

Two Decades of Inorganic Carbon Dynamics Along the Western Antarctic Peninsula

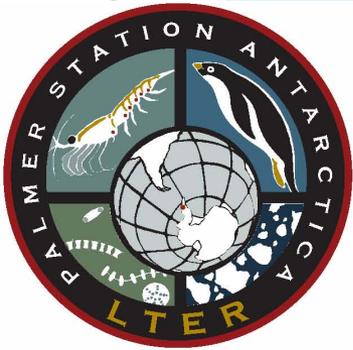
Scott Doney (WHOI) & **Claudine Hauri** (UAF)

Hugh Ducklow & Taro Takahashi (LDEO/Columbia)

Matthew Erickson (Antarctic Support Contractors)

Grant Jiang (U. Melbourne)

Physics & biology effects on regional CO₂-system patterns
Ocean acidification & climate change trends in CO₂-system



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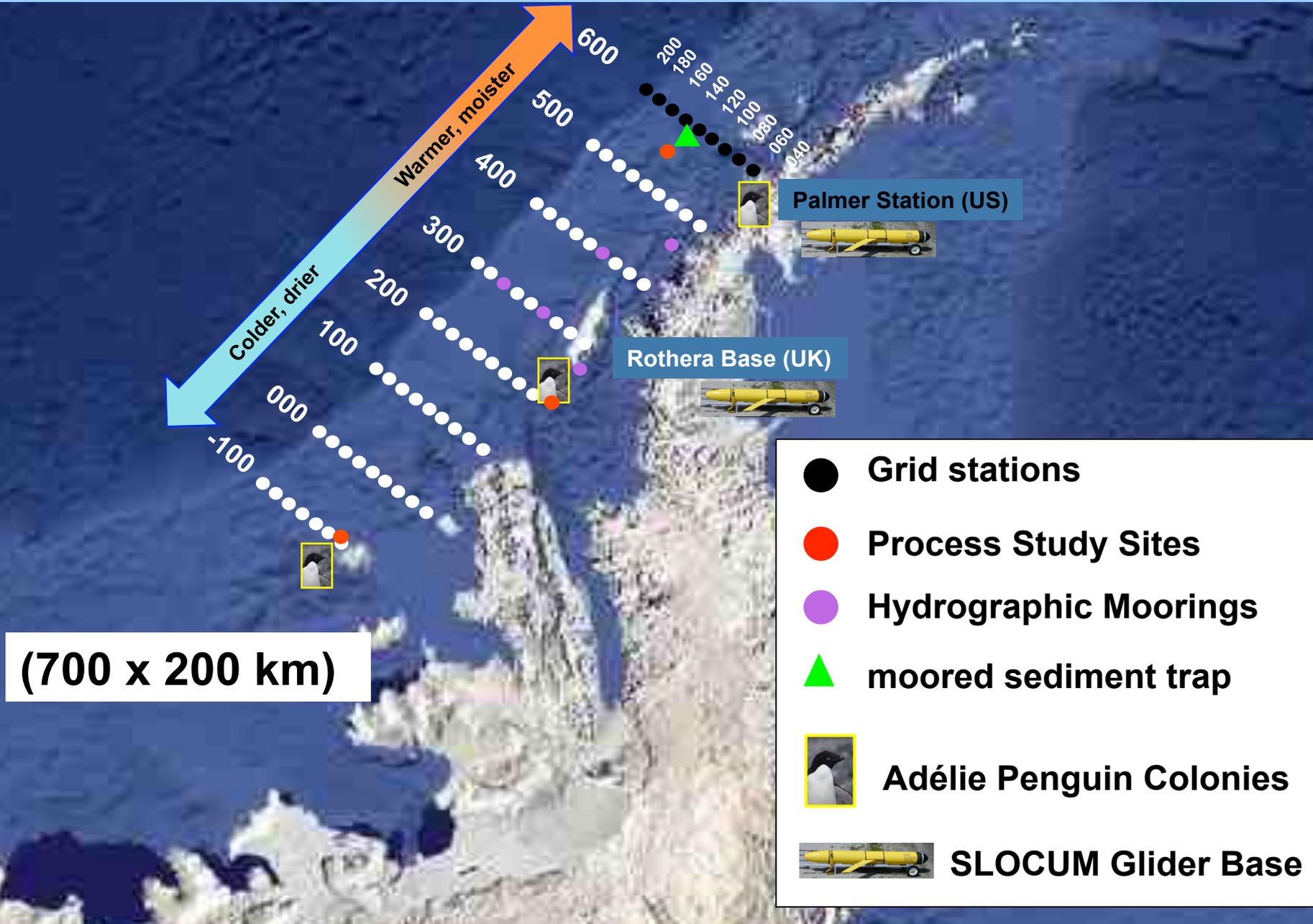
Research Article

