

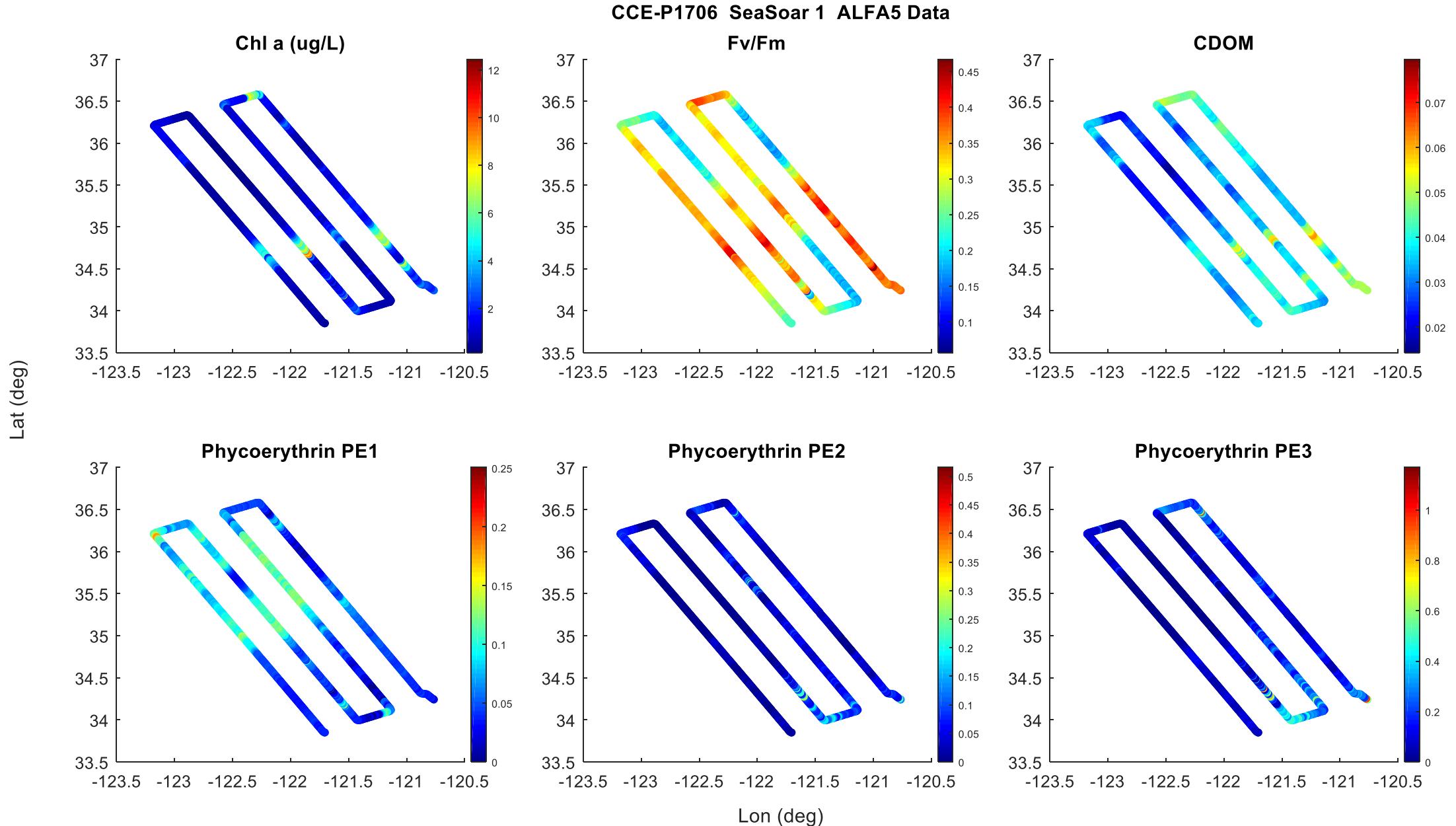
NCP CCE-LTER

Discussion April 19th 2018

Overview

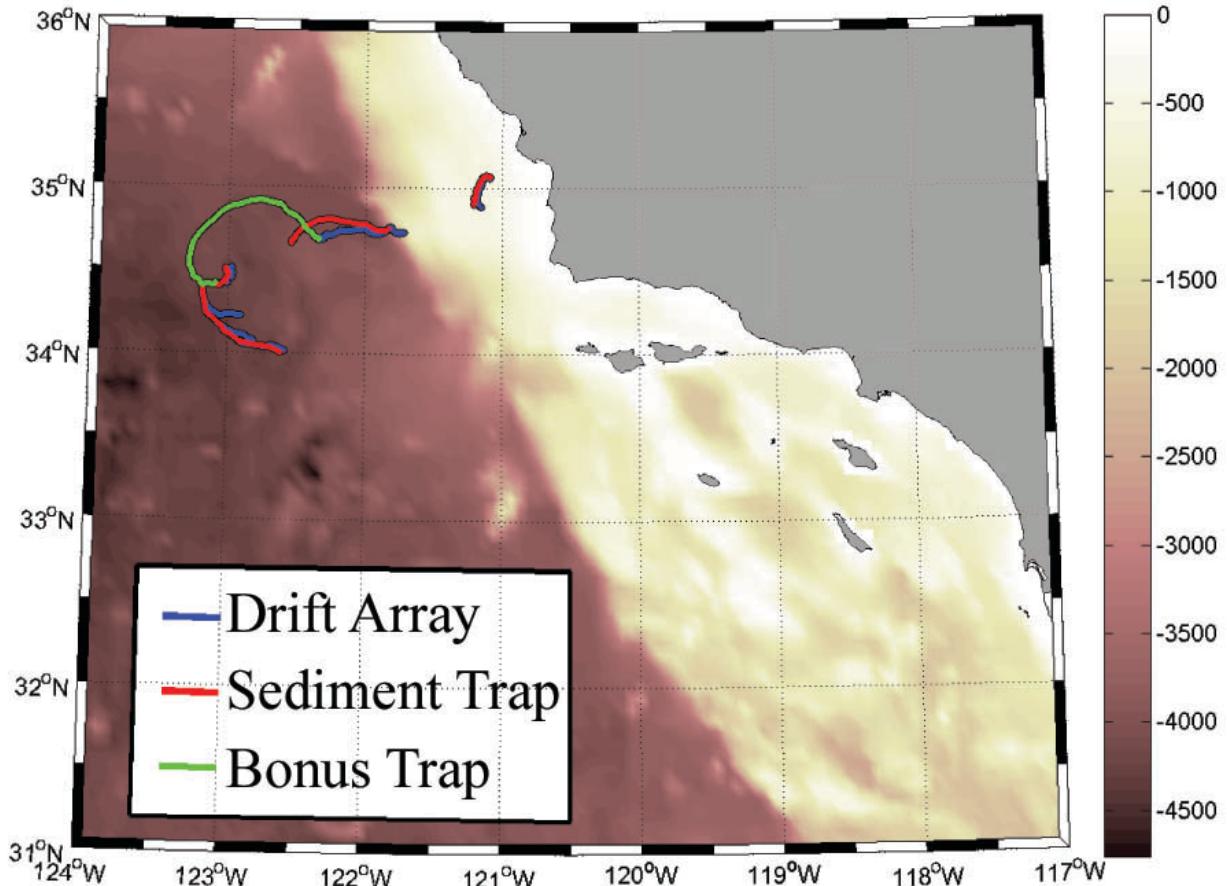
- Setting the scene: CCE-LTER, peripheral data (Wind, temperature comparison, R-code, NCP-parametrization, calibration)
- EIMS data
- MIMS data
- MIMS vs. EIMS comparison
- Spatial vs. time and space (Langrangian cycles) O₂/Ar data
- Profiles
- Further data analysis
 - FRRF / CCE-LTER....
- Papers to be written

P1706 SeaSoar 1: ALFA5 Data on Lat-Long



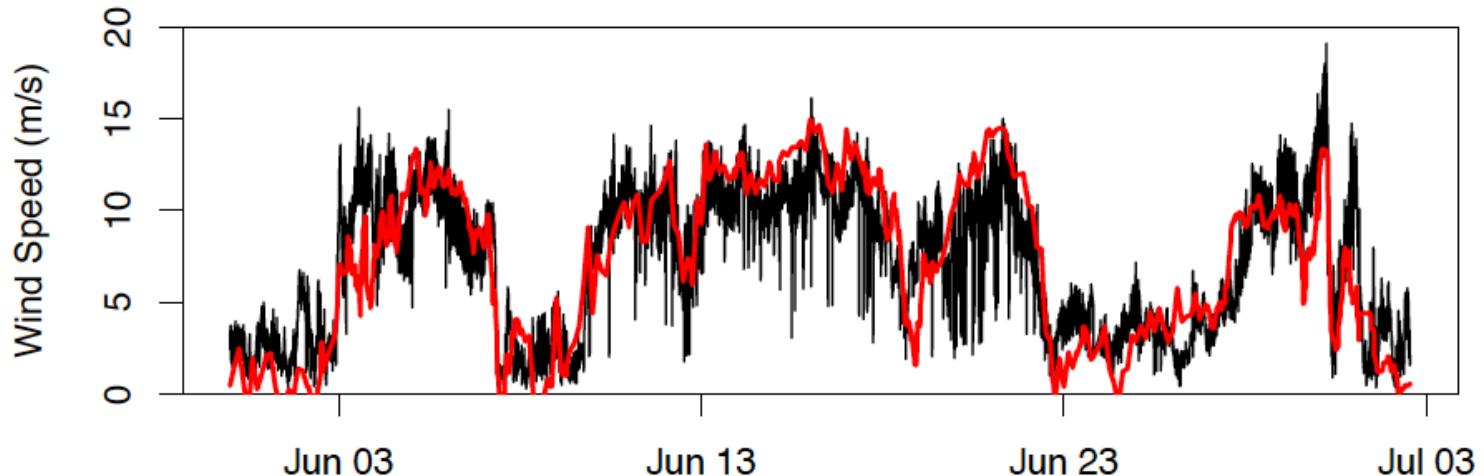
CCE-LTER P1706

- DATA:
 - MIMS and EIMS O₂/Ar
 - MIMS profiles
 - Ship data / CTD
 - 2 SEASOAR transects- high spatial resolution
 - 4 stations (2 with high productivity)
 - 4 transects through filament
- R-script to analyze the data – to be published!



