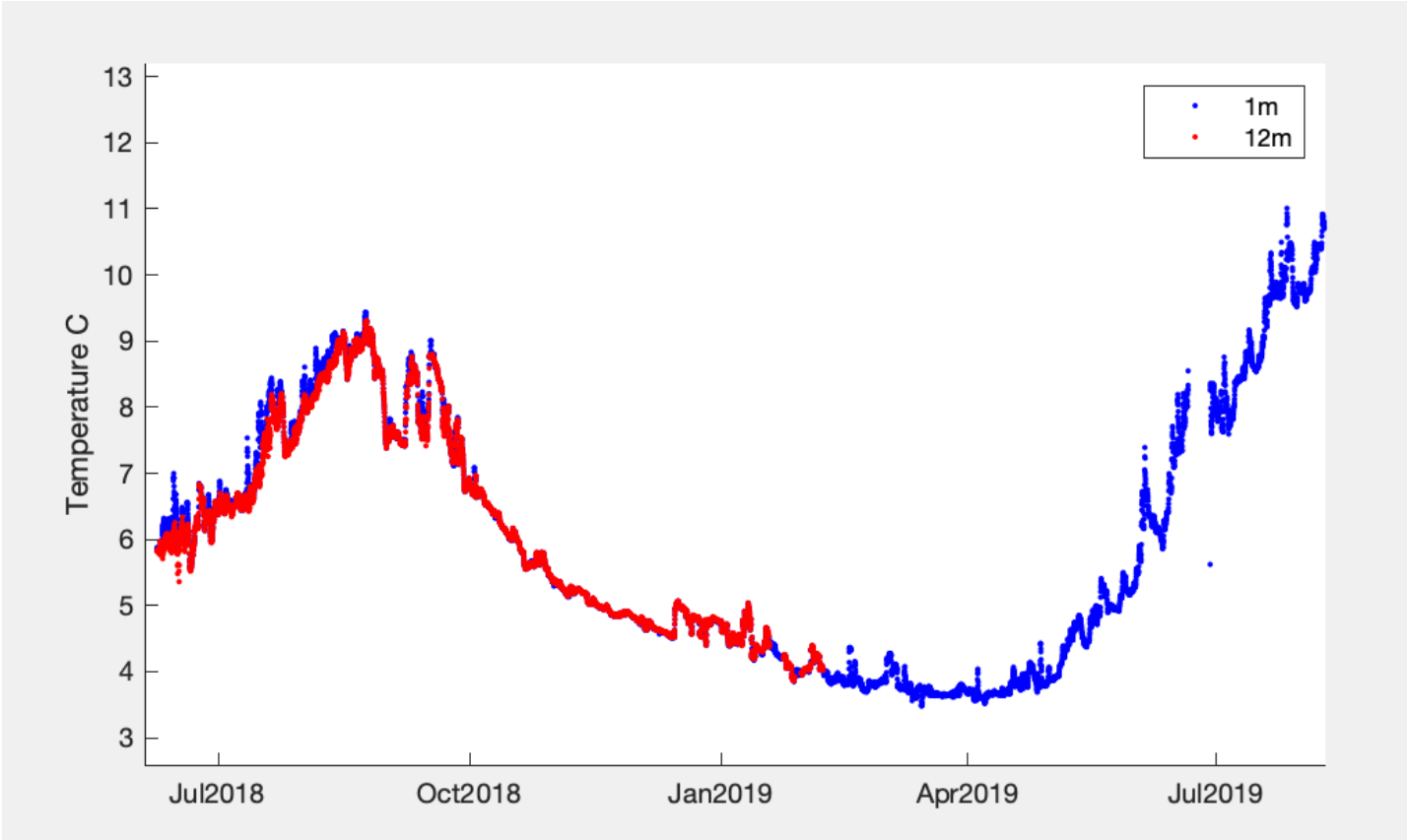
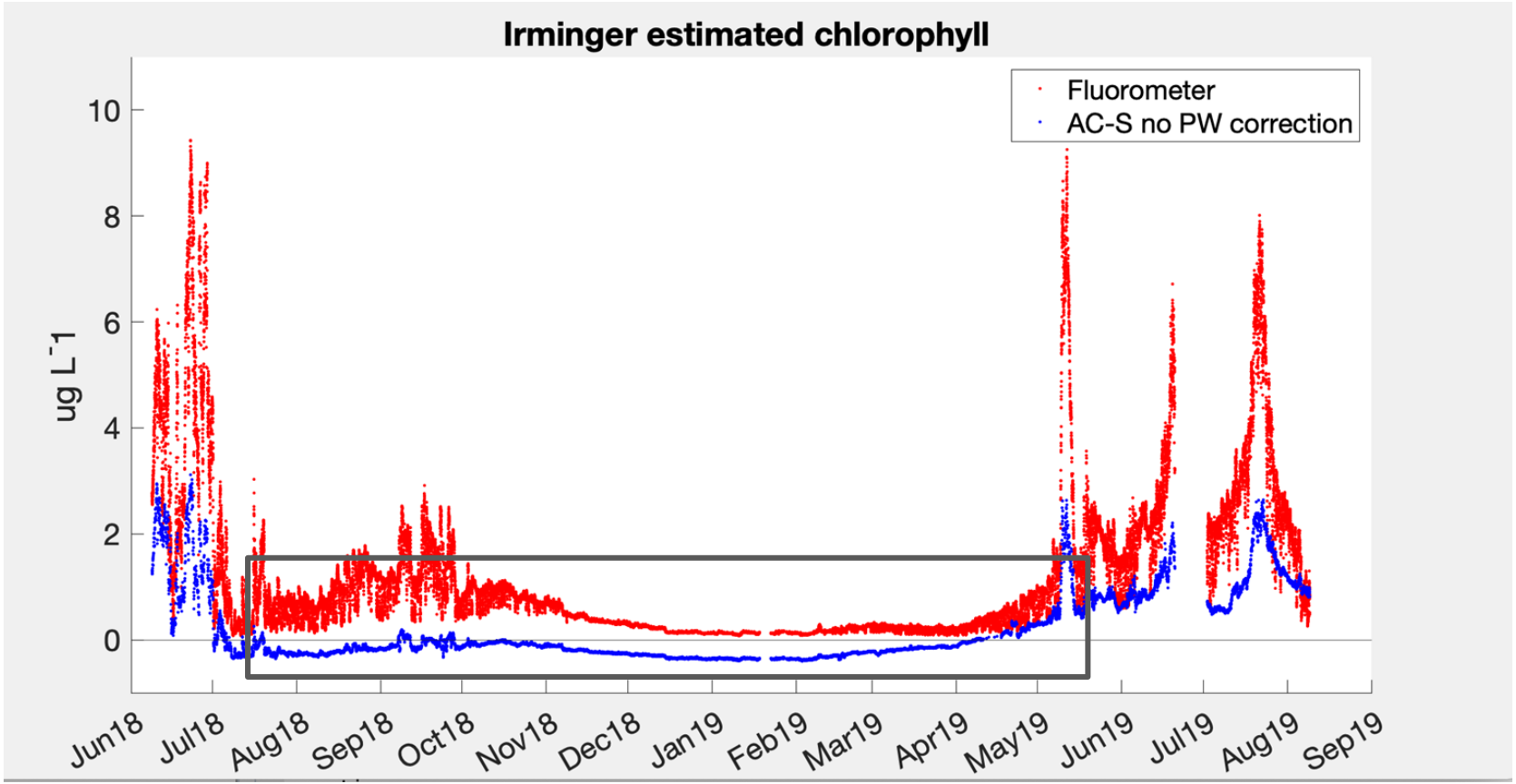
Deployments 2-8, 12m Near Surface Instrument Frame