**Two decades of inorganic carbon dynamics along the
Western Antarctic Peninsula**

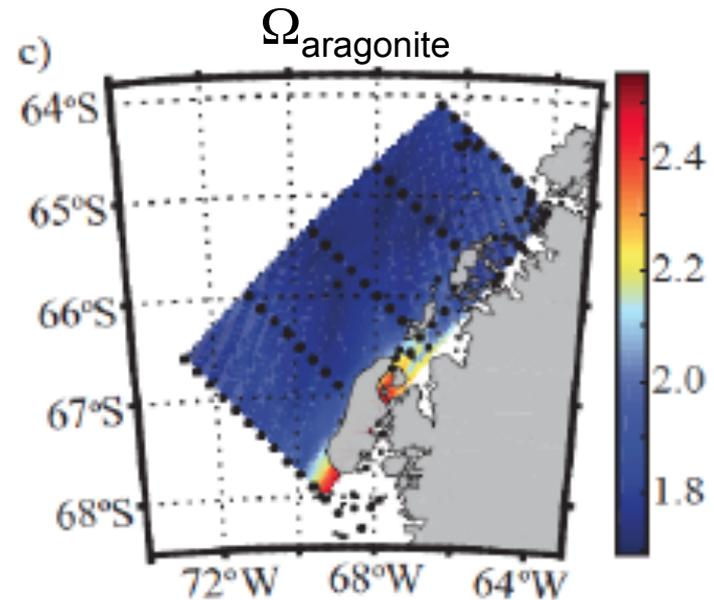
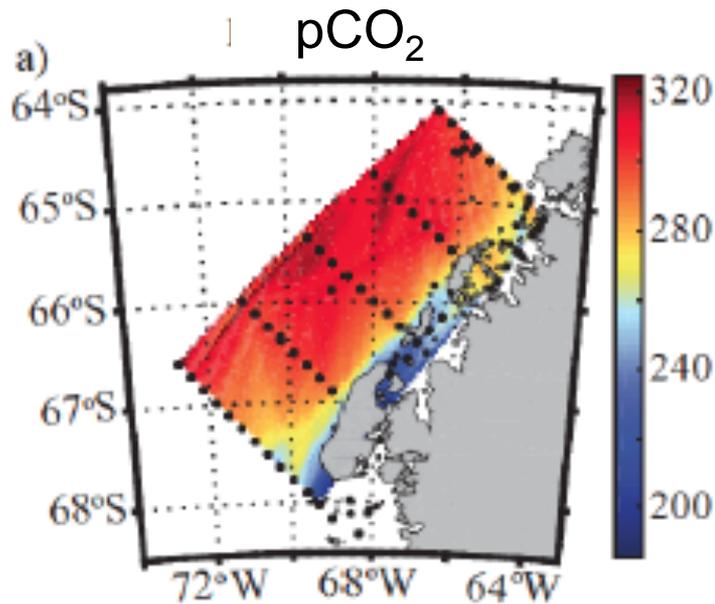
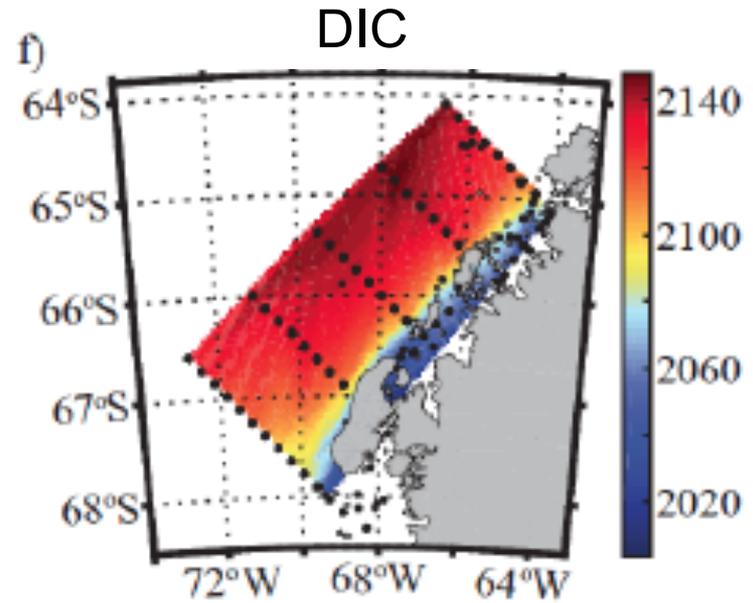
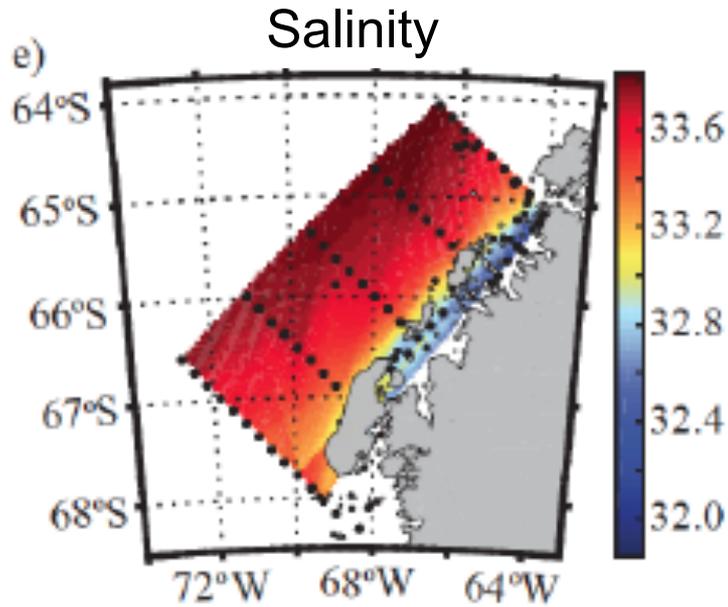
C. Hauri^{1,2,3}, S. C. Doney⁴, T. Takahashi⁵, M. Erickson⁶, G. Jiang⁷, and
H. W. Ducklow⁵