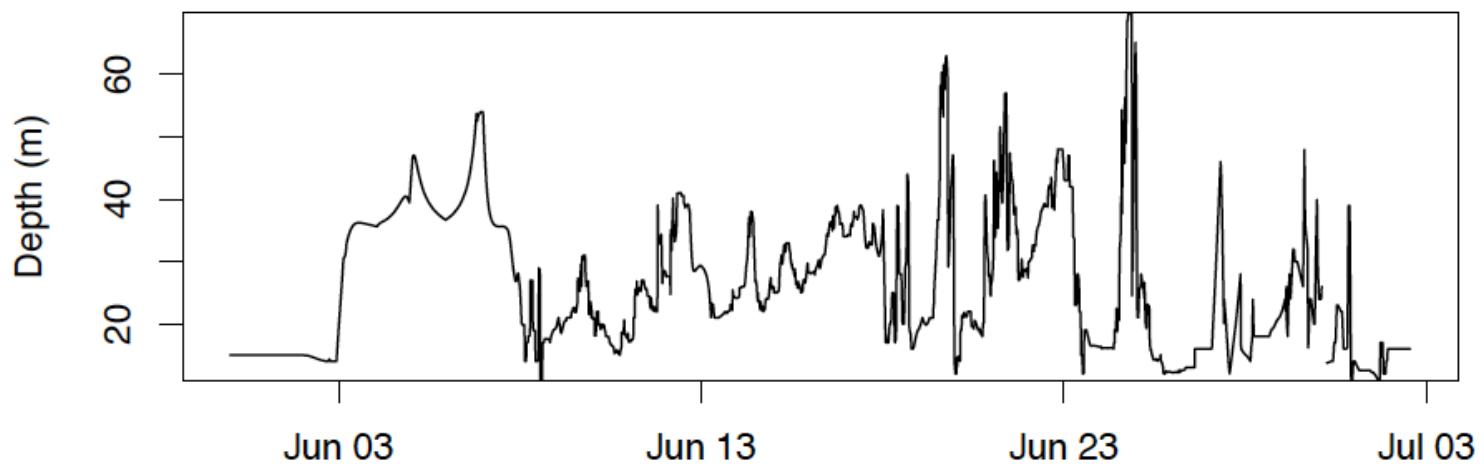
Wind - ship and
NARR database

Ship-based Wind



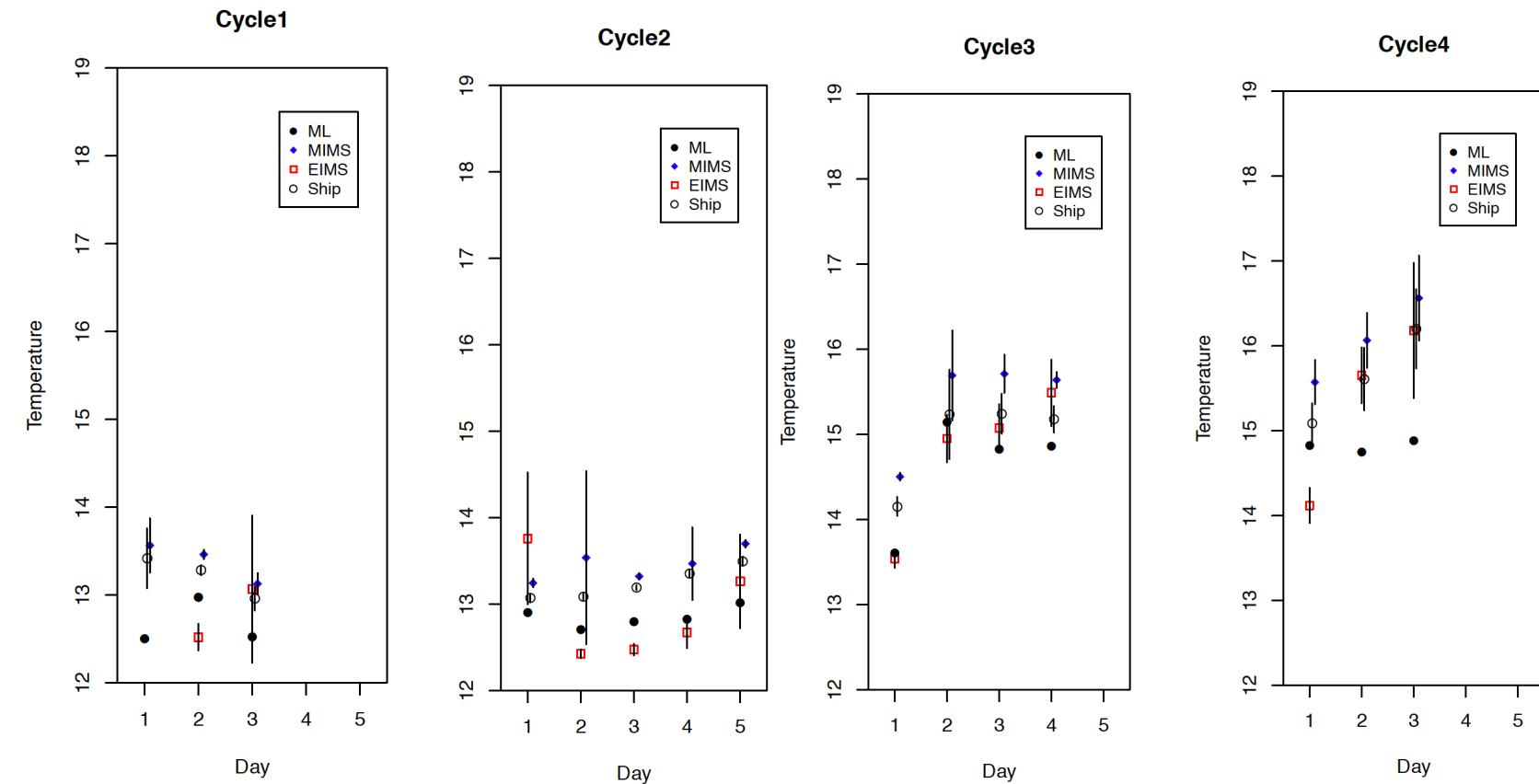
MLD from CTD
profiles and
seasoar

Mixed Layer Depth



EIMS / MIMS temp sensors inlet vs. ship-data temp

All data fall within 1C difference
Ship and MIMS seem to overlap best!
EIMS seems to have some negative (not consistent) offset



ML: mixed layer average temp

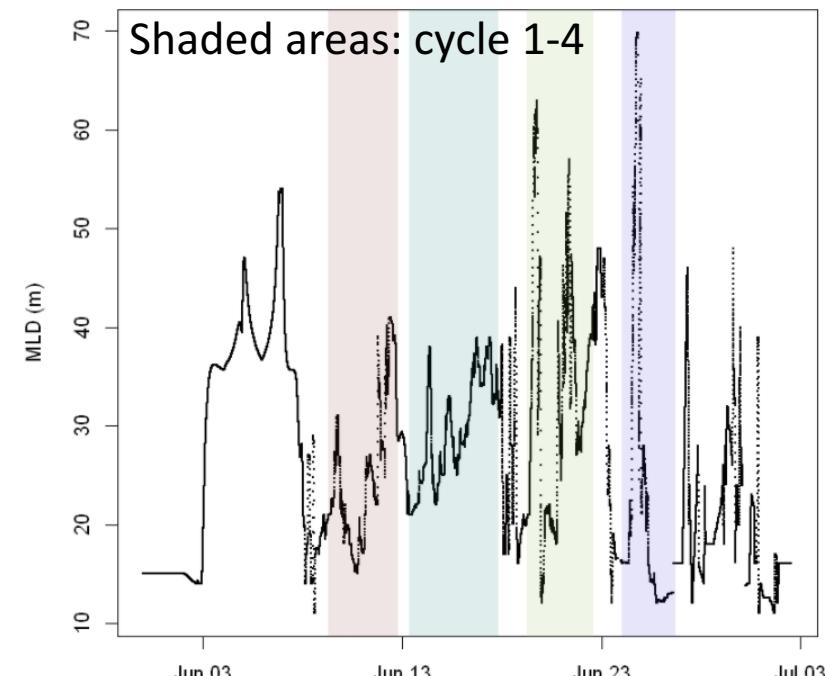
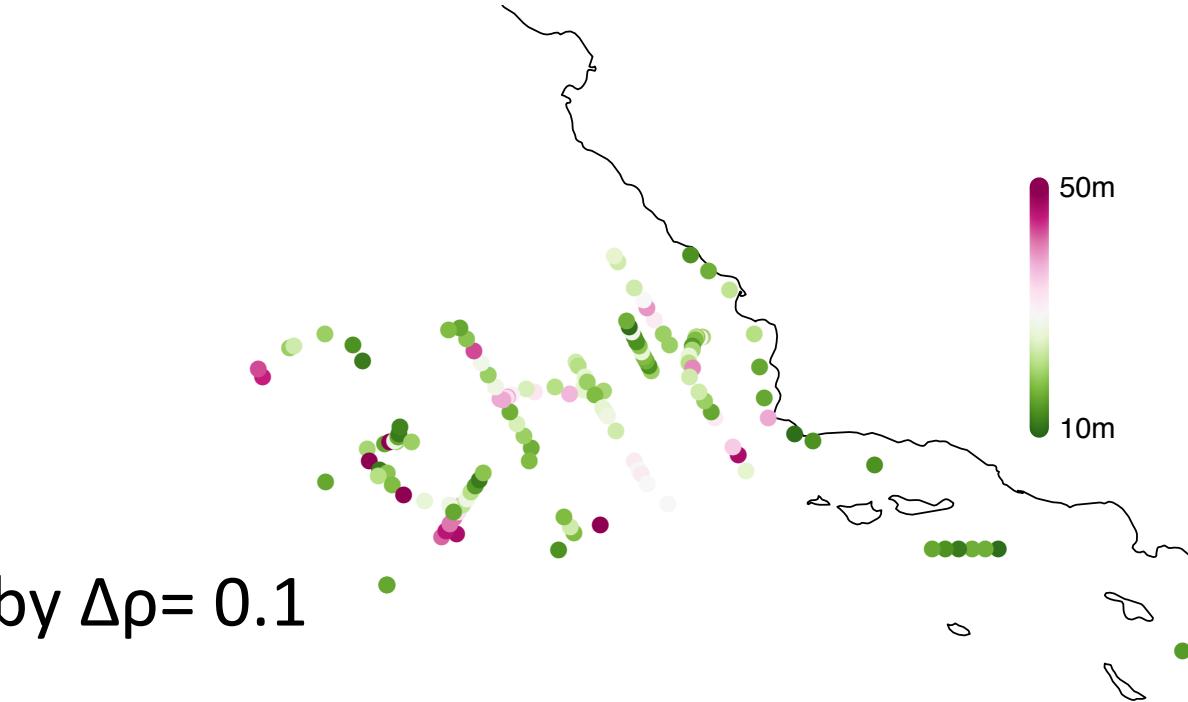
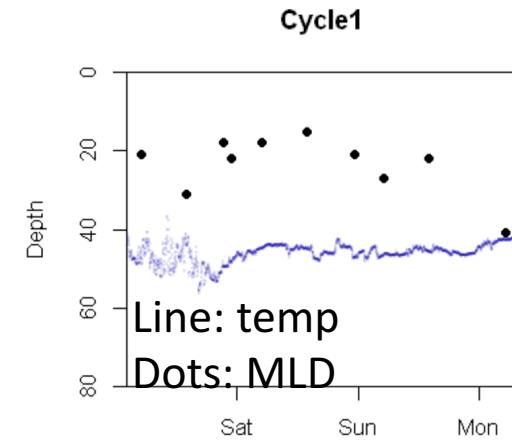
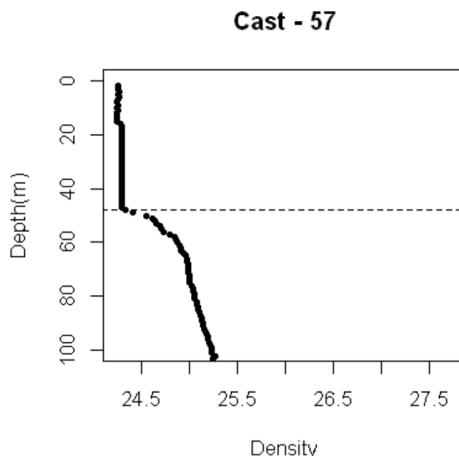
At the moment, the ship thermometer is used for O₂ solubility in NCP calc!

R-code

- <https://github.com/tbrycekelly/MIMS-TBK>

NCP parametrization

- Wind data from NARR database!
- Parameterization from Wanninkof 2014
- k calculated as in Reuer 2007
- MLD = from CTDs and seasoar estimated by $\Delta\rho= 0.1$
- O₂/Ar from EIMS and MIMS

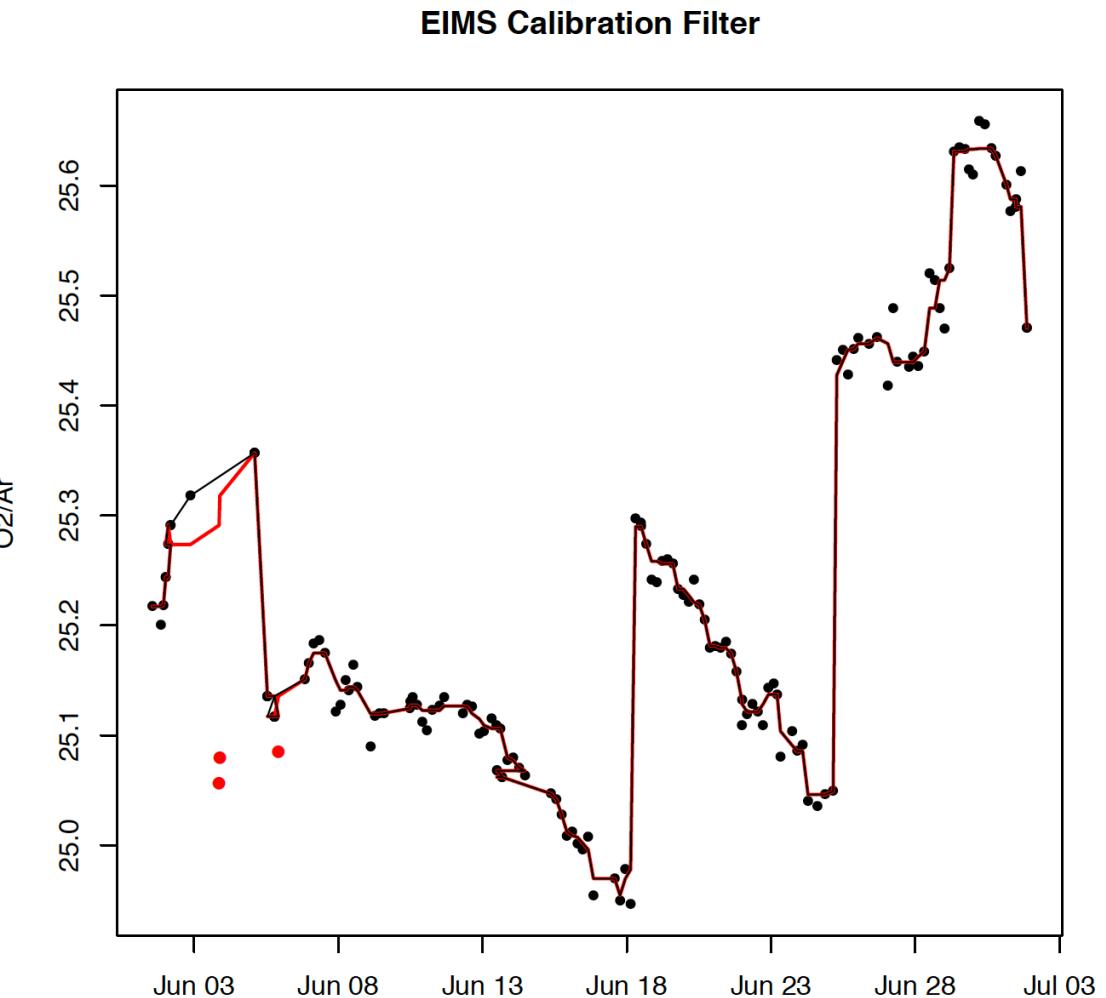


EIMS calibration:

EIMS calibration is very consistent, ranging between 25 to 25.6 .

