First results of the SONATA / COMICS experiment to compare ORCHESTRA/SOCCOM carbon observations with ship-borne data

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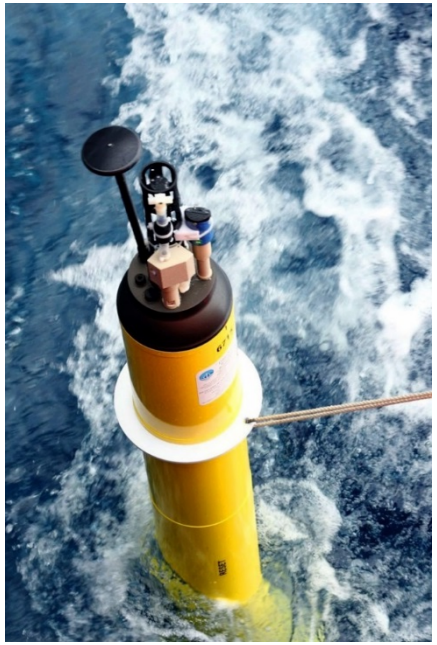
Acknowledgments: Andy Watson, Ute Schuster, Paul Halloran, Brian King, Richard Sanders, Elaine McDonough, Ken Johnson, Vassilis Kitidis



http://www.comerfamilyfoundation.org/articles/making-the-invisible-ocean-visible

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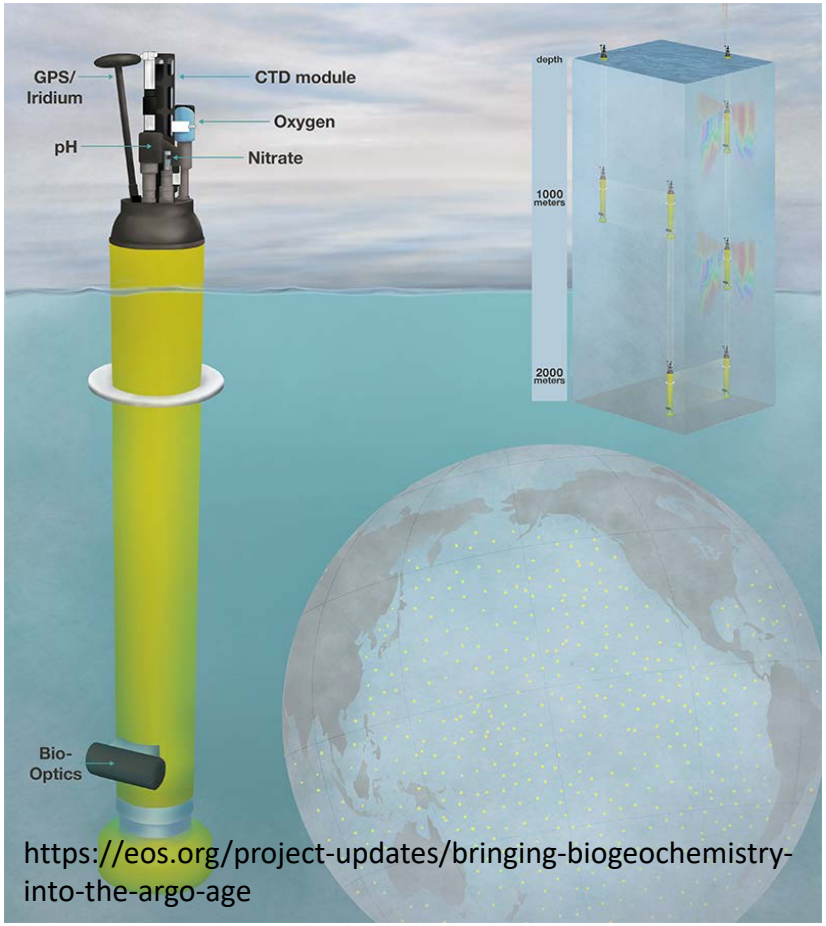
Aims/ Objectives