Hauri et al.
Biogeosci.
Discuss.
2015

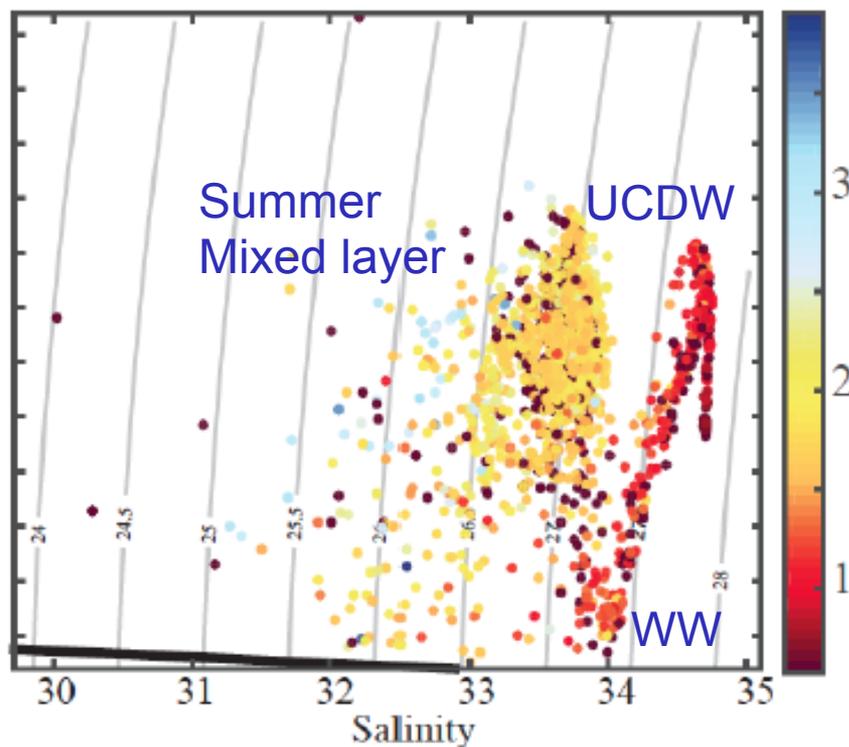
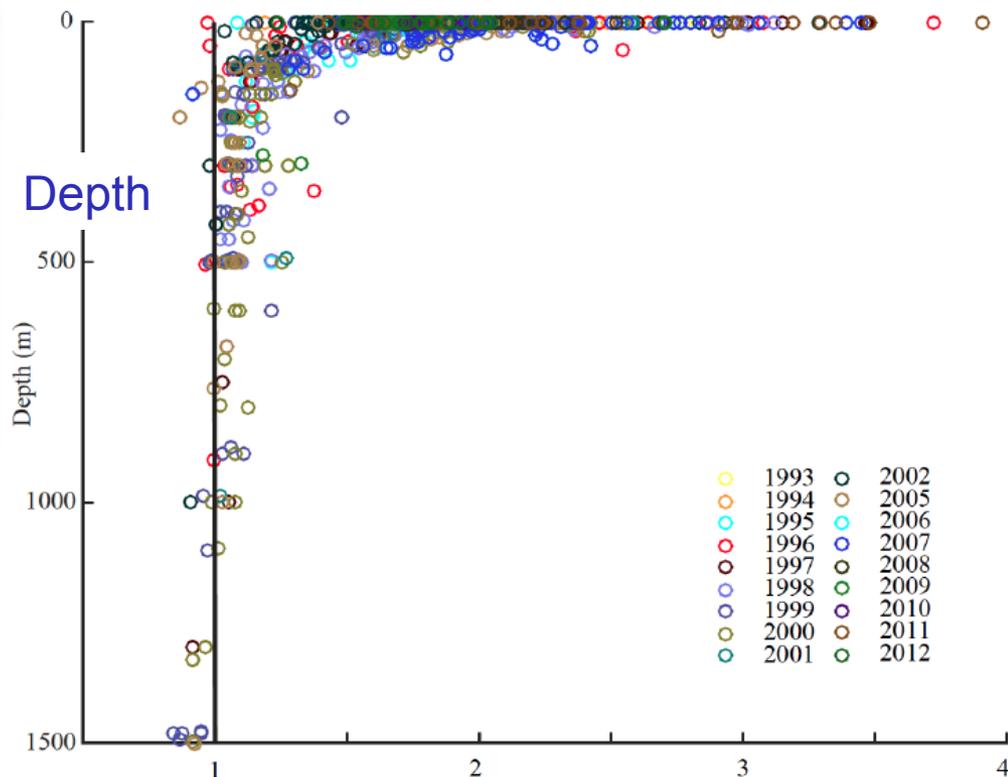
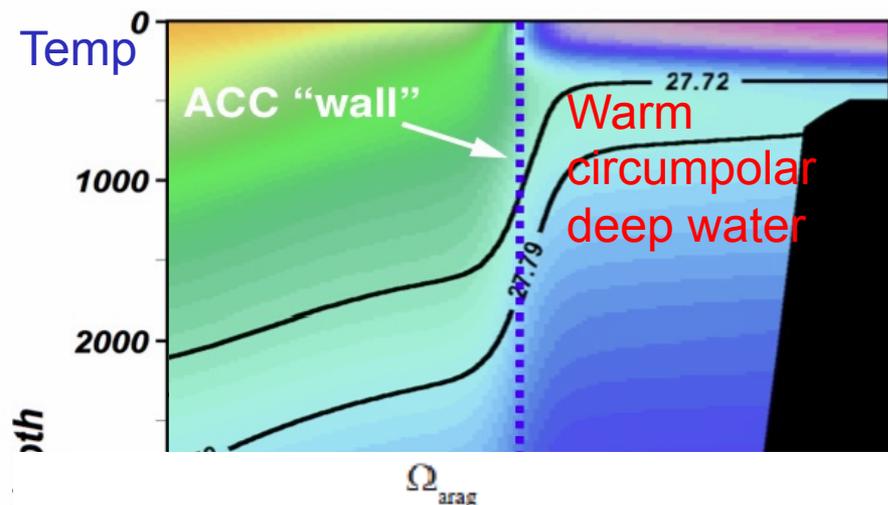
Palmer LTER Study Region