Offsets happened after EIMS was recalibrated (software recal.)

– Seaver – could you check in the data from the PC when those calibrations where done exactly? – I did not write it down in my lab-book. I need to check for my system, too!



MIMS calibration:

MIMS calibration shows a strong drift!

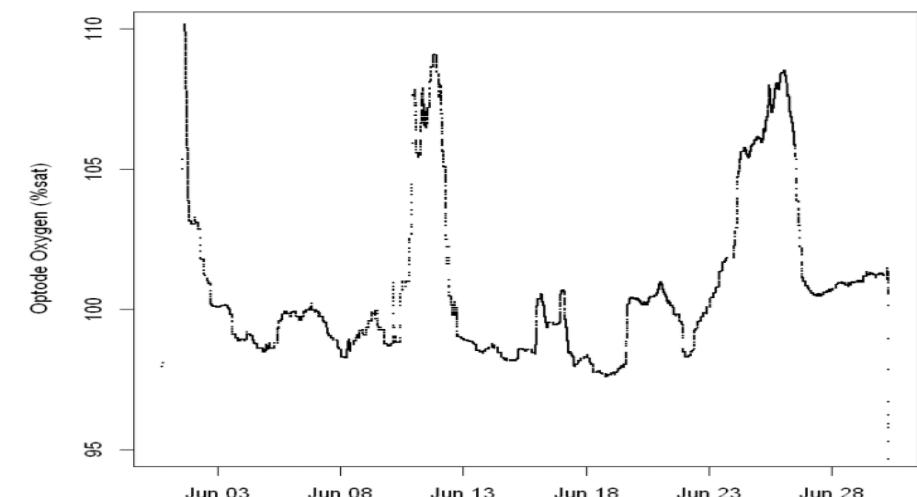
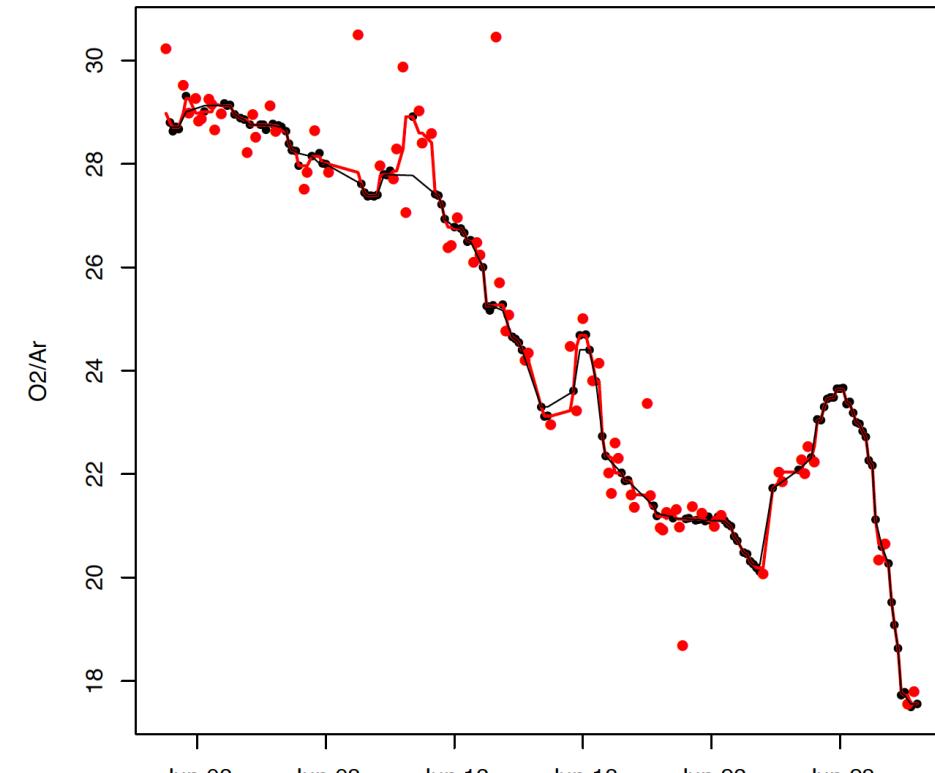
This is likely due to the change in membrane diffusivity for O₂ and Ar and or potentially due to H₂O in the system?

Ionization changes? / Calibration?

0.01mm PTFE membrane with 0.5mm PTFE frit.

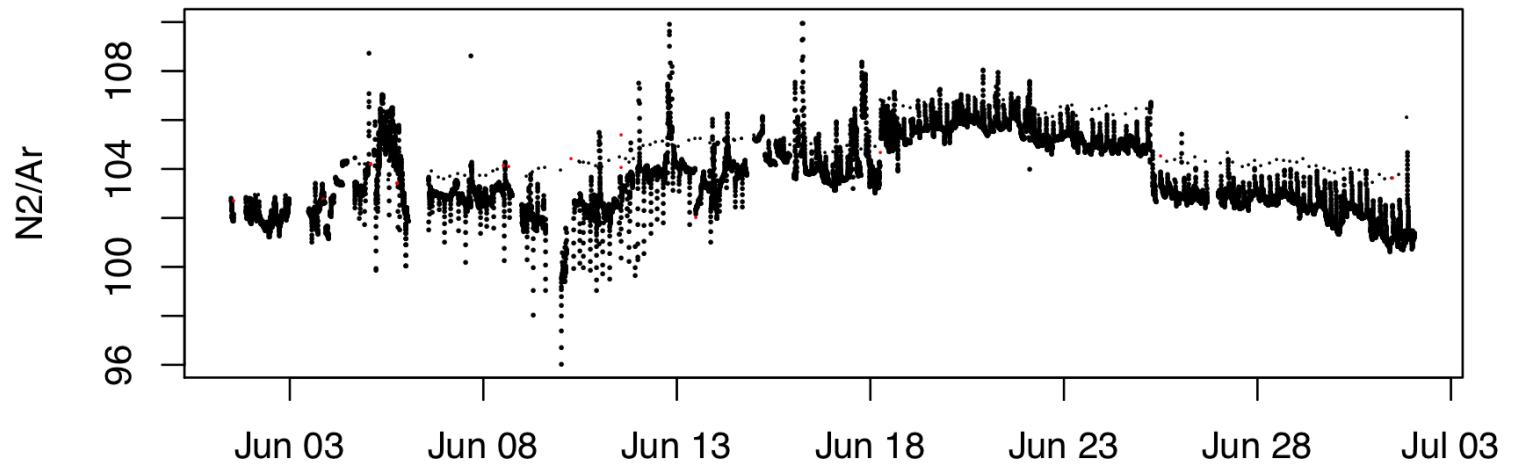
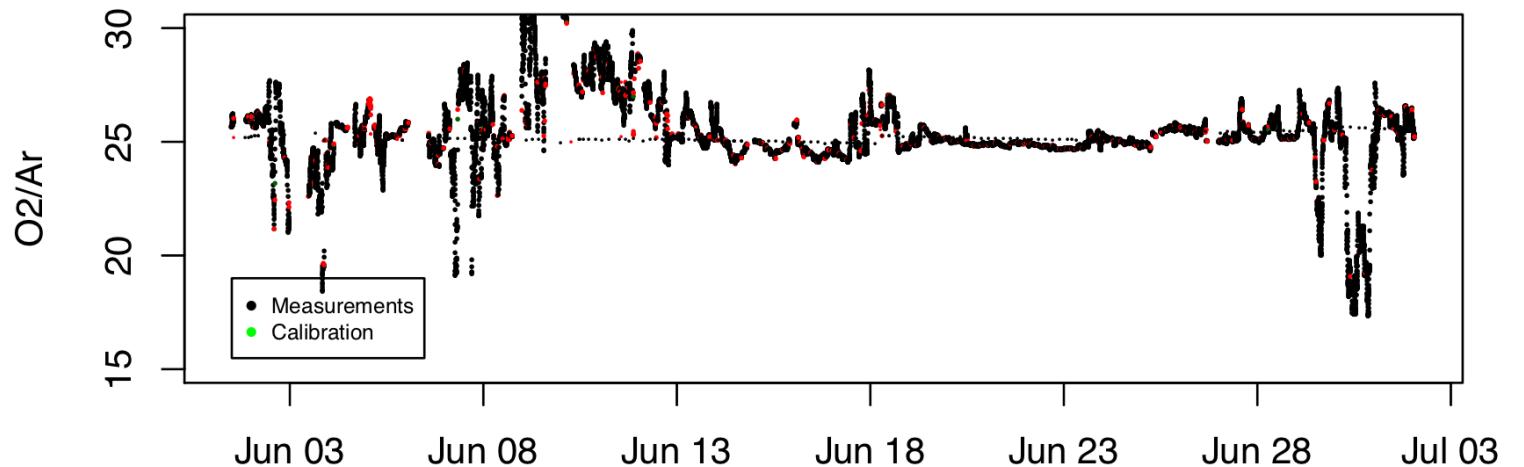
Changed membrane around June 18 and recalibrated (including offset calc) . Did not change the frit!

O₂ conc. in calibration solution was relatively constant, yet did show similar peaks as shown in MIMS O₂/Ar!



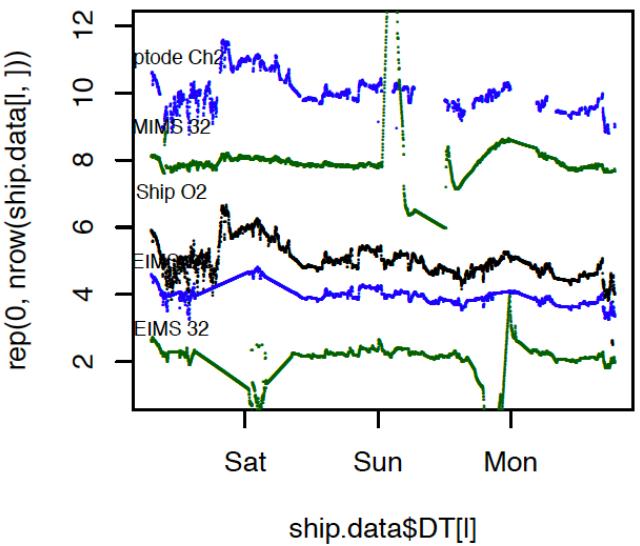
EIMS data

Data coverage....