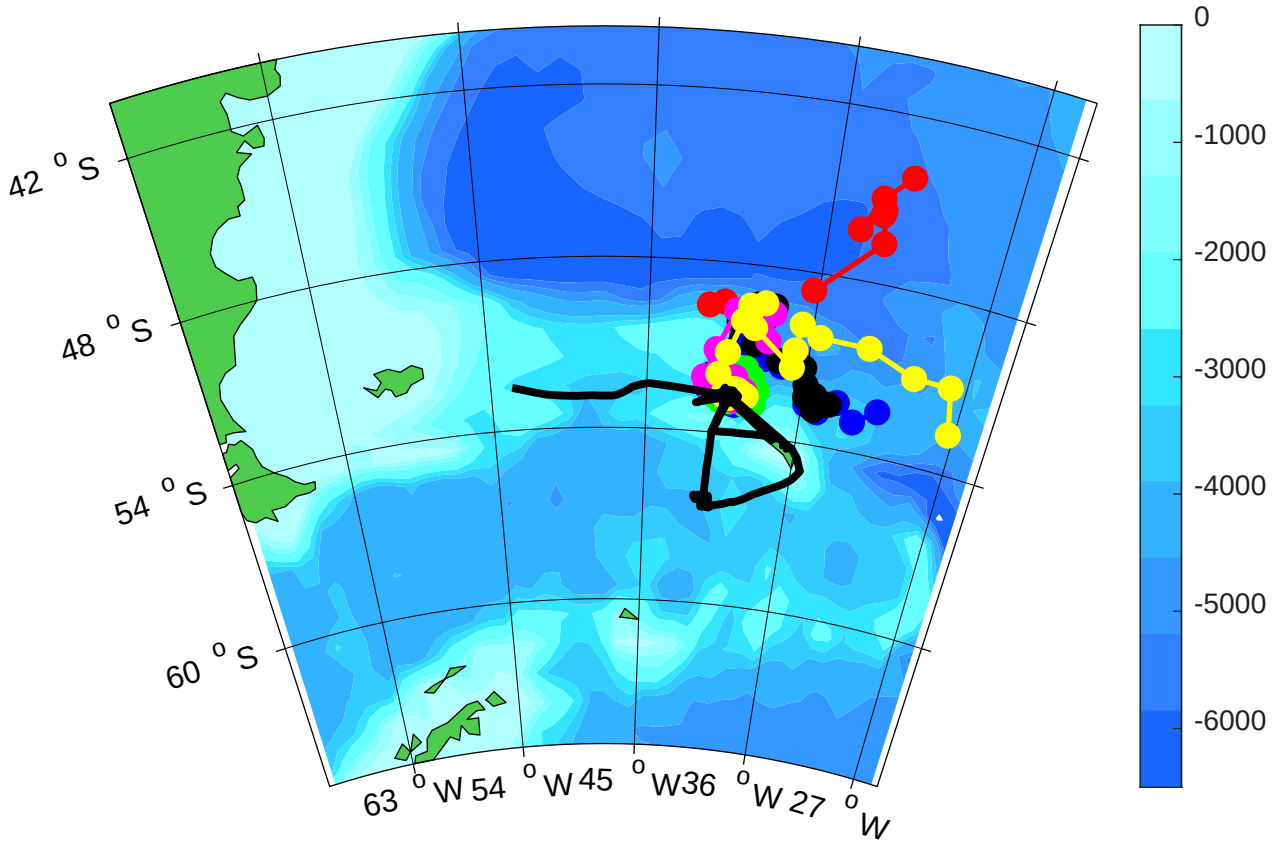
- To validate / ground truth the float derived pCO_2 estimates
- Evaluate calibration and pCO_2 derivation methodology as per Williams et al 2016