Climatological Surface Means



Water-mass Structure & Aragonite Saturation State



$\Omega_{\text{aragonite}}$

$\Omega_{\text{aragonite}}$

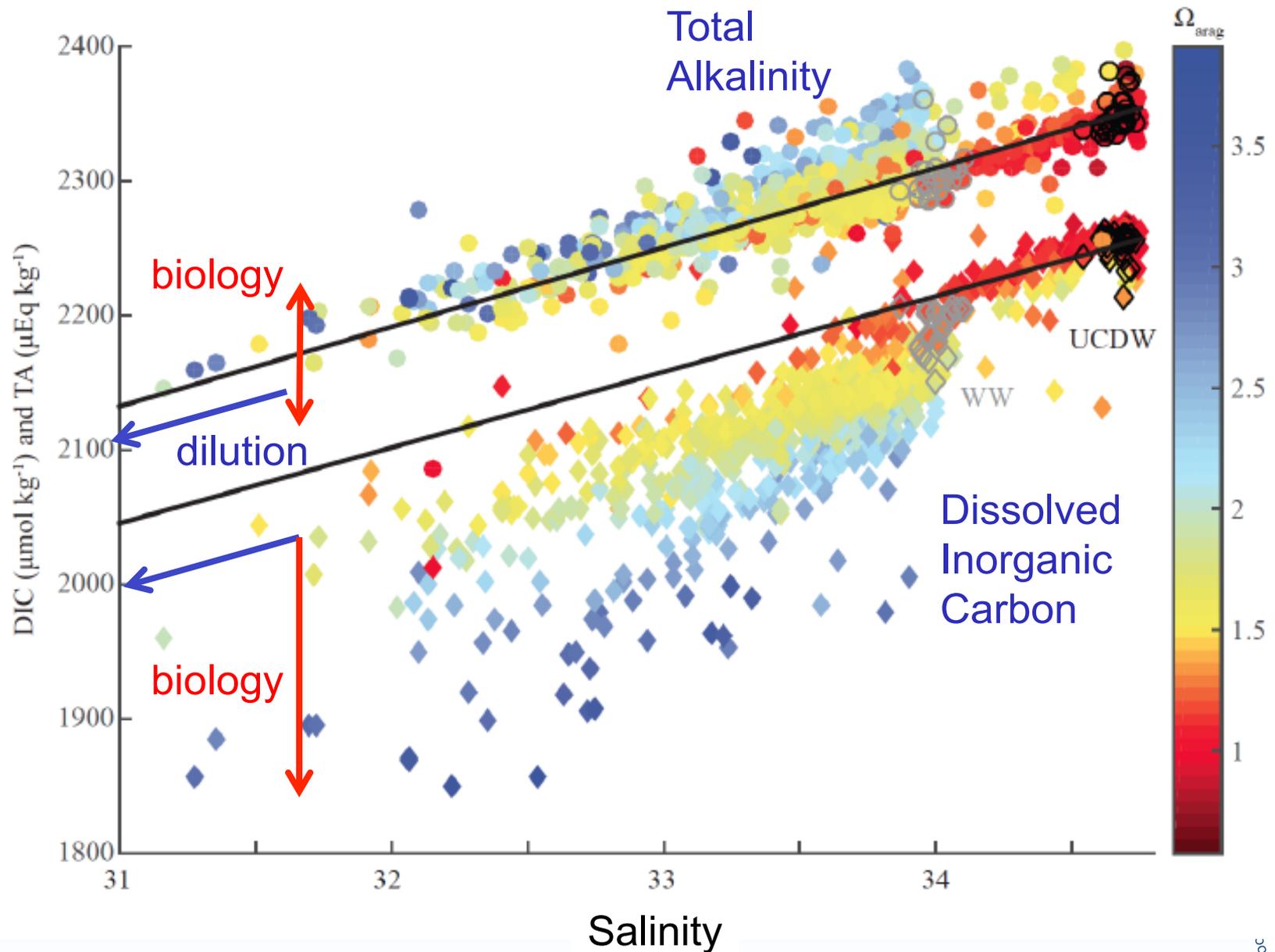