Benefit of OOI arrays - sensor redundancy



Deployment 5: AC-S estimated chlorophyll vs Fluorometer



Pure Water Calibration (PWC)

- Calibration beyond the factory calibration is needed in **low chlorophyll (oligotrophic, open ocean, etc.)** regions, because it makes up a substantial portion of the signal

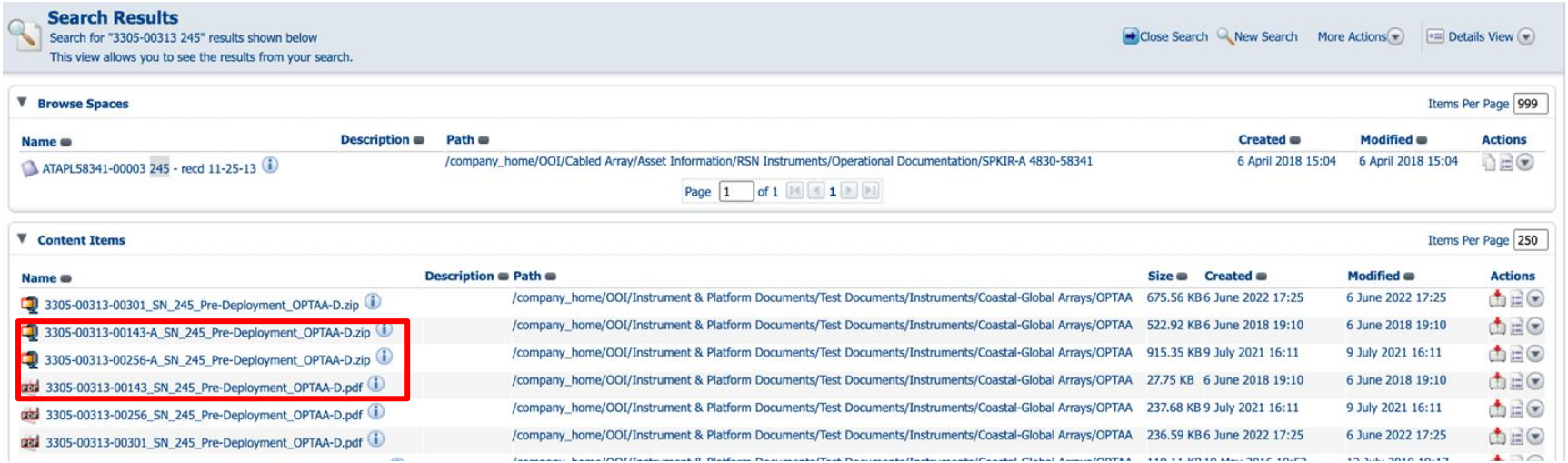
- To apply the pure water calibration
  - Acquire calibration files from Al Fresco
  - Apply temperature and salinity correction to the calibration file
  - Subtract TS corrected calibration from the TS corrected absorptance
  - Apply the scatter correction
  - Interpret data?

Applying the pure water calibration: get associated data

Find the serial number and time period of deployment of your sensor

-> Go to Al Fresco and find the associated files

OOI > Instrument & Platform Documents > Test Documents > Instruments > Coastal-Global Arrays > OPTAA



The .pdf - getting the water calibration temperature

Instrument Pre-Deployment Procedure & Results

Document Number	Version	Title	
3305-00313-00143	1-03	OPTAA Pre-Deployment Procedure	
Author		**Approver**	**Effective Date**
Russell Desiderio		Sheri N. White	2018-03-08

Instrument Make/Model	Instrument Class-Series	Instrument Serial Number
WET Labs / ac-s In-Situ Spectrophotometer	OPTAA - D	245
Conductor	**Quality Reviewer**	
A. Smith, 2018-05-29	Rebecca G. Travis, 2018-06-06	

Scope & Description

This procedure applies to WET Labs ac-s units and will establish pure water baseline blank values for all its optical channels prior to deployment. It should be applied to the ac-s in the same fin

Reference Documents

Vendor Supplied Information: acs
OOI documentation: OPTAA_pre
An ACS_Calibration_Logsheet_F

The above documents are all four

Required Tools & Equipment

ac-s calibration kit (includes clean
most recent ac-s device ("dev") file; OOI ac-s calibration logsheet, if desired.
Windows OS PC w/ USB or Serial port
RS-232 to USB adapter (if Test Computer does not contain a Serial port)
WETView7 RevF software
20 liters of pure water from a Barnstead water purification system or equivalent
20 ml spectroscopic or HPLC grade methanol.
5 gallon bucket for wastewater if necessary