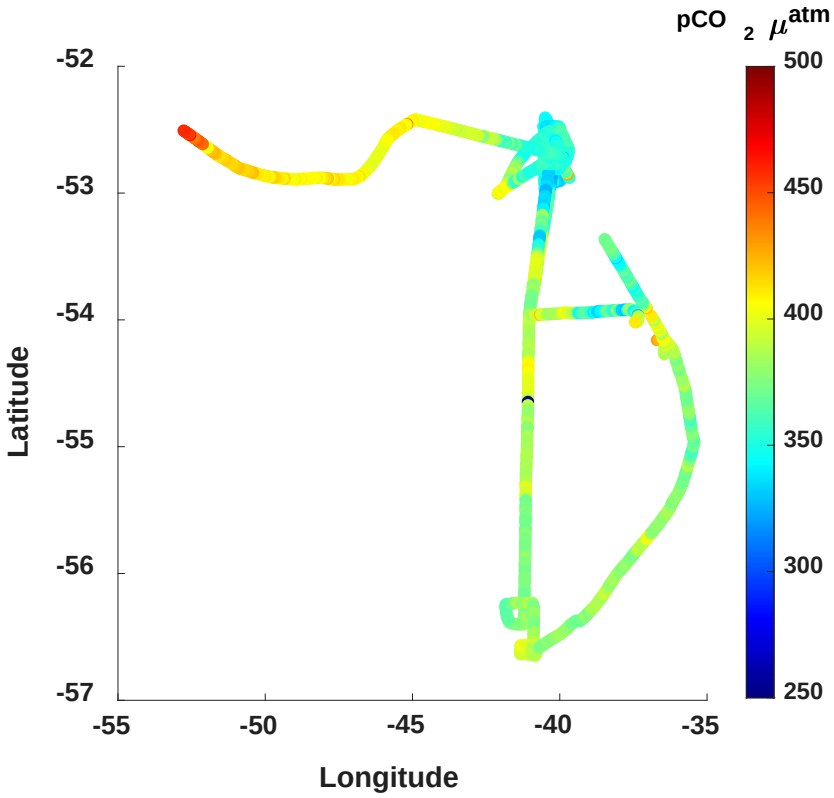
https://eos.org/project-updates/bringing-biogeochemistry-into-the-argo-age

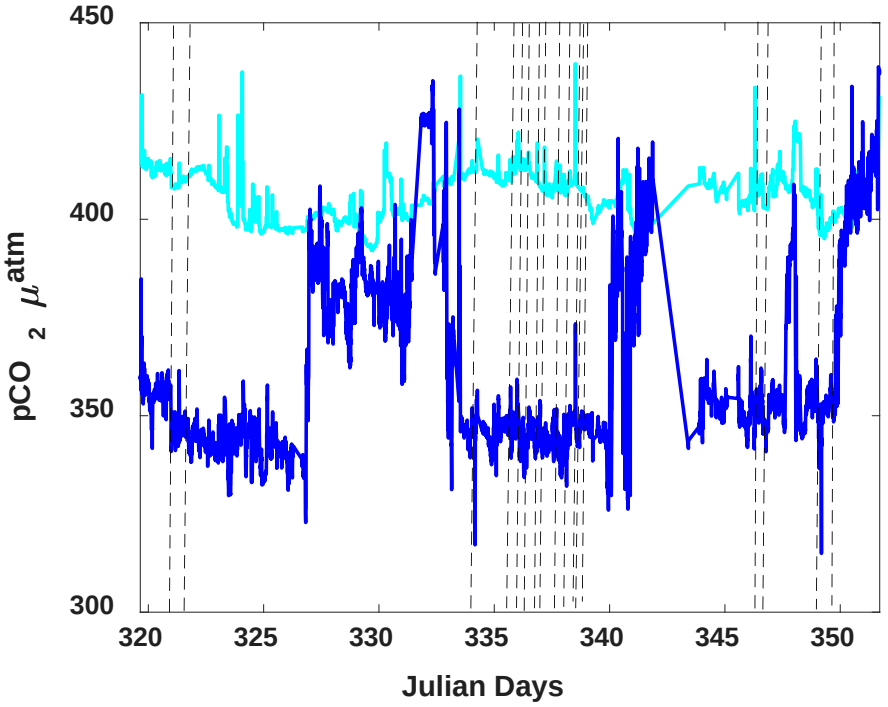
Deployment

- Deployed on COMICS cruise
- Deployed into an eddy
- ~ 1 month of proximal ship based data