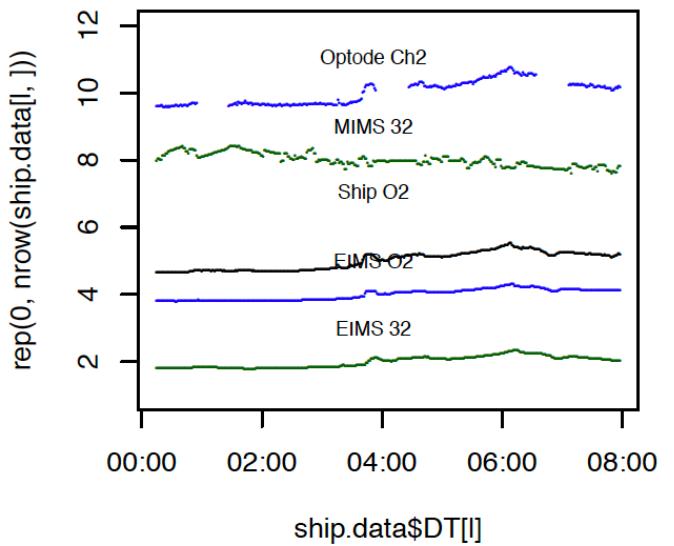


Time-series review

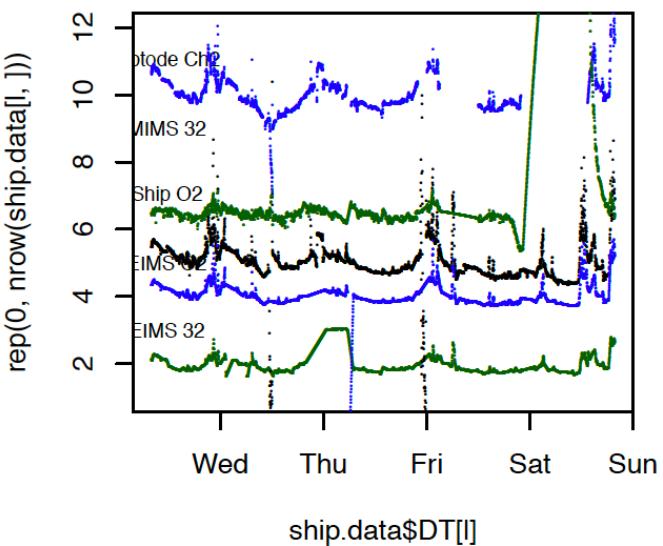
Cycle1



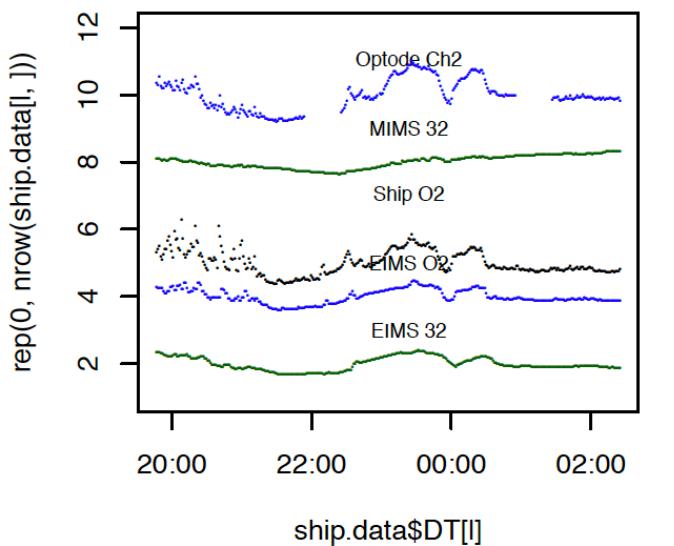
MVP Transect 3



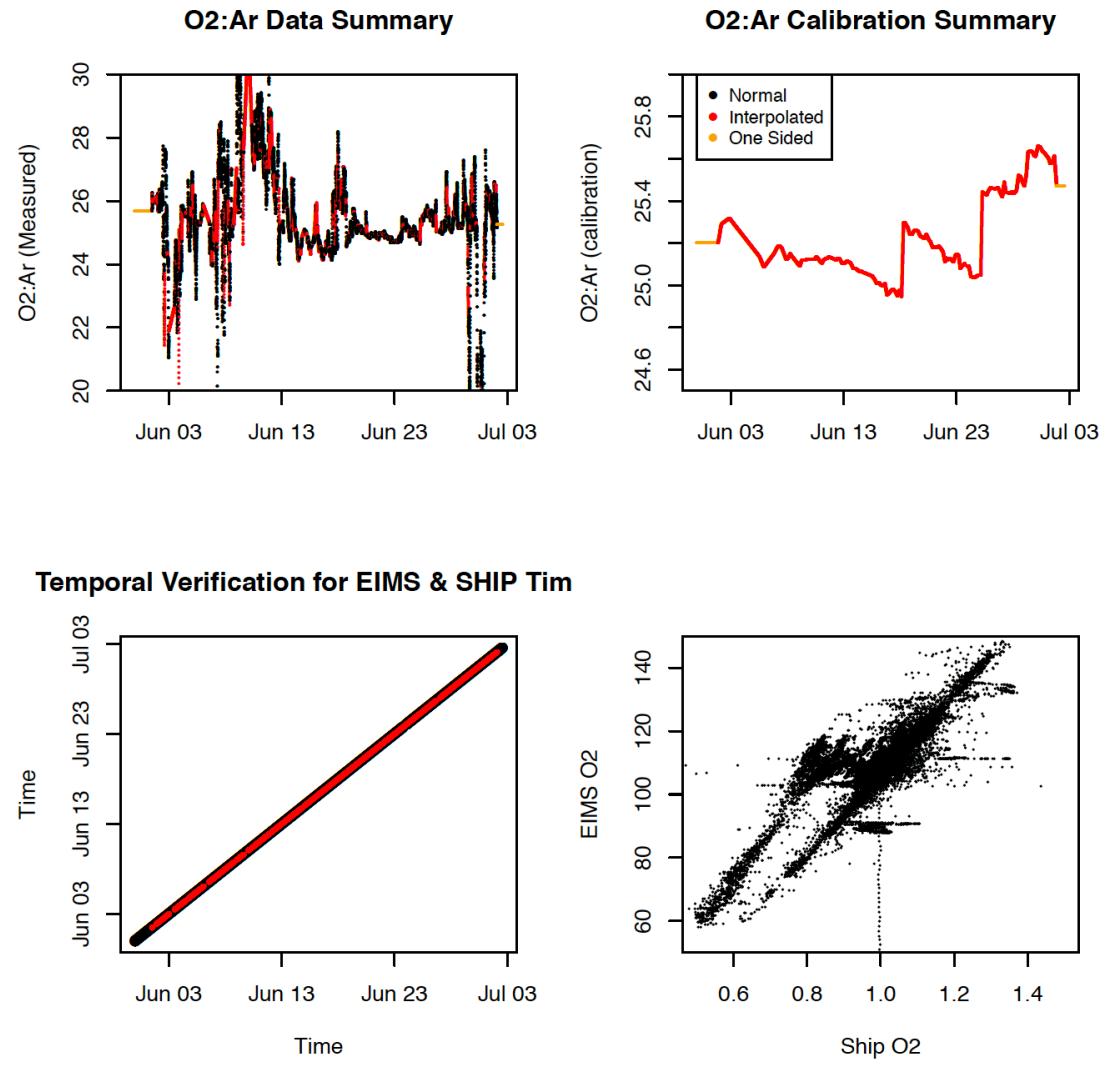
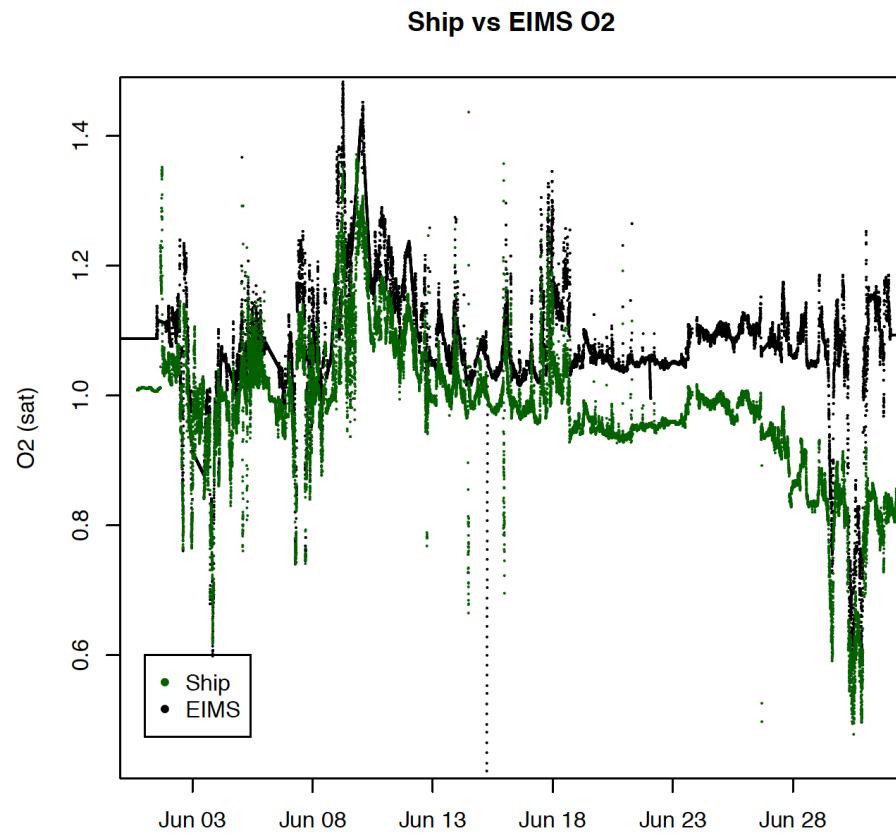
Cycle2