$$\Omega = \frac{[\text{Ca}^{2+}][\text{CO}_3^{2-}]}{K_{\text{sp}}}$$

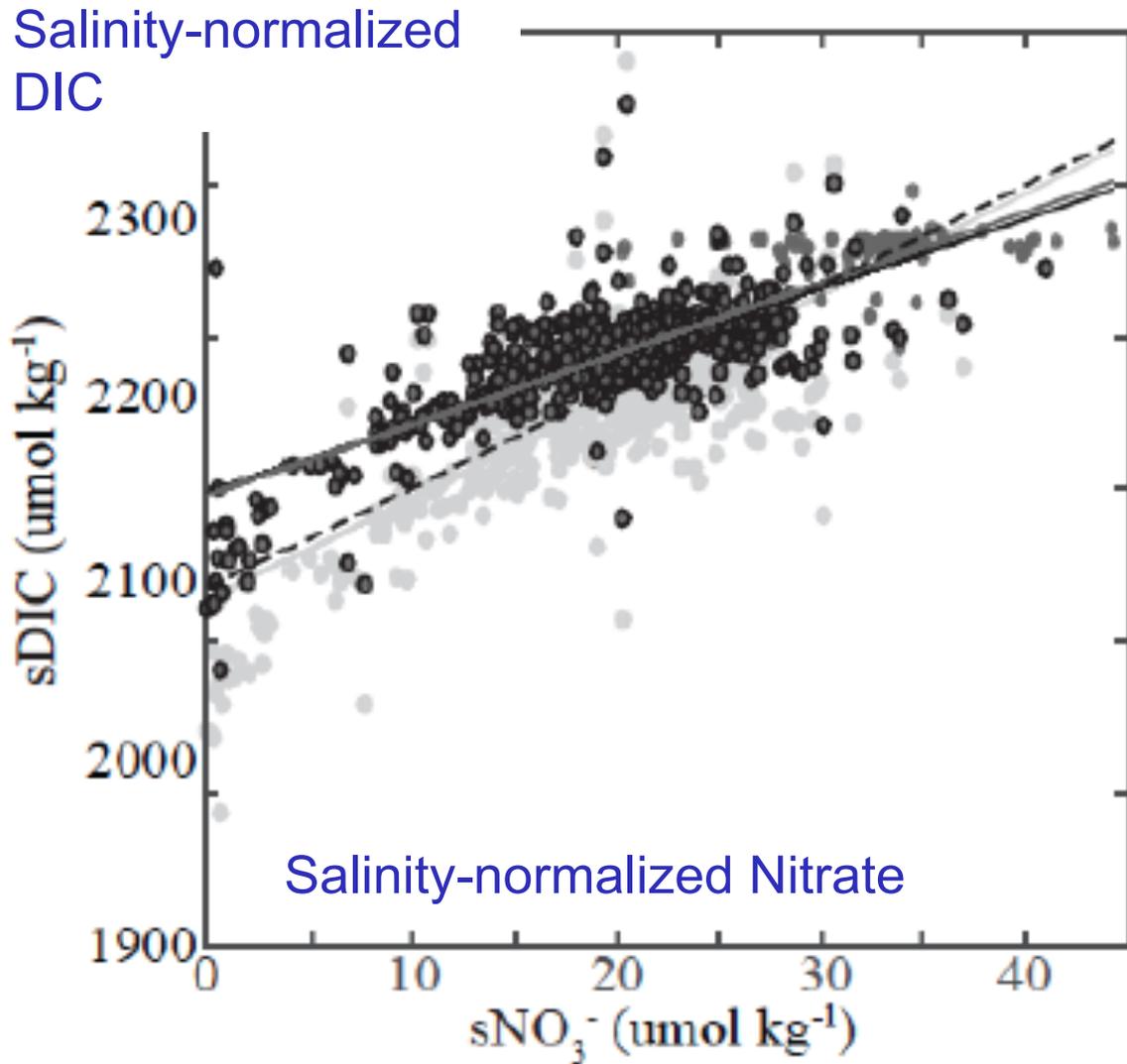
$\Omega > 1$ saturated

$\Omega < 1$ undersaturated

Mixing versus Biological Drawdown