23	If all test channel values are stable, continue to step 24. If not, turn off pump, de-pressurize system, and repeat steps 17-22.	AS		
24	Acquire 30 seconds of data while recording cal water temperature reading at ac-s outflow at right.	AS		
25	Stop data acquisition.	AS		
26	Turn off pump and de-pressurize system.	AS		

The .zip -

acs245.dev	Nov 6, 2017 at 11:15 AM	68 KB	Document
SN_245_Channel_A1.dat	May 29, 2018 at 9:44 AM	443 KB	Document
SN_245_Channel_A1.RTC	May 29, 2018 at 10:19 AM	467 bytes	Document
SN_245_Channel_A2.dat	May 29, 2018 at 9:47 AM	455 KB	Document
SN_245_Channel_C1.dat	May 29, 2018 at 10:02 AM	375 KB	Document
SN_245_Channel_C2.dat	May 29, 2018 at 10:14 AM	443 KB	Document

.dev file
open in text editor

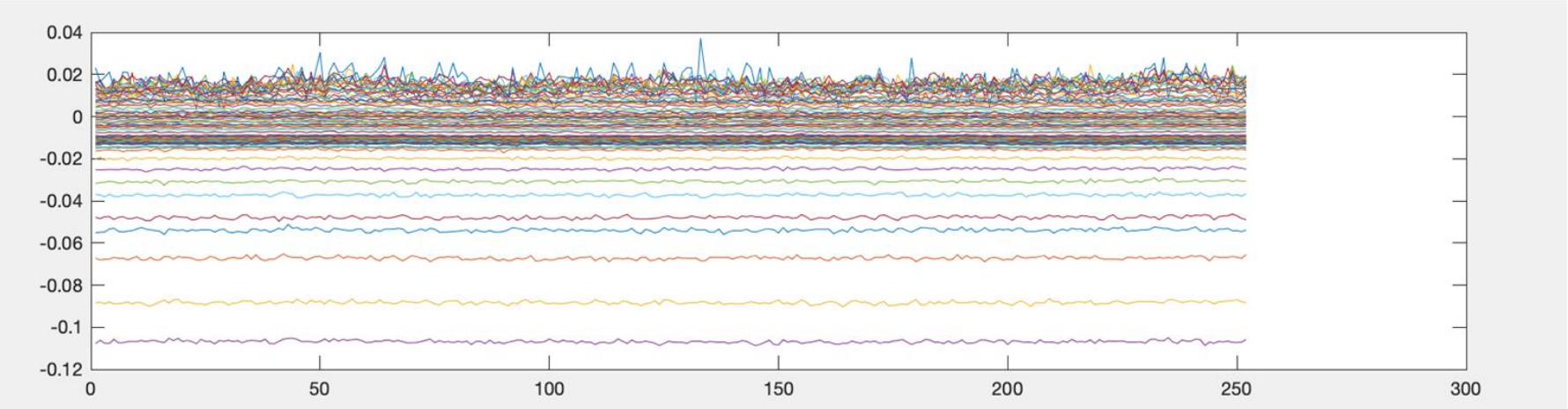
```
ACS Meter
530000F5        ; Serial number
3       ; structure version number
"tcal: 20.8 C, ical: 18.8 C. The offsets were saved to this file on 11/3/17."
0       0               ; Depth calibration
115200                  ; Baud rate
0.25                    ; Path length (meters)
88                      ; output wavelengths
35                      ; number of temperature bins
                                        0.726152 1.397111 2.463976 3.46037  4.464186 5.453939 6.473704 7.492609 8.474762
9.480952 10.487368      11.50125 12.493125      13.489375       14.505333       15.500667       16.498824
17.507895       18.503  19.4915  20.49   21.478421       22.49   23.501429       24.466  25.479524       26.479444
27.478824       28.485294       29.47125 30.486471      31.488  32.481111       33.48   34.483889       ; temperature
bins


C400.0  A398.4  8       -0.790074       -2.675946               0.027232 0.022275 0.018047 0.014849 0.013693 0.013498
0.010915 0.010199 0.009017 0.006624 0.005977 0.005174 0.00426  0.005363 0.003308 0.001652 0.003379 0.002527 0.001265 0.001561
0.000896 0.00079  -0.0012  -0.000937       -0.000716       0       0.001102 0.000744
0.001051 -0.000738       -0.00014 -0.00047 0.001833 0.001081
0.001385        -0.086231       -0.088909       -0.087929       -0.085524       -0.080393       -0.078025       -0.0728
1       -0.07003 -0.065453       -0.06127 -0.058983       -0.054934       -0.05117 -0.046442       -0.042903       -0.0411
42      -0.036296       -0.035217       -0.030212       -0.026968       -0.021956       -0.019185       -0.01514 -0.0088
6       -0.005293       0       0.005011 0.009948 0.014641 0.017451 0.022122 0.026548 0.030678 0.034077 0.038345        "; C
and A offset, and C and A temperature correction info"
C402.6  A401.6  10      -0.66116 -2.413254              0.015222 0.012596 0.010184 0.008207 0.006869 0.006211 0.005611
0.003825 0.004833 0.002988 0.002176 0.002107 0.002299 0.001352 0.000365 0.000198
0.00017  -0.000607       -0.000292       -0.000513       0.000056 -0.000663       -0.000086       0.000305 -0.001203
0       -0.000228       0.001098 0.000772 0.000719 0.000775 0.001647 0.001843 0.002288
0.002928        -0.078137       -0.079757       -0.078152       -0.075893       -0.071727       -0.068811       -0.0643
```