MVP Transect 4

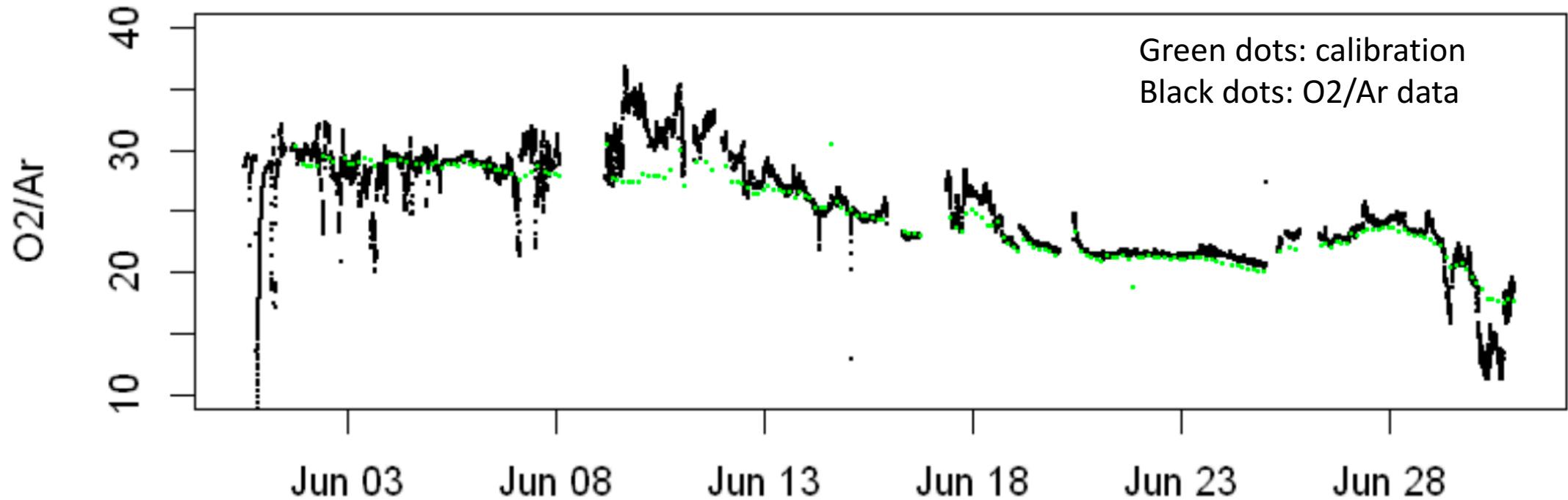


EIMS data

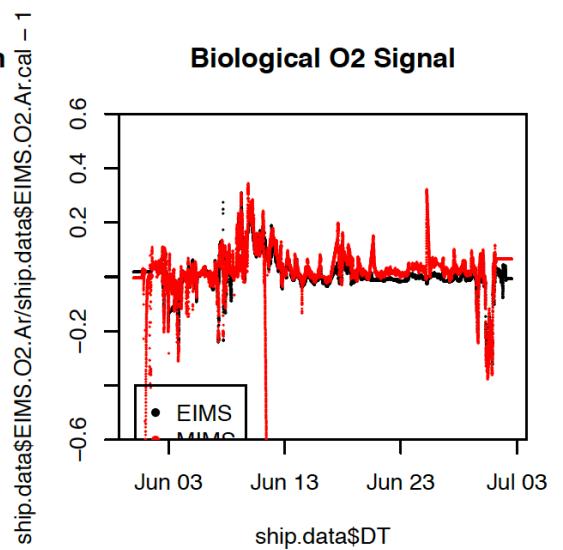
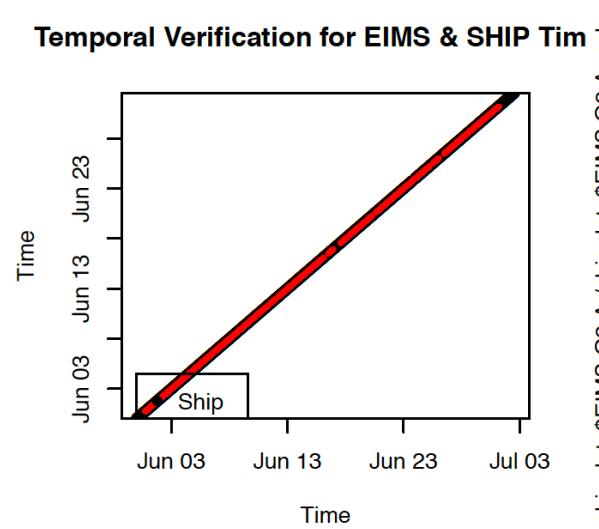
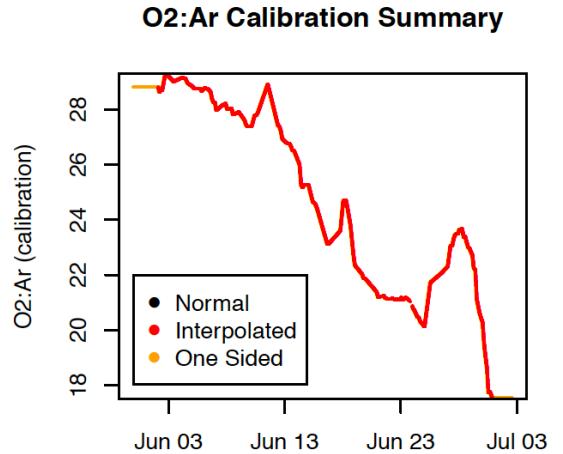
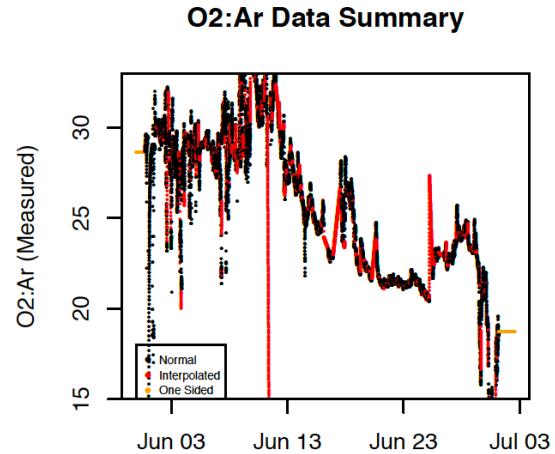
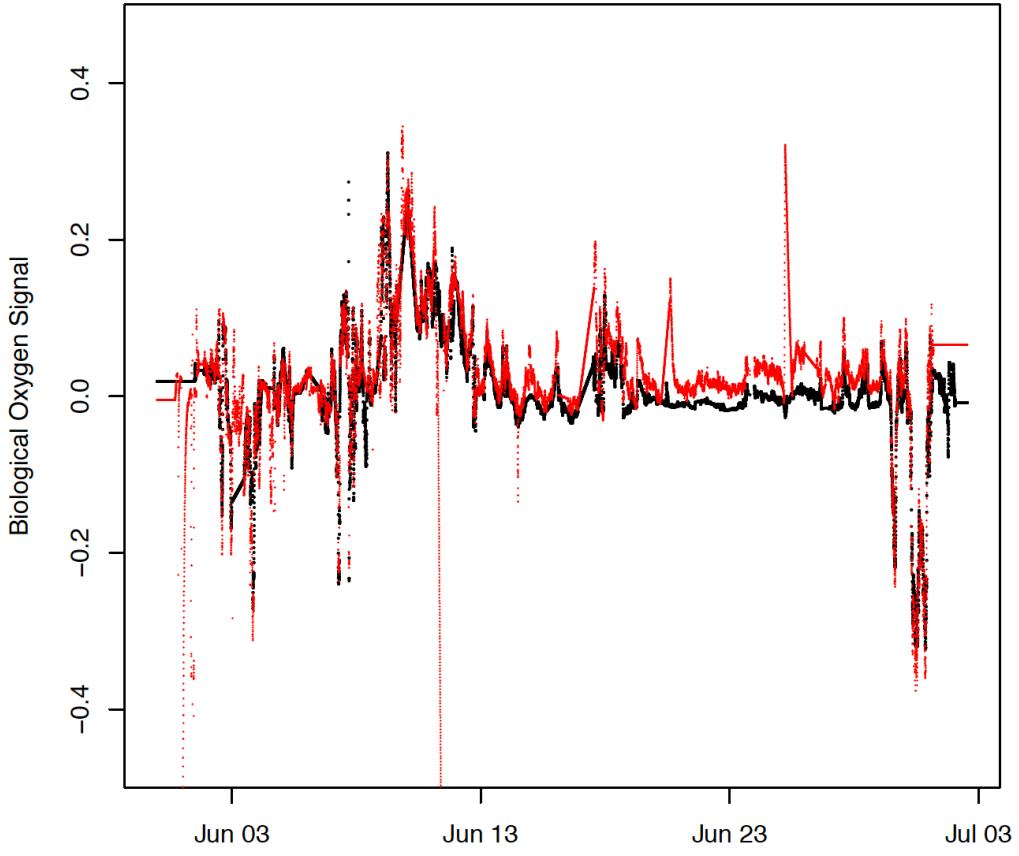


EIMS-O₂ data deviate!!!! Why?

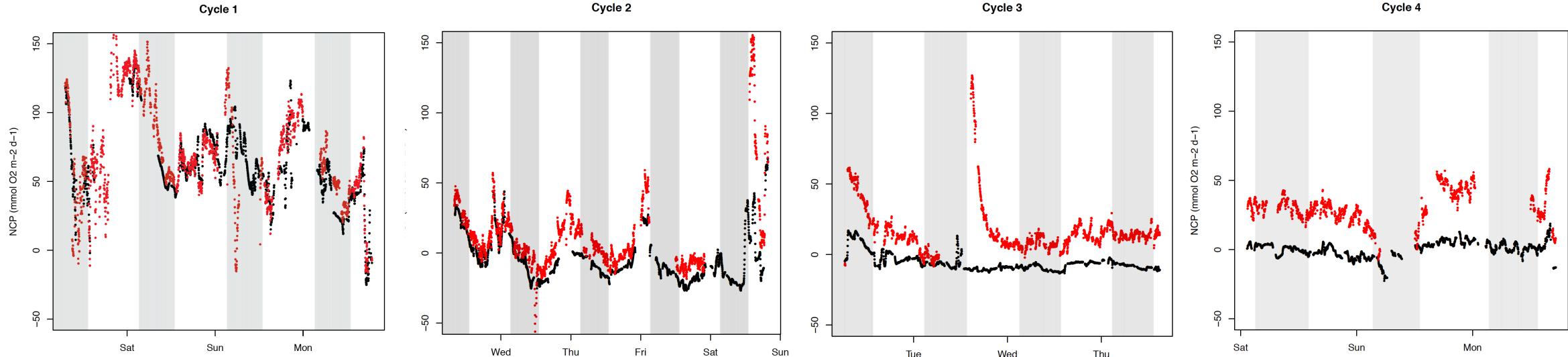
MIMS data



MIMS data



MIMS vs. EIMS NCP cycle 1-4



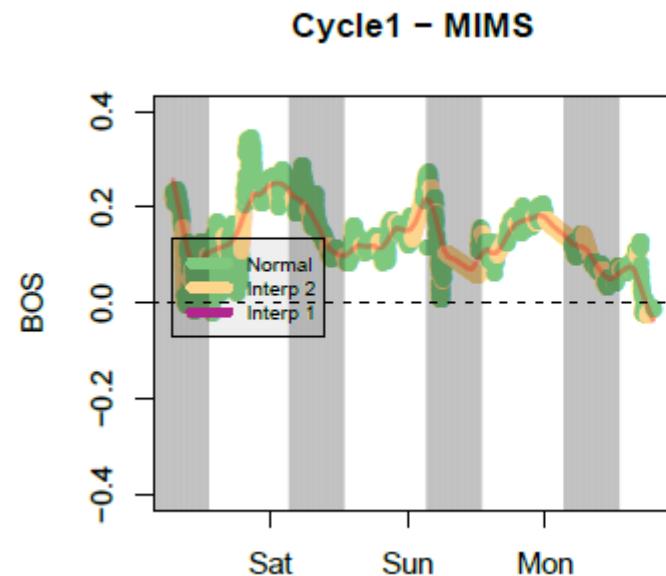
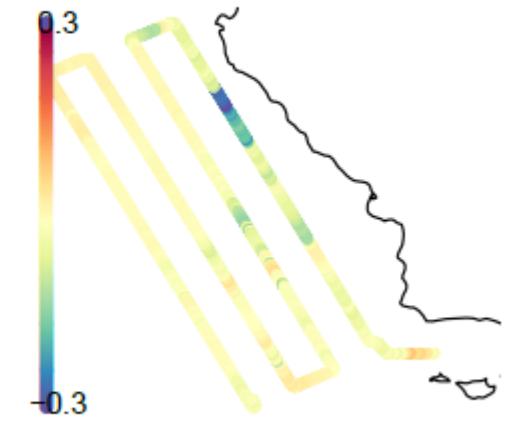
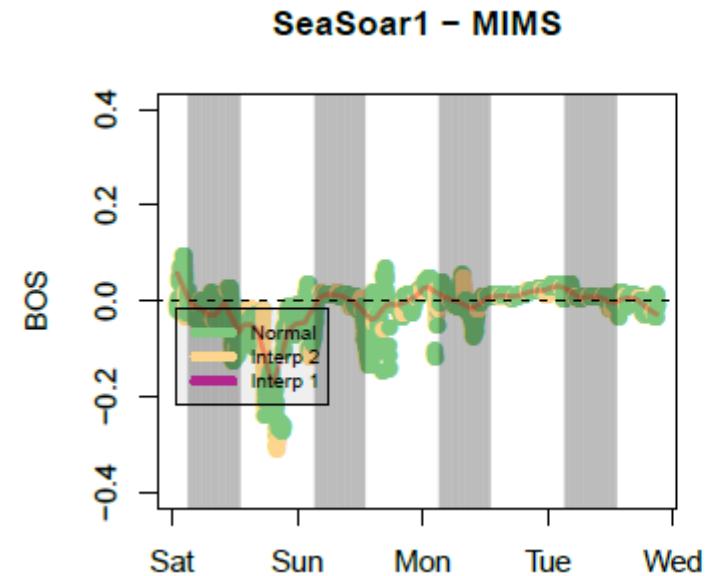
Clear diurnal pattern
in cycles 1 and 2

Deviation of NCP in
cycles 3 and 4!!

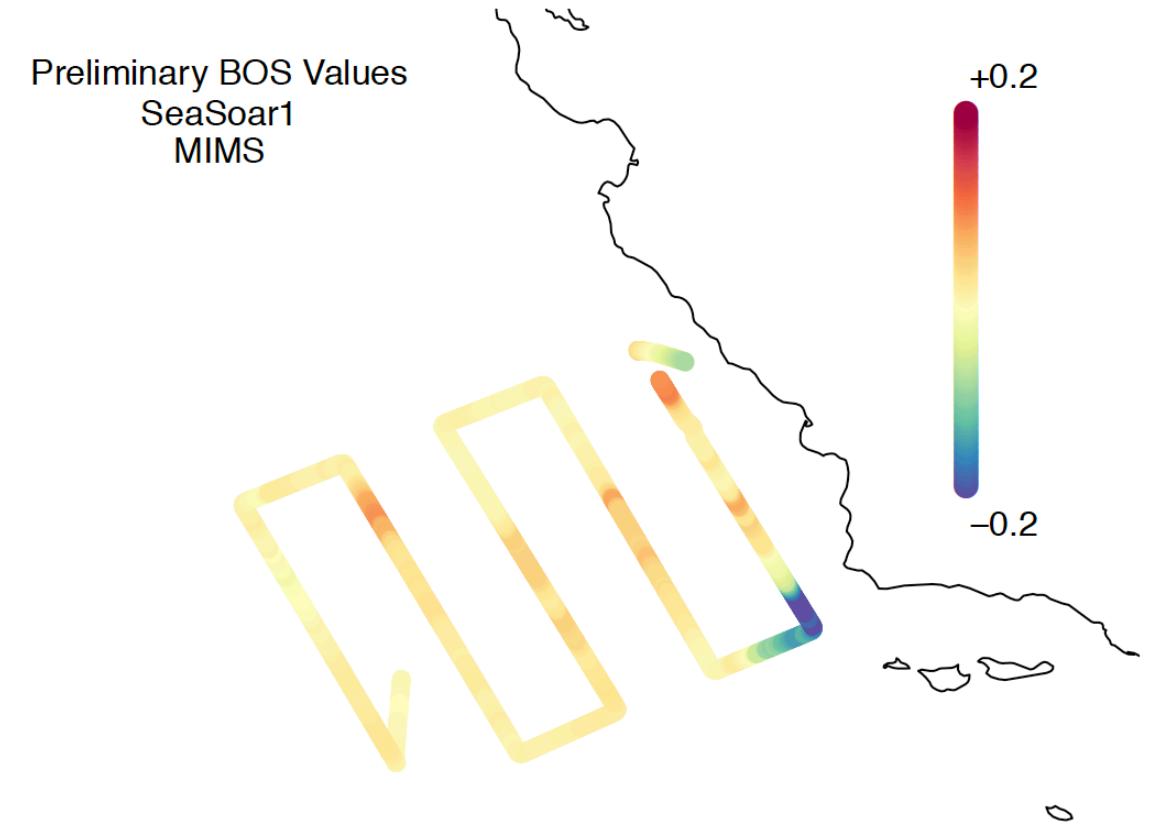
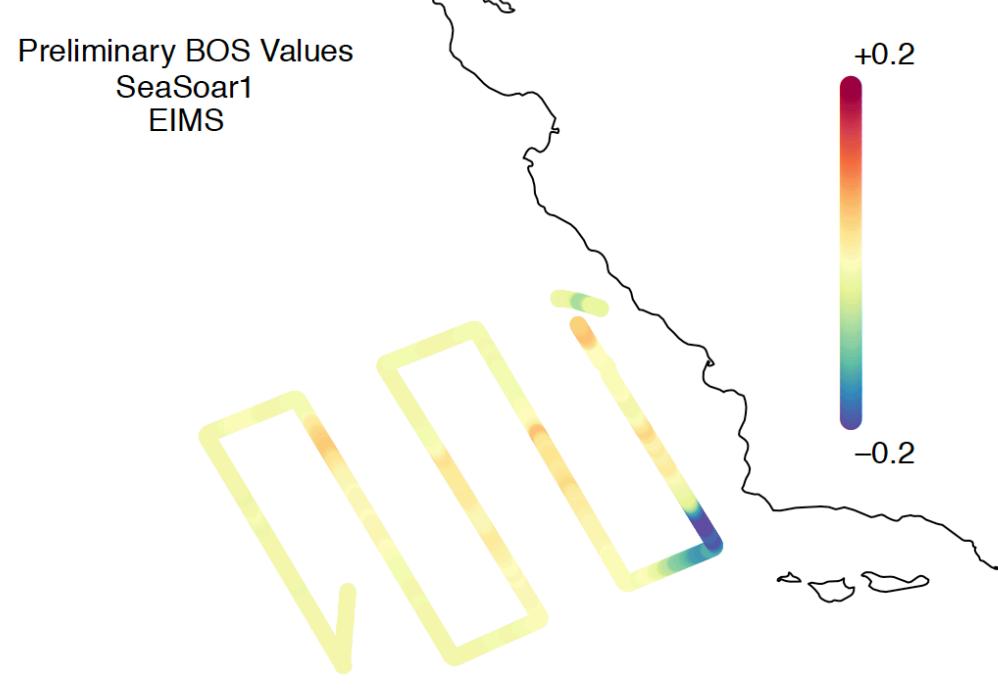
Why?