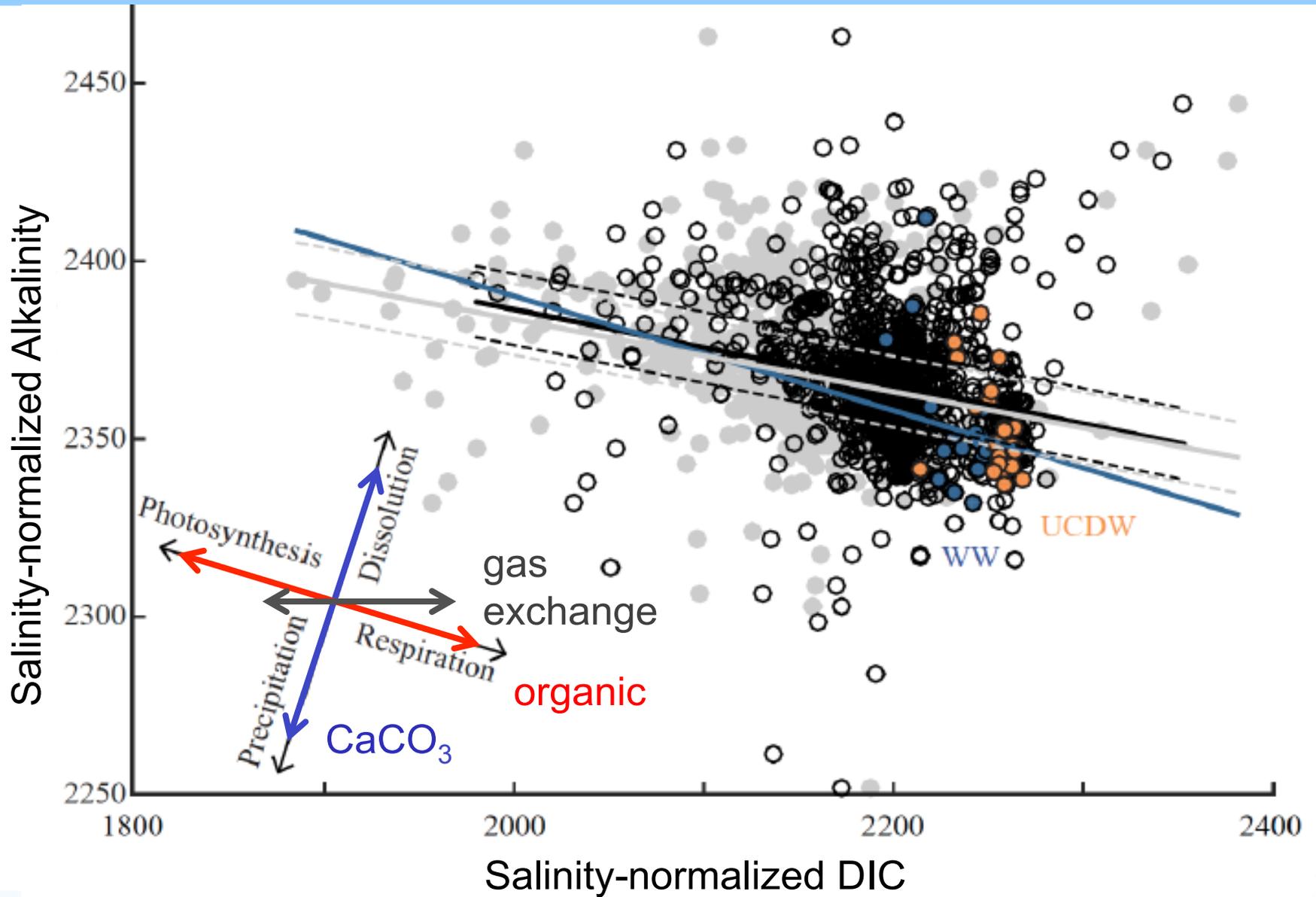


Net Community Production

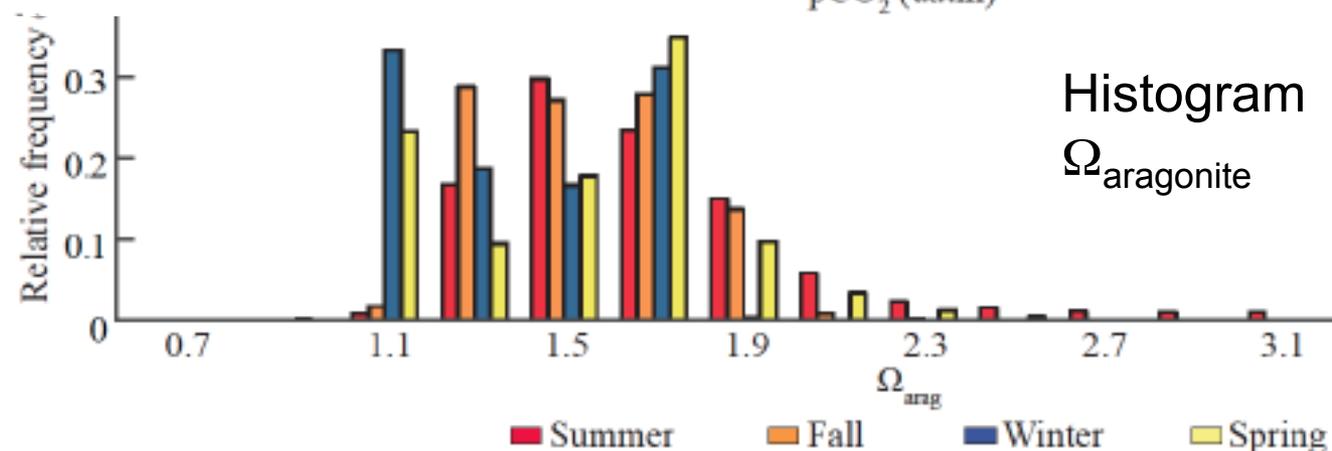
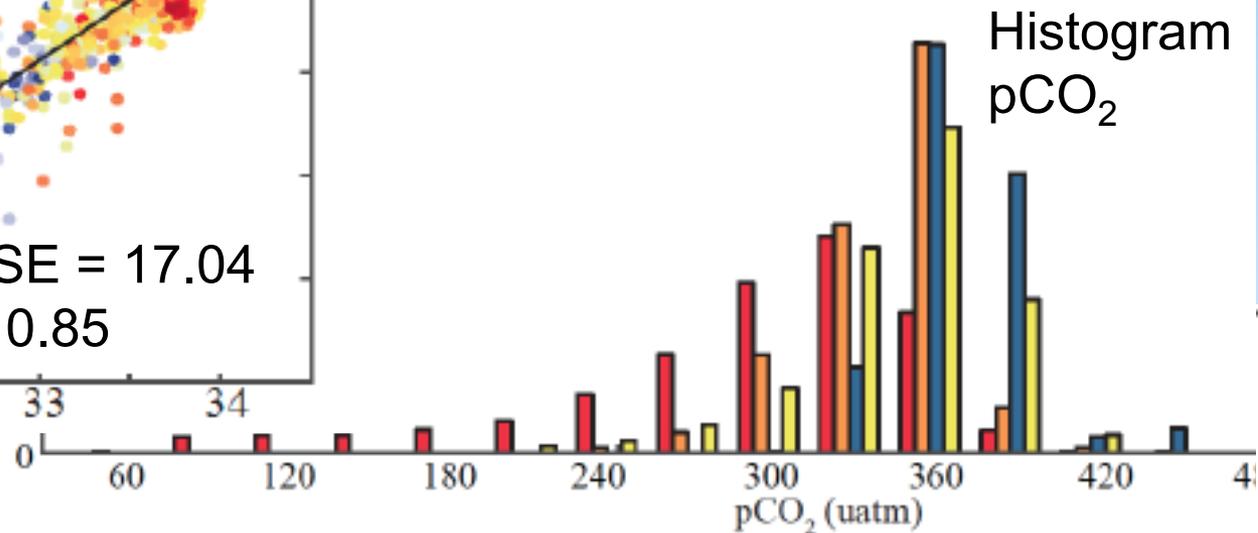
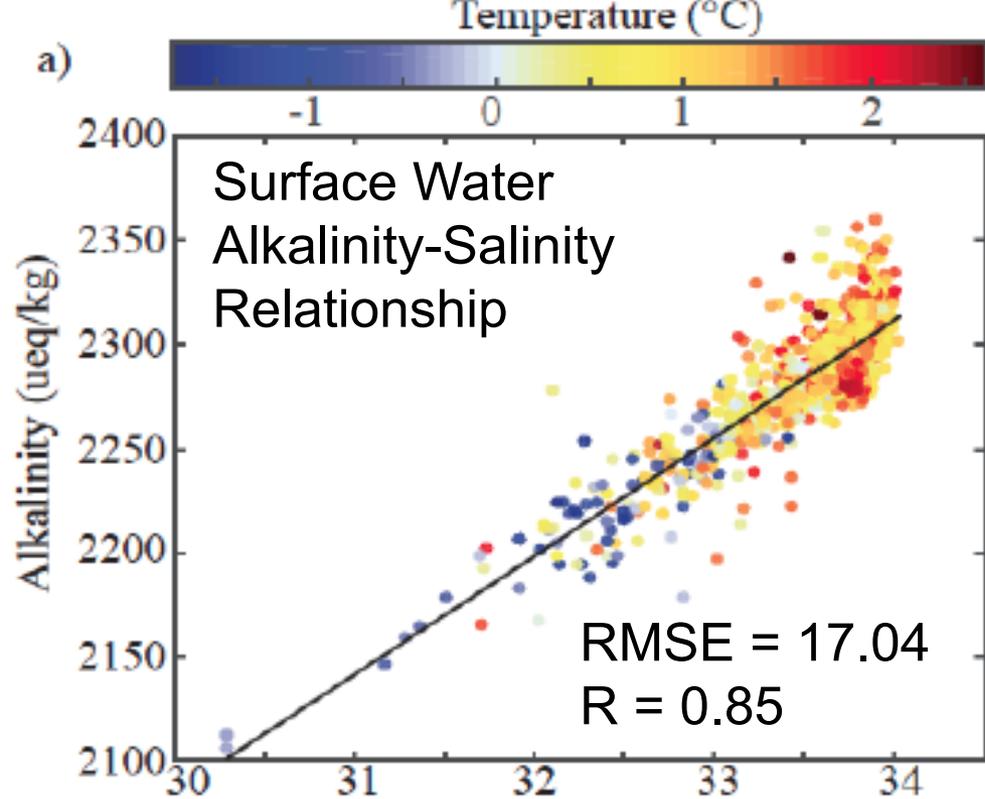