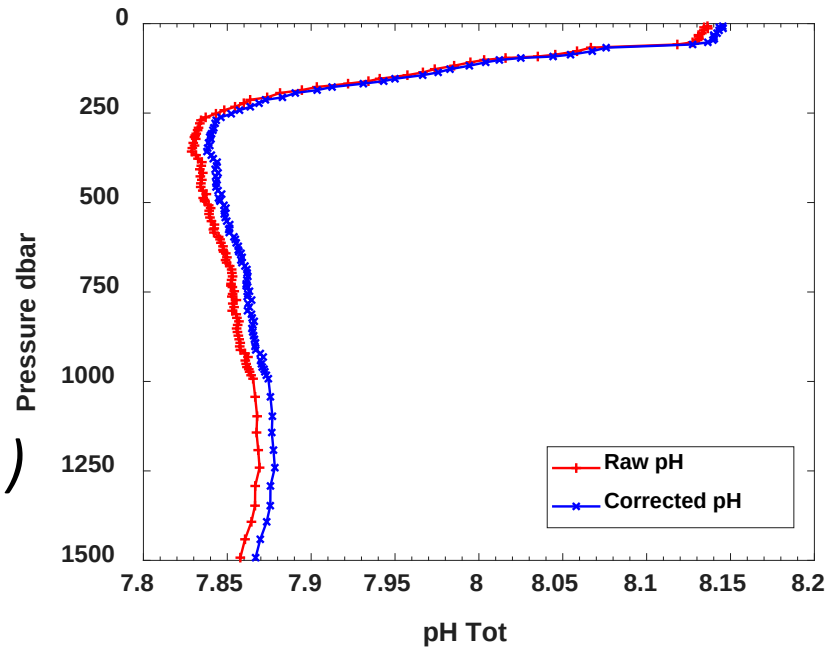
Underway data





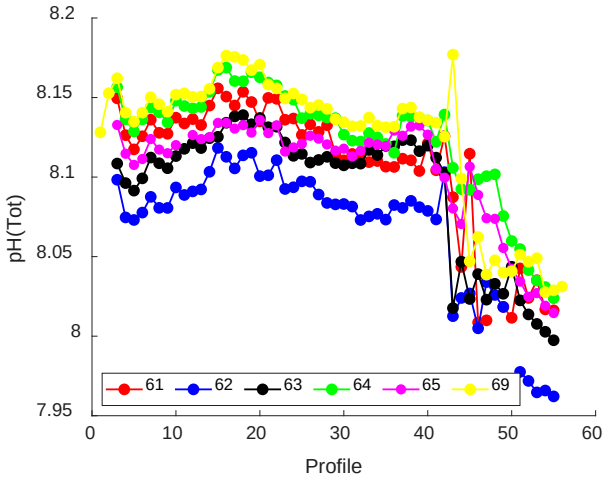
Float pCO2

- MLR to calibrate pH at depth (1500m)
  - *pH = f(Sal, Temp, Pres, Oxy)*
- LIAR derived total Alkalinity
  - *Alk = f(Sal, ΘTemp, AOU, gpan)*
- CO2 sys pCO_2 estimates