EIMS spatial data

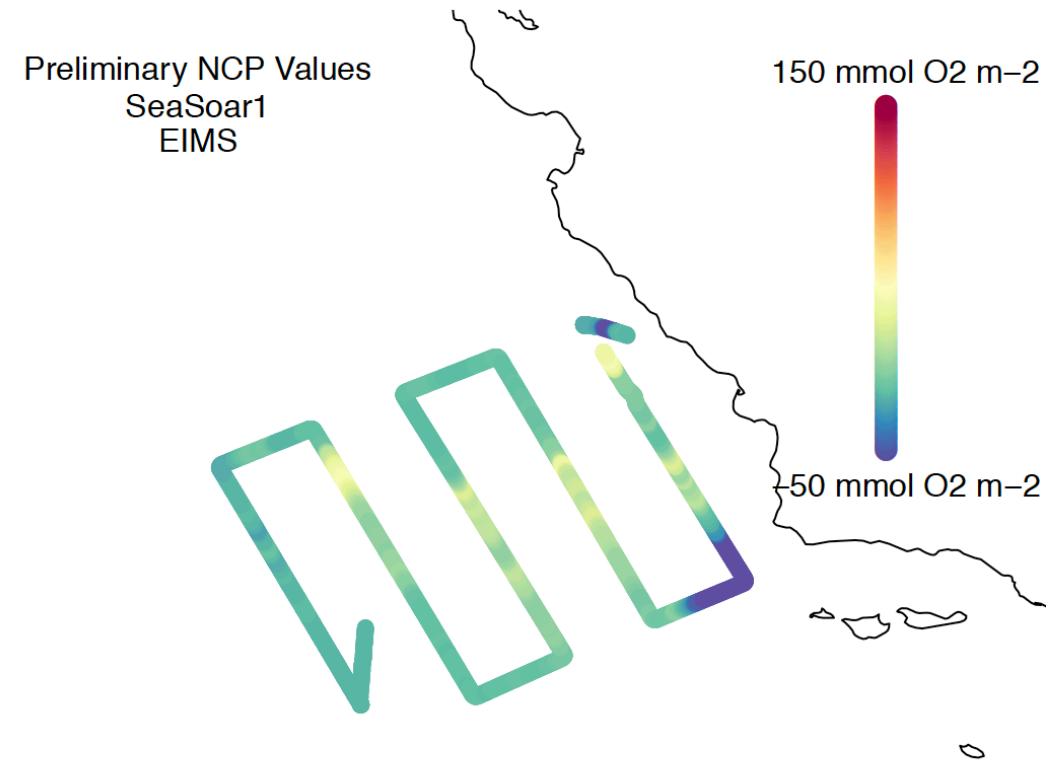
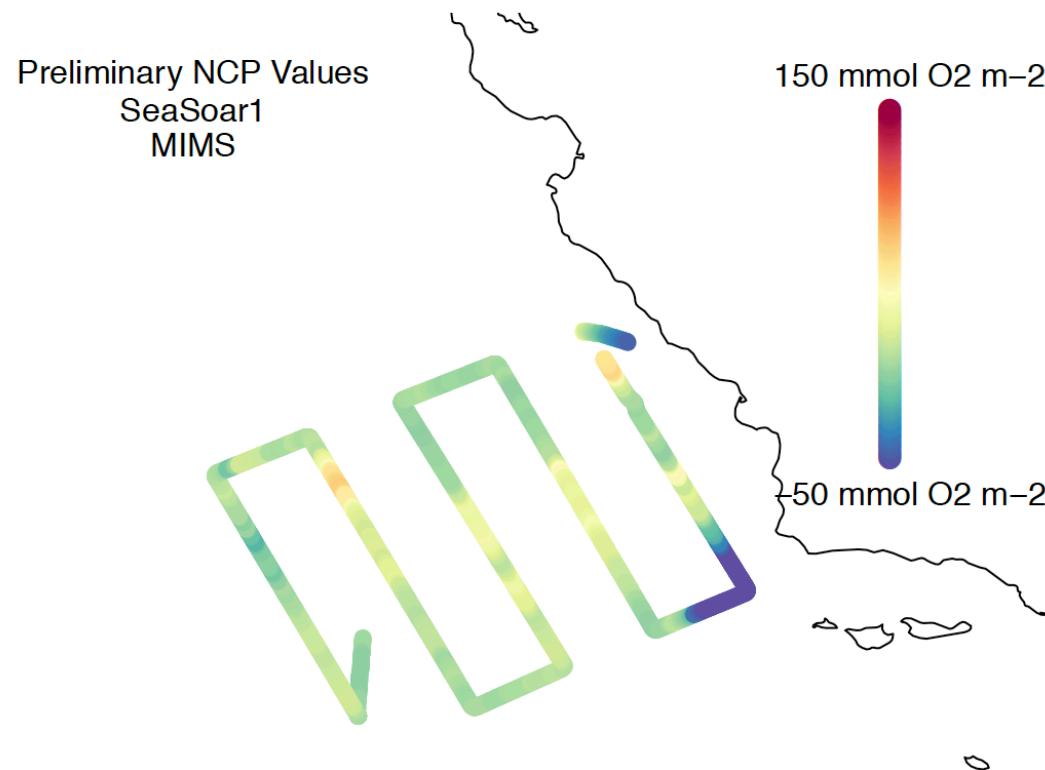
Example EIMS:



Data – spatial EIMS vs. MIMS – *seasoar 1 or 2*

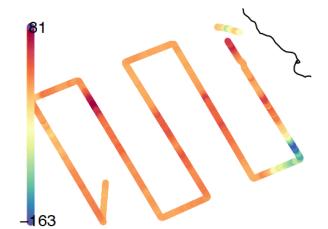


Data – spatial EIMS vs. MIMS – *seasoar 1 or 2*



Impact of diurnal cycles on NCP analysis:

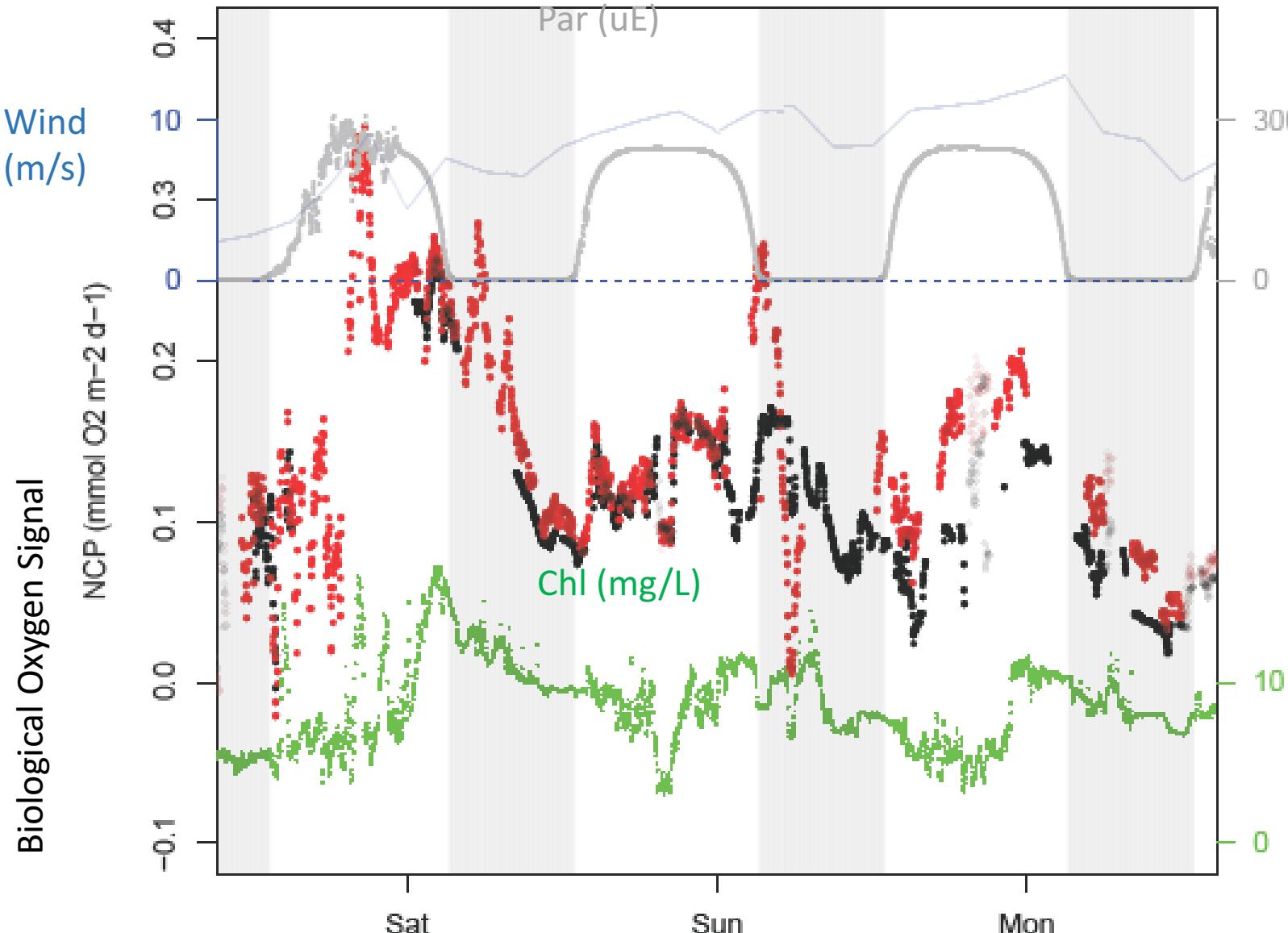
- See Jonsson et al 2013 – work on MLD and wind – use his model framework to analyze diurnal impact!
- Diurnal NCP is supposed to include the O₂ signal from the past days (*k)- *yet diurnal O₂ changes dramatically – hence diurnal changes influence O₂/Ar analysis!*
- Use of cycle (1 and 2) as example (up to 4 days) – maybe add Seavers data?
- Use of high frequency FRRF GP data to potentially correct for the diurnal signal in the SEASOAR data!
- Build model framework!



Example of strong diurnal periodicity!