The temperature and salinity correction

Create the .csv and take it to python

See if the calibration
is good,
might need to subset

```
adat = rad_read_acs_datfile('SN_245_Channel_A2.dat');
cdat = rad_read_acs_datfile('SN_245_Channel_C2.dat');
```



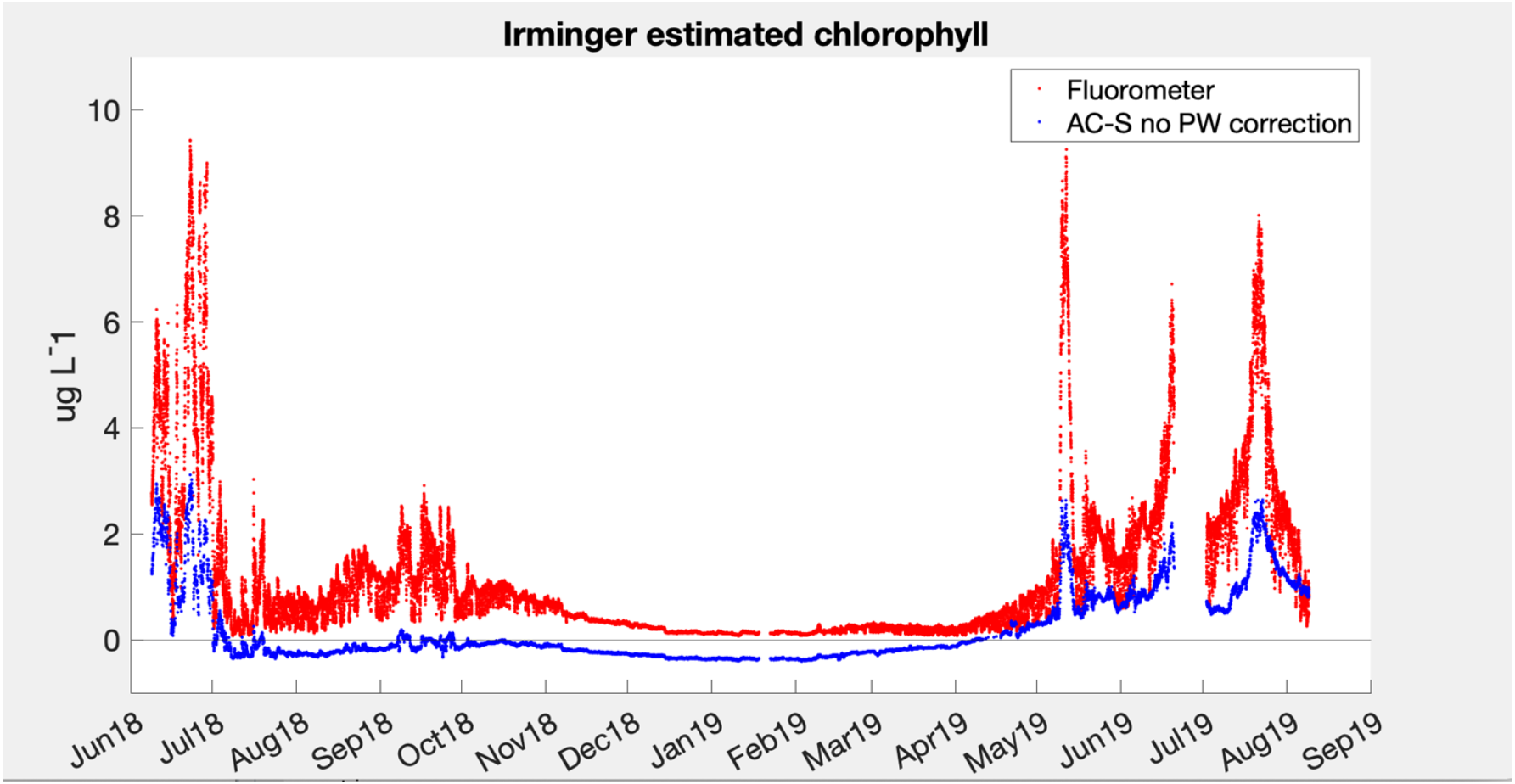

```
fclose(fid);

cdat_avg = median(cdat.ccc(:, :), 1);
cdat_tsavg = median(ccorr(:, :), 1);
fid = fopen('acs245pre_deployment_cdat.csv', 'w+');
fprintf(fid, 'wavelength,offset,offset_Tcorr\n');
for i = 1:numel(cdat.cwvl)
    fprintf(fid, '%.1f,%.8f,%.8f\n', cdat.cwvl(i), adat_avg(i), adat_tsavg(i));
end %for
fclose(fid);
```