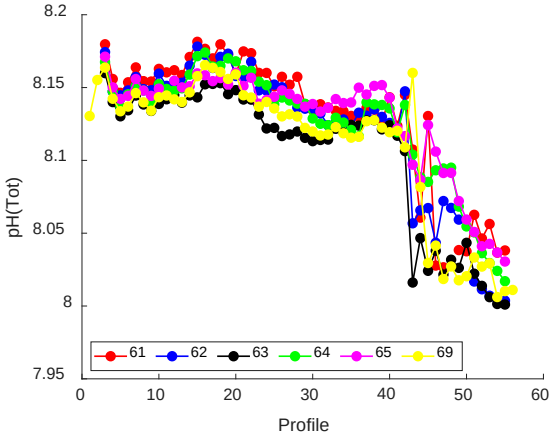


pH Correction

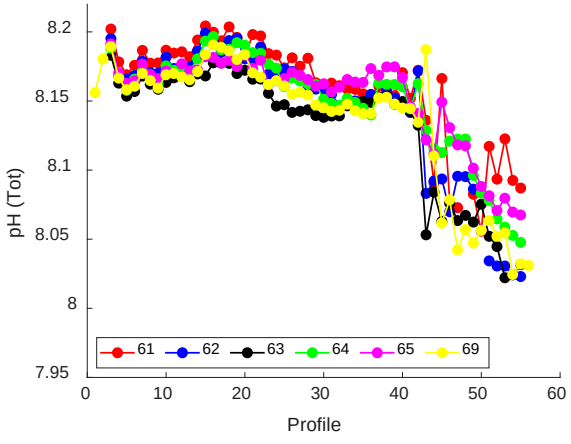
Uncorrected



Williams MLR Corrected

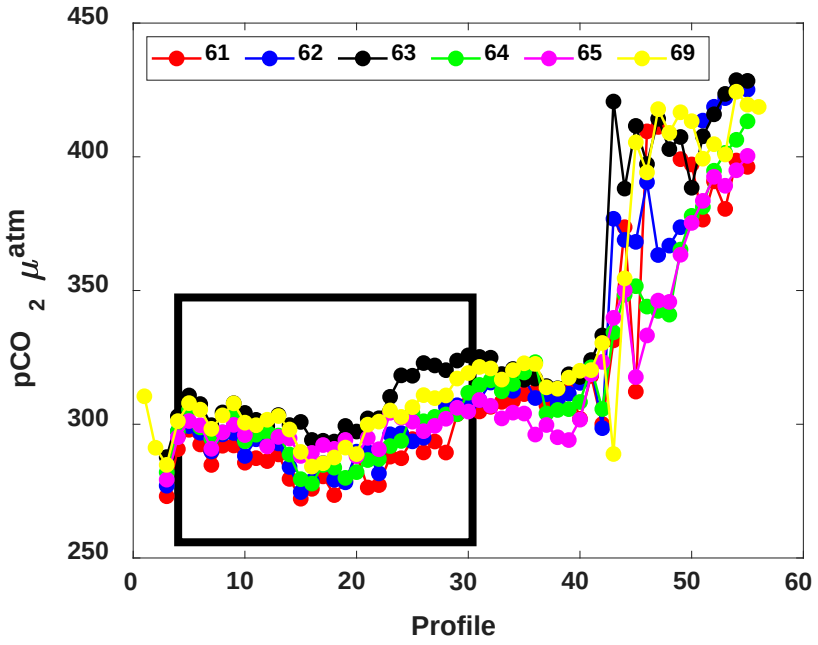


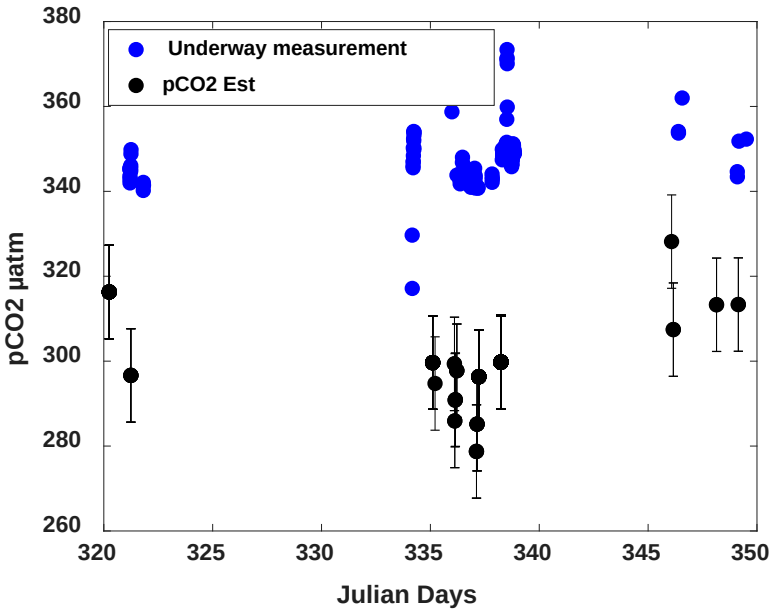
GLODAP Corrected



These two method produce very similar results