After correction for gas exchange, seasonal DIC-nutrient drawdown ratio agrees well with Redfield C/N

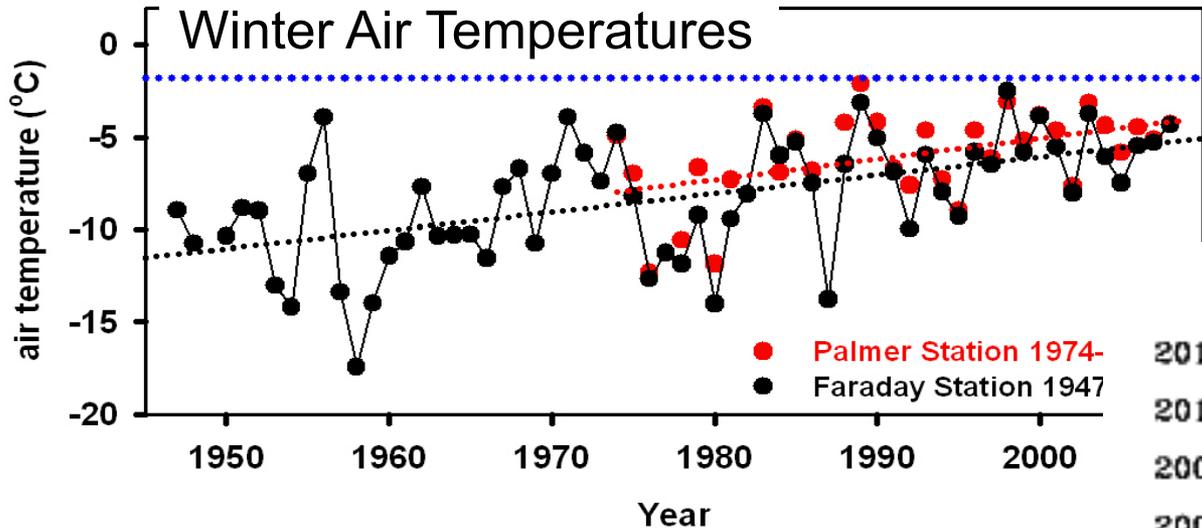
Organic versus Inorganic Carbon Uptake



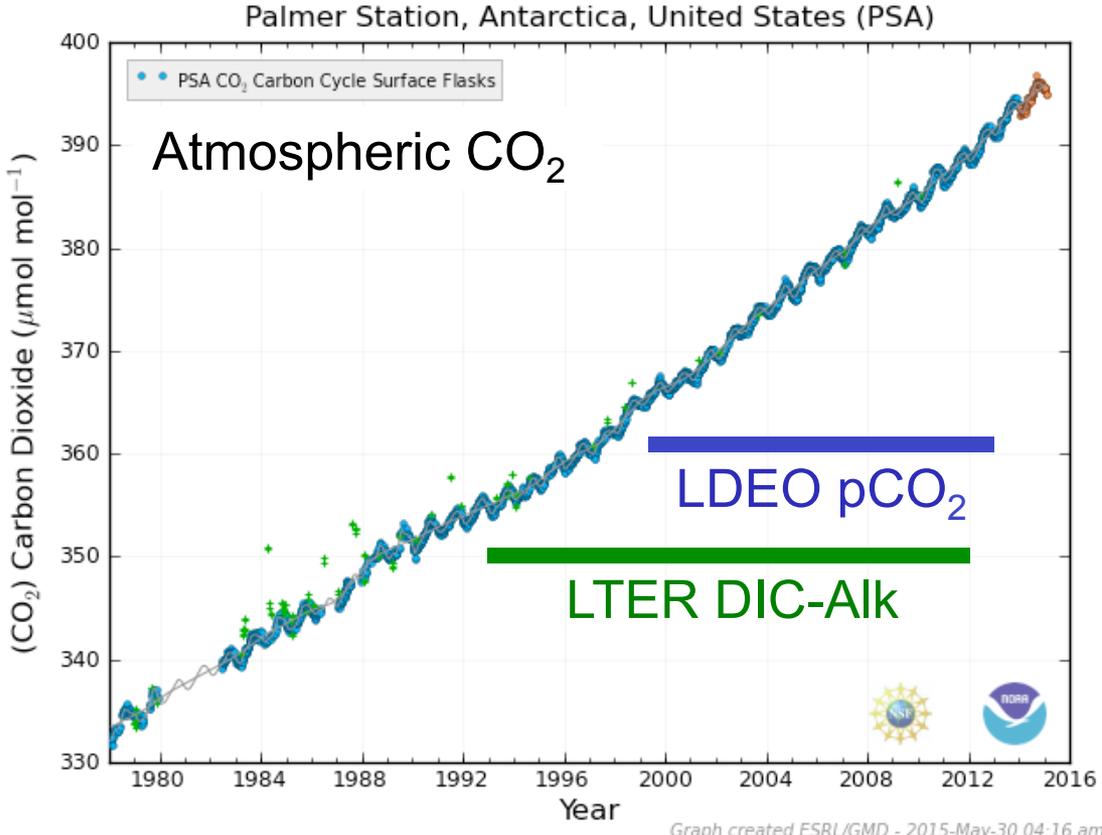