Apply Pure Water Cals

Go into process_optaa.optaa_datalogger function and add some code

Subtract PWC from TS corrected absorbance

```
# re-process the raw data in order to create the intermediate variables, correcting for the holographic
# grating, applying the temperature and salinity corrections and applying a baseline scatter correction
# to the absorption data. All intermediate processing outputs are added to the data set.
burst = apply_dev(burst, cal.coeffs)
burst = apply_tscorr(burst, cal.coeffs, burst.sea_water_temperature, burst.sea_water_practical_salinity)
# Here is where to apply the pre-deployment purewater calibration (subtract the A and C)
if a_pure_water is not None:
    # Apply the a_pure_water cal. Note, the pure water cal should be a dataset indexed based on the same
    # number of wavelengths as your dataset. If not
    burst["apg_ts"] = burst["apg_ts"] - a_pure_water
#    burst["apg_ts"].attrs["comment"] = burst["apg_ts"].attrs["comment"] + "This datasets has had the pure water calibration applied."
if c_pure_water is not None:
    # Apply the c-channel pure water cal
    burst["cpg_ts"] = burst["cpg_ts"] - c_pure_water
#    burst["cpg_ts"].attrs["comment"] = burst["cpg_ts"].attrs["comment"] + "This datasets has had the pure water calibration applied."
burst = apply_scatcorr(burst, cal.coeffs)
```