3000

Cycle1



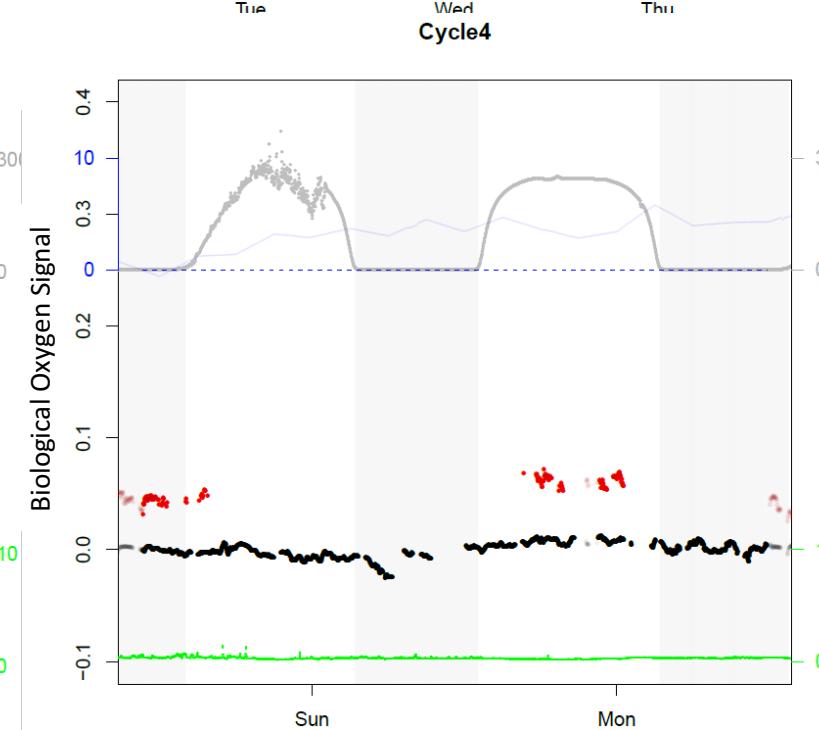
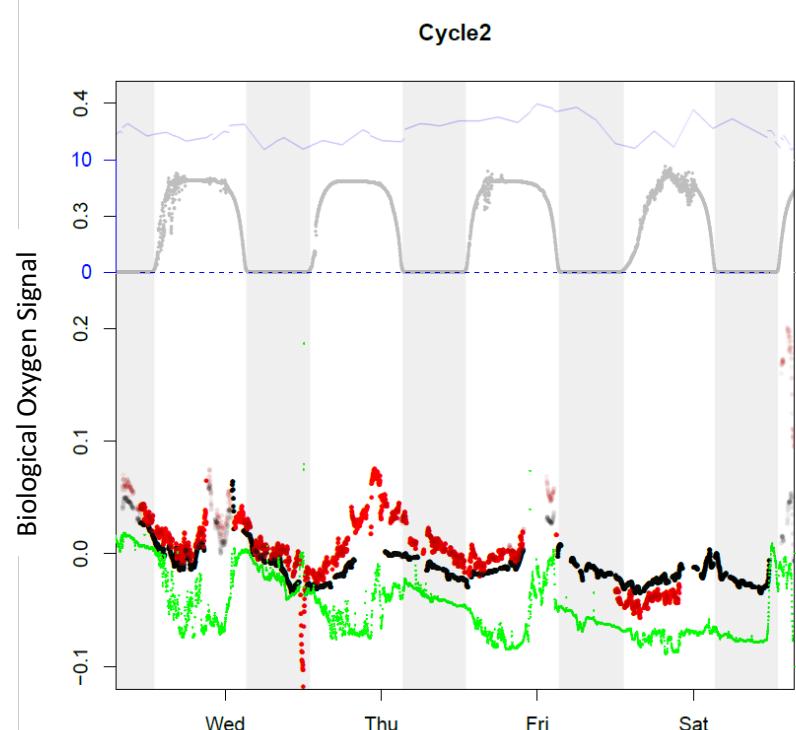
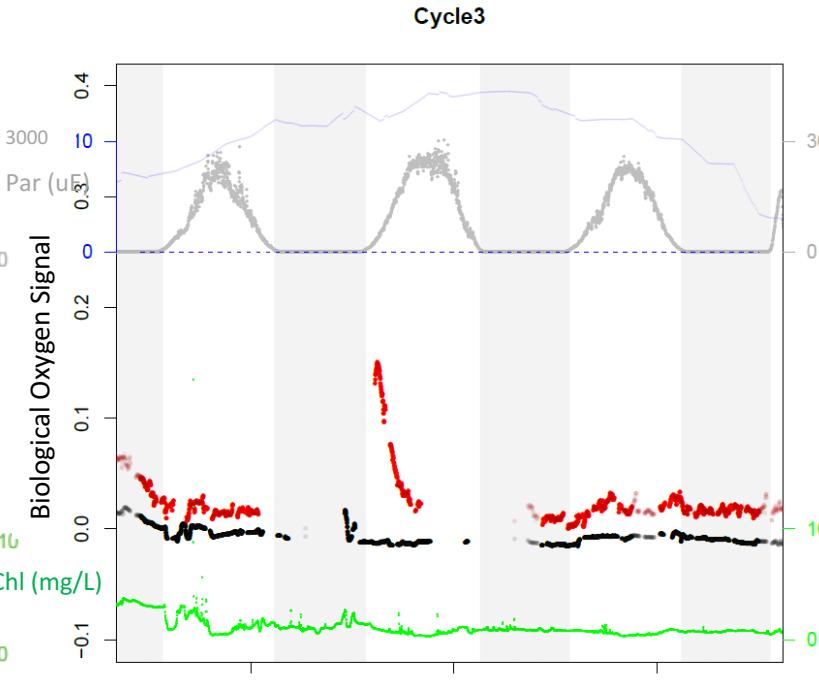
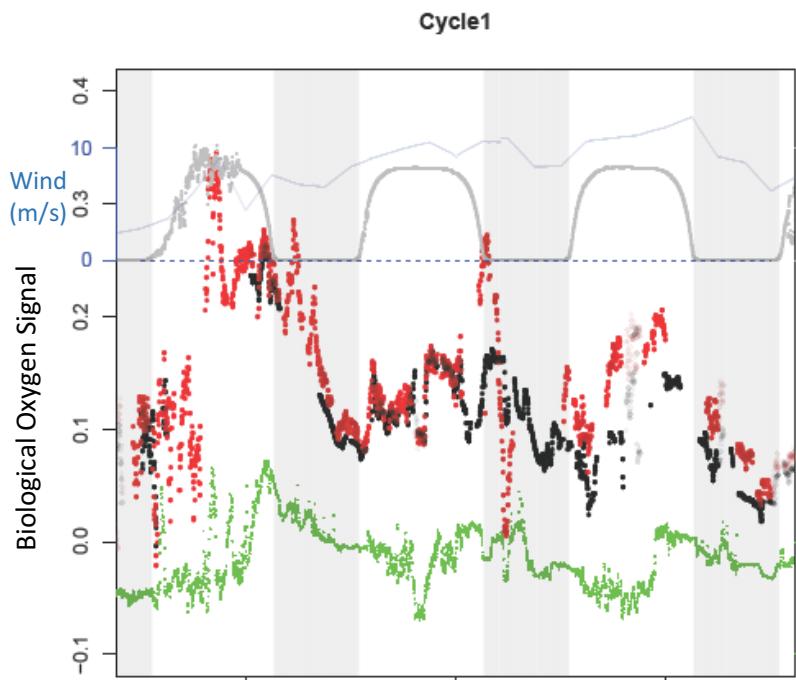
For internal use only ;-)

Maybe add NO3

Maybe add GP from FRRF

RESIDENCE TIME OF O₂?

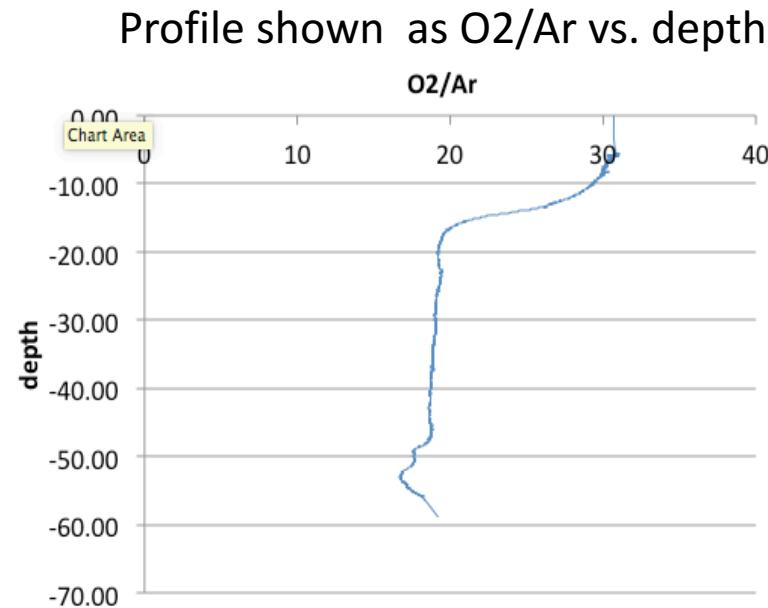
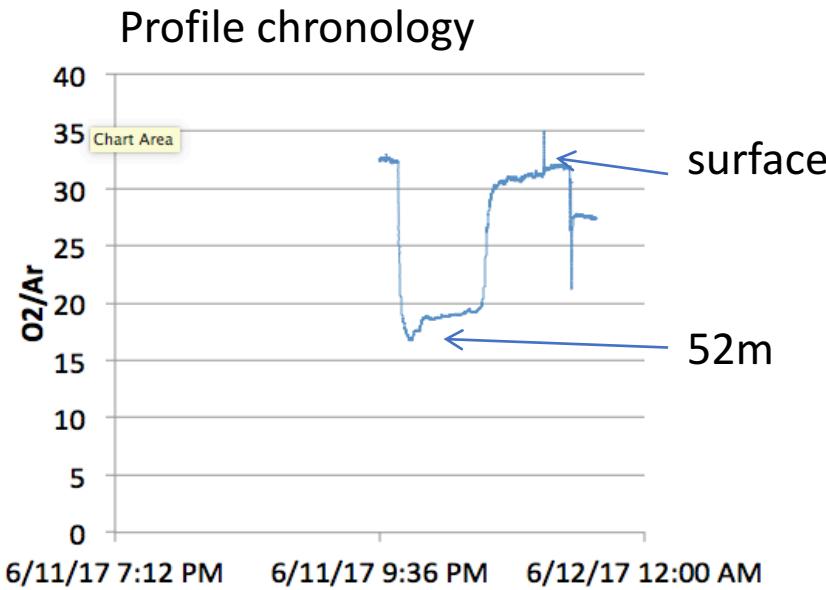
Changes in wind?



O₂-Ar profiles

- Data:
 - 3 profiles to approx. 50m
 - Using a well pump and tubing connected to the MIMS/EIMS inlet
 - Profile @1m/min - upwards
 - Flow rate: approx 10L/min into the inlet system
 - Delay: approx 20 sec from intake to MIMS
 - Duration approx. 1h of measurement

Profiles

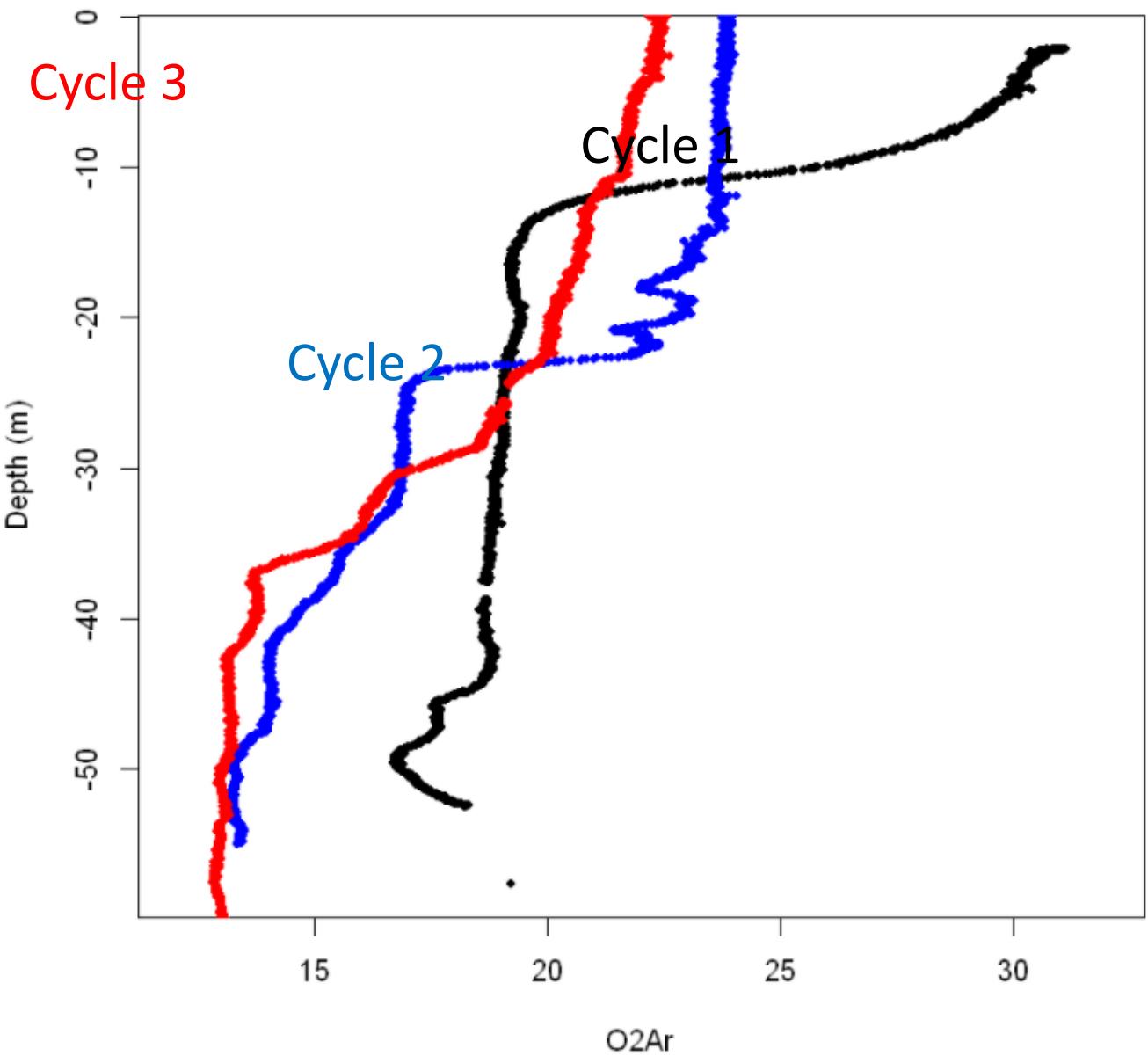


Depth O_2/Ar profile uncorrected for pressure and temperature!