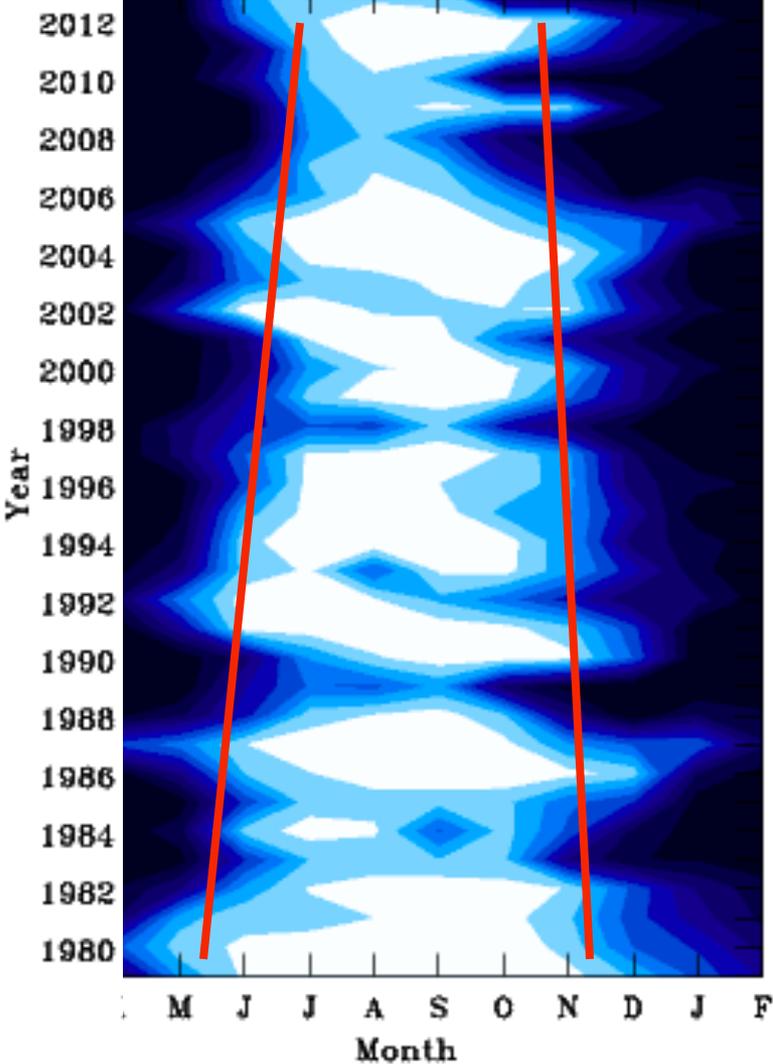
LDEO Surface Water pCO₂ Data



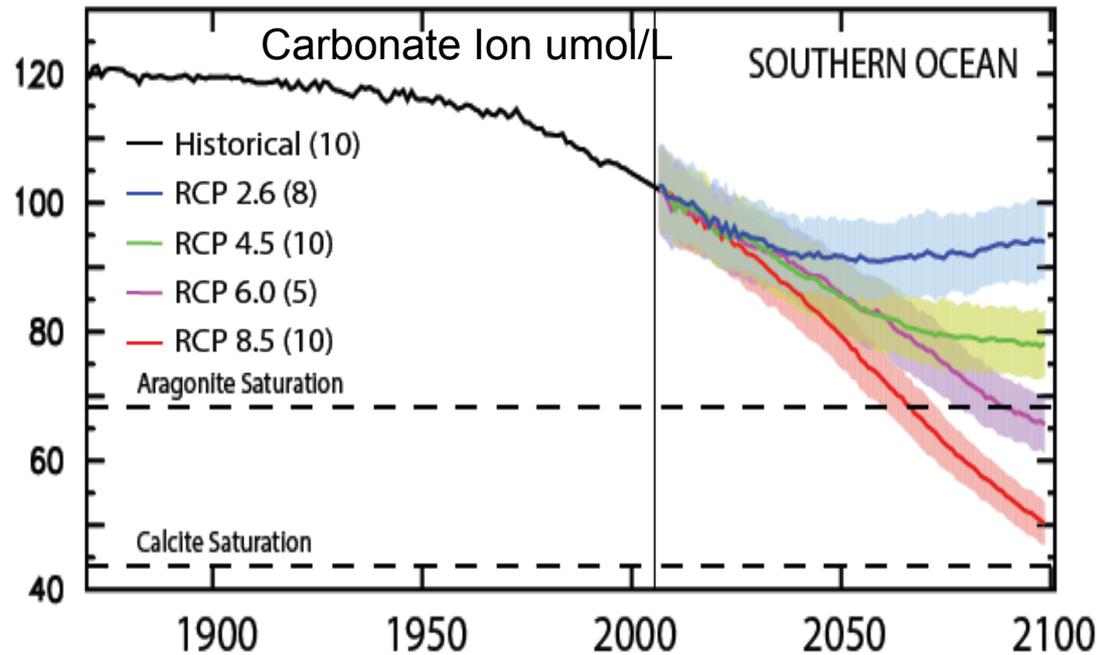
Climate Trends & Variability



Seasonal Sea-Ice



Seawater CO₂ System Trends