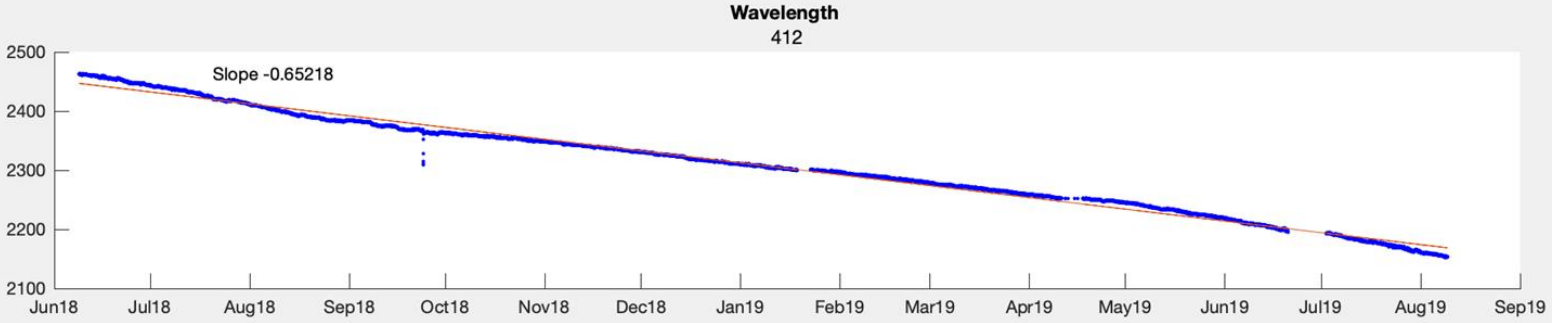

Irminger estimated chlorophyll
Fluorometer
AC-S no PW correction
ug L-1
10
8
6
4
2
0
Jun18
Jul18
Aug18
Sep18
Oct18
Nov18
Dec18
Jan19
Feb19
Mar19
Apr19
May19
Jun19
Jul19
Aug19
Sep19

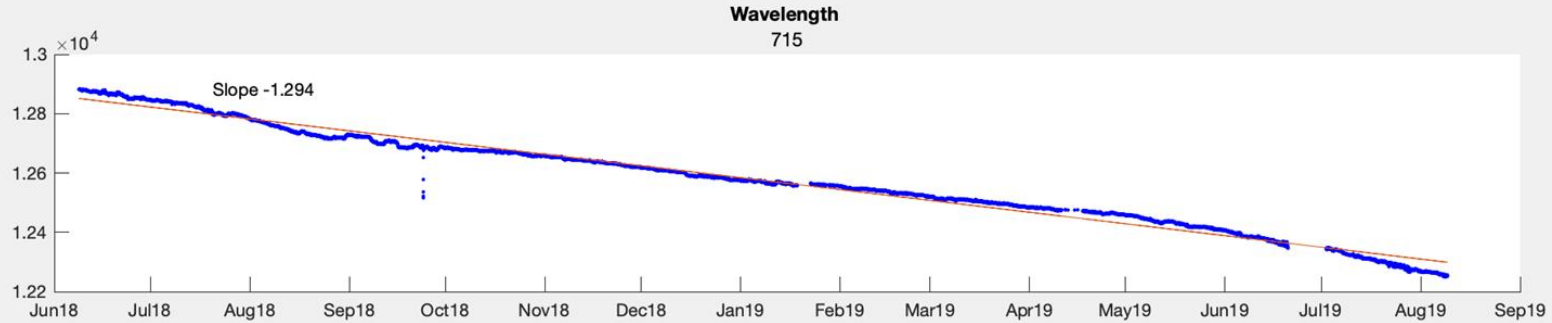
Lessons learned and future exploration

- Irminger data needs the pure water calibration applied to be interpretable
- Fluorometer and AC-S estimated chl follow the same patterns but have a different magnitude
    - Might this be the result of the method used to calculate chl? Needs further investigation

Future work

- Can we see evidence of phytoplankton community change in the spring bloom, or in the spring vs fall blooms?
- Does changing the line height chlorophyll specific absorption coefficient (a*p) impact the alignment with fluorometer data?
- Look for evidence of lamp dimming and how it might be corrected


Wavelength
412
Slope -0.65218
2500
2400
2300
2200
2100
Jun18
Jul18
Aug18
Sep18
Oct18
Nov18
Dec18
Jan19
Feb19
Mar19
Apr19
May19
Jun19
Jul19
Aug19
Sep19


Wavelength
715
×10^4
Slope -1.294
1.3
1.28
1.26
1.24
1.22
Jun18
Jul18
Aug18
Sep18
Oct18
Nov18
Dec18
Jan19
Feb19
Mar19
Apr19
May19
Jun19
Jul19
Aug19
Sep19