Motivating question

What are the biological and physical processes driving O$_2$ saturation and net community production variability at the Palmer LTER region?

Drivers of biological O$_2$ flux in the Western Antarctic Peninsula

- Physical processes
  - Nutrients, Energy

- Biological processes
  - Taxonomy, Physiology

Biological O$_2$ flux

[Map of the Antarctic Peninsula with grid stations and depth contours]
Gas saturation at the Peninsula

**Argon (Ar)**

**Physical O₂**

- Warming
- Decreasing Atm Pressure
- Sea-ice Formation
- Increasing Salinity
- Bubble Processes
- Mixing Different T Water Masses

**Biological O₂**

- Photosynthesis
- Respiration
- Upwelling of O₂ undersaturated waters

Gas Exchange

NCP = Photosynthesis - Respiration

Eveleth et al. (2014)
Biological and Physical Oxygen (January 2012)

Total $O_2$
$\Delta(O_2)_{total}$ (%)

= Biological $O_2$
$\Delta(O_2/Ar)$ (%)

+ Physical $O_2$
$\Delta(Ar)$ (%)

Eveleth et al. (in prep.)
$\delta^{18}O$ data from Mike Meredith (BAS)

Eveleth et al. (in prep.)
January NCP Grid Variability

Regional Mean NCP

(Note: No correction for vertical mixing at this time)
Schoefield et al. 2013, Kavanaugh et al. 2015, in press
$R^2 = 0.46$

$\Delta O_2/Ar$ vs. $F_v/F_m$

All MLD <40m

$R^2 = 0.46$

Lin et al., in prep
Cracking the black box...
Cracking the black box...

Lin et al., in prep.
Paleo-proxy of NCP?

Stations ranked in descending $O_2$/Ar/POC proxy
Which Diatoms?

- Thalassiosira
- Corethron
- Proboscia

3 of 5 most dominant Diatom OTUs show strong correlation ~ NCP

Linear model - stepwise regression:

$$NCP \sim 1.63C1 + 2.49C2 + 1.37C5$$

$$R^2 = 0.85$$  
P < 0.0001
How interactions influence NCP?

NCP = Photosynthesis - Respiration

Autotrophs

Heterotrophs
- Gamma
- Unclassified
- Flavo
- Alpha
- Beta
Preliminary Conclusions:

One (biological/physical) solution does not fit all...

- High iron sufficiency
- Fe supply from upwelling?
- Strong Ar undersaturation from melt
- High iron sufficiency
- Ice may supply Fe and lead to shallower MLDs?

Eveleth et al. in prep.
Preliminary Conclusions

- **Grid** region: **Biology** dominates O₂ saturation (strong anti-correlation O₂/Ar vs. pCO₂)
- However, large **physical** Ar undersaturation at the ice edge in **Grid** (Drake: **Physics** dominates O₂)

- **NCP**: **Diatoms** are not equal, not just **Crypto** vs. **Diatoms**
- Light vs. Fe modulating NCP (Grazing?)
- Role of canyons in NCP (field, satellite observations & penguin colonies)

- Winter priming is important, biological response varies
Questions?

Wish list:
- More winter measurements
- Increased joint use of biogeochemical & molecular tools
- Physical circulation in the canyons
- Relation of NCP to carbon and other nutrients attenuation at depth