with the Williams MLR producing slightly lower pH estimates (< 0.02 difference within quoted uncertainties)

pCO_2 Comparison





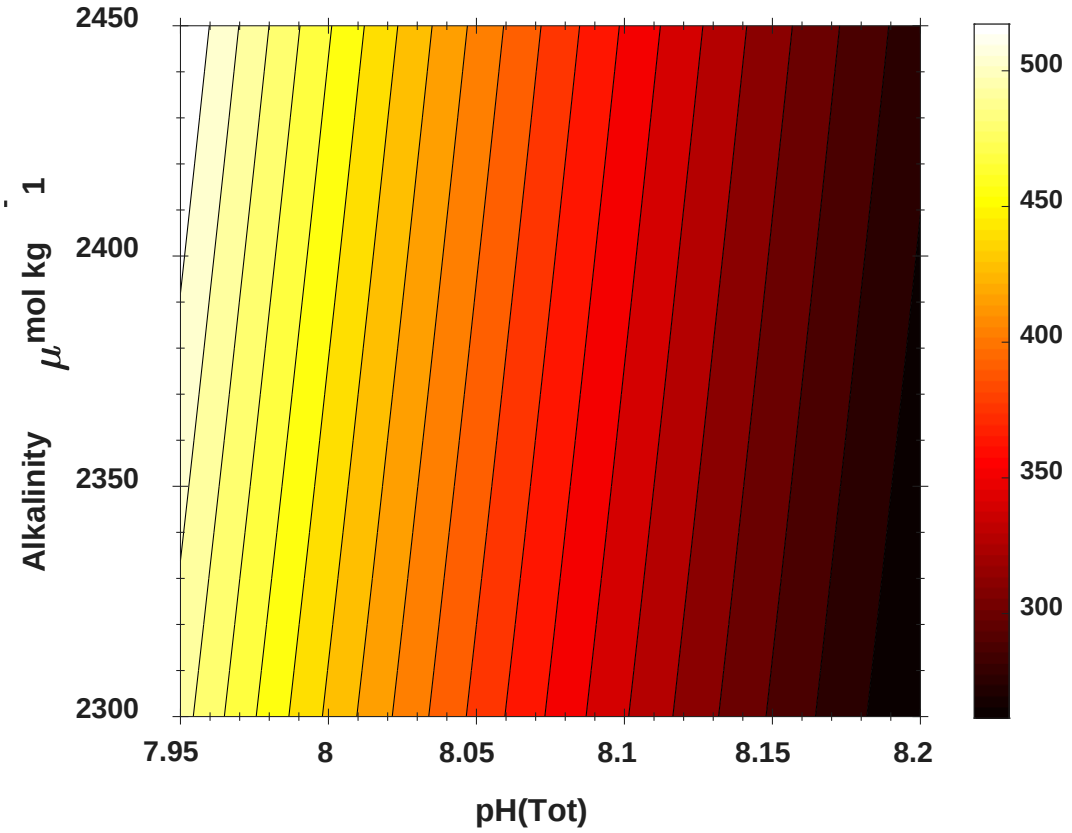
Float pCO_2 estimate is **LOW**. This is especially interesting as previous float estimates have predicted higher pCO_2

Sensitivity to input variables

	pH Δ0.01	O_2 Δ5 µmol kg^{-1}	Temp Δ0.5˚C	Alk Δ50 µmol kg^{-1}
pCO2 Δ µatm	~8-9	~ 7.5	~ 3 - 4	~6.5

- Mean surface alkalinity in GLODAP is 2310.9± 13.6 µmol kg^{-1} (on average 40 µmol kg^{-1} more than LIAR estimate)

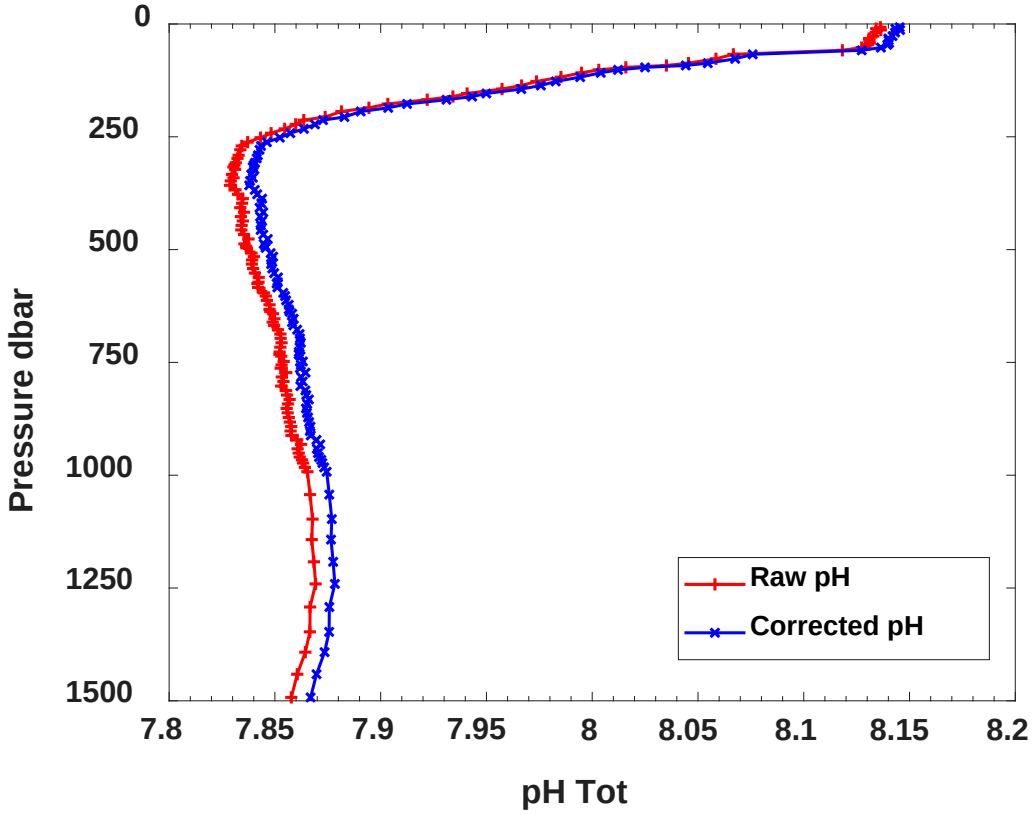
- Oxygen variability explains 74% of pH variability in MLR calibration



Why is there a difference?

- The ship based pCO_2 measurements are systematically high (currently being checked)?

- The pH sensors (the Deep-Sea DuraFET) are displaying a systematic issue with pressure, which was previously thought to have been corrected for (Johnson et al., 2016)?



Conclusion & Further work

- Float pCO_2 is much lower than expected
- Two main hypothesis identified; pH sensor error and ship based error.

Future testing

- Compare data (i.e. oxygen) with CTD measurements
- Calculate pCO_2 from bottle (lab measured) Total Alkalinity and DIC

Questions?

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