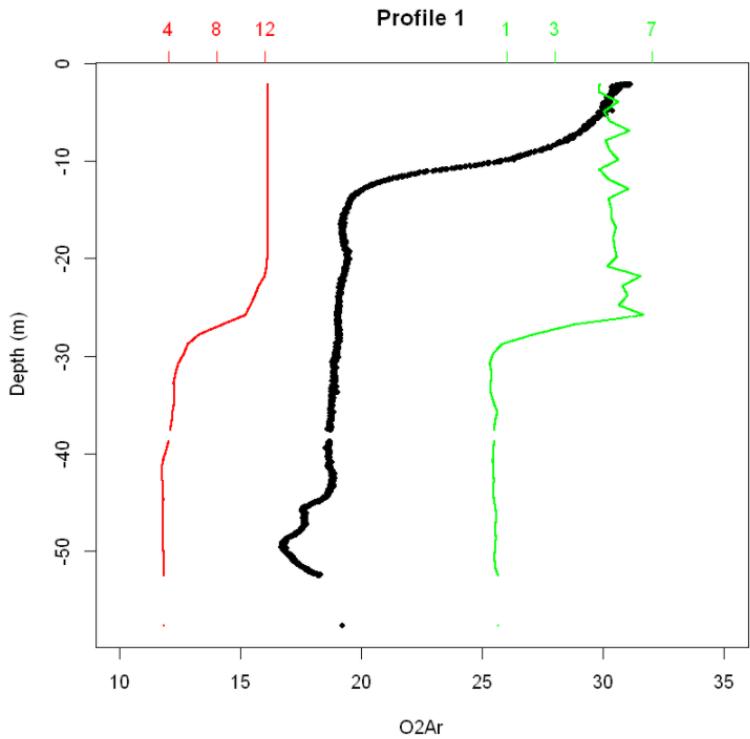
- do we have to?
- Ar and O₂ both change over depth (temperature effect on membrane?)

O₂/Ar profiles

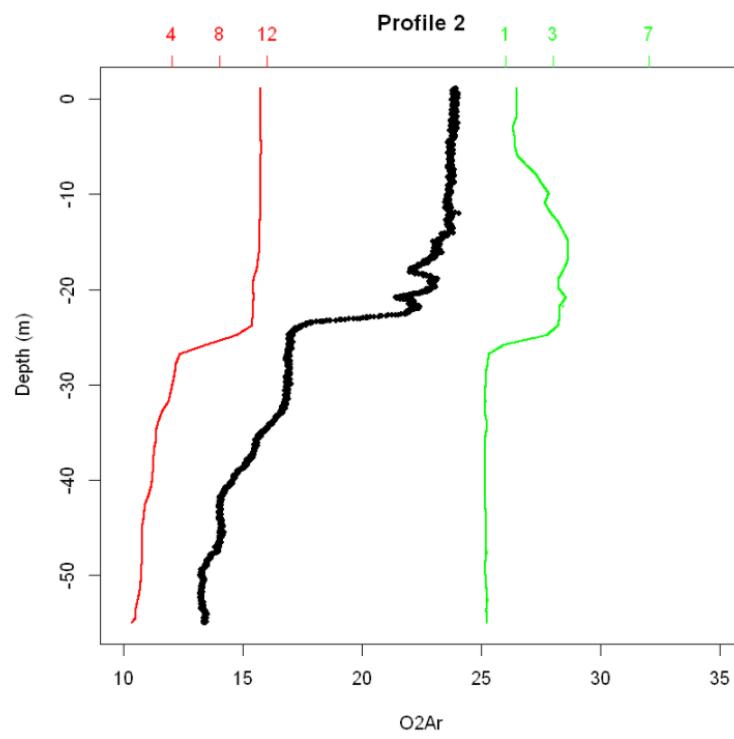
Profiles



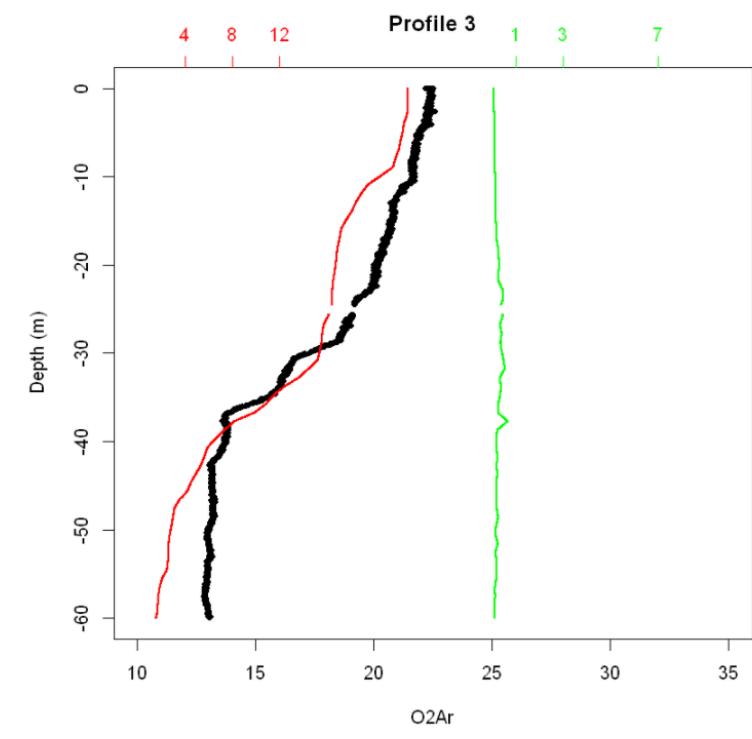
O₂/Ar profiles (blk) vs. fluorescence (gr) vs. temp (red)



Cast 23 MLD 23m



Cast 32? MLD 22m



Cast 74 – MLD 12

Further data analysis / comparison (synthesis)

- Use CCE-LTER dataset to verify data!
 - ^{14}C (N)PP (24h) in situ from MLD + below (for model) “with constrains”
 - Bacteria productivity (resp1)- in the mixed layer
 - Grazing rate (resp2) – in the mixed layer
 - Chl a
 - Species
 - Secondary productivity
 - Biomass?
 - Export and new production!
- Add data from on-deck incubation (CACLOFI) to constrain PP pattern in the CCE region
 - use O₂ profiles...

FRRF

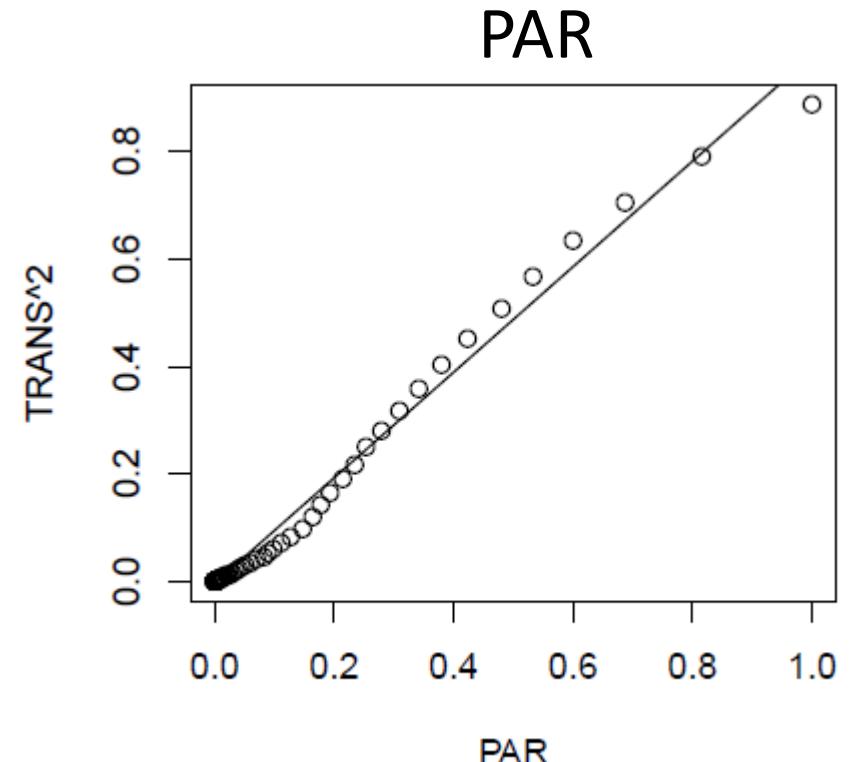
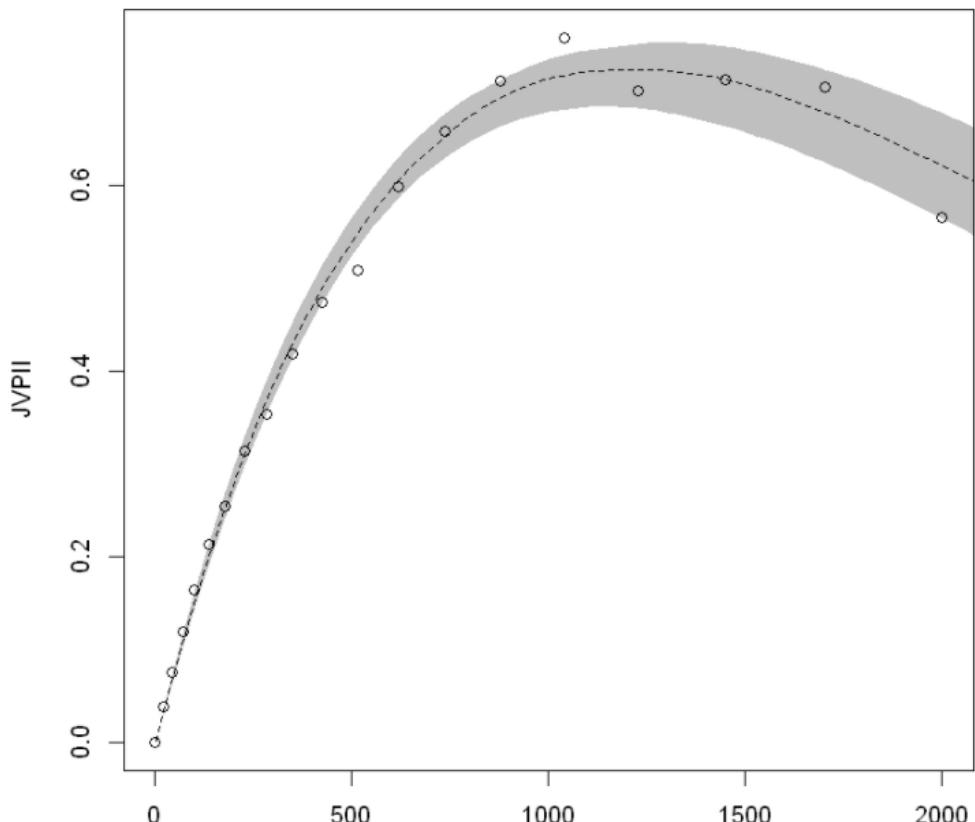
- Available data:
- E_k – light saturation
- JVPII (mol electrons PSII-1 m⁻³ d⁻¹) – to be converted to mol C fix
- Calculate/plot electron transport for each of the cycles / cruise segments – using P-E analysis and (incident or average) light intensity throughout the mixed layer.

FRRF

Platt 1980:

$$JVPII = A \cdot (1 - e^{-\alpha \cdot \frac{I}{A}}) \cdot e^{-\beta \cdot \frac{I}{A}}$$

Uncertainty Analysis → Jackknife bootstrapping



$$PAR(z) \cong E(0) \cdot trans^{2d}$$

Surface PAR may be unreliable due to ship's shadow?

$$GPP = \int_{MLD}^{0 \text{ m}} \int_{-1 \text{ day}}^{\text{now}} JVPII_p(E(t) \cdot (trans)^{2d}) dt dd$$

On going, will have preliminary data soon

Potential projects

- SEAVER:
 - diurnal pattern and correction for vertical structure
- Sven:
 - Diurnal and correction for measurements during transects/SEASOAR and correction for vertical structure using profiles
 - Synthesis - Using ALL data from CCE : NCP (O₂/Ar) : GP (diurnal MIMS, ¹⁴C, FRRF, NO₃) – respiration (bacterial, grazing) + diffusion correction from seavers paper?!!
 - Sven's ¹⁴C C – uptake – using Taylor's pCO₂ / MIMS CO₂ data
- Tom: Hydrodynamic model

Impact of hydro-dynamics on NCP (Tom's model)

- Use O₂ profile data
- Use physical model (ROMS model – 40VARS version)
- Use O₂/Ar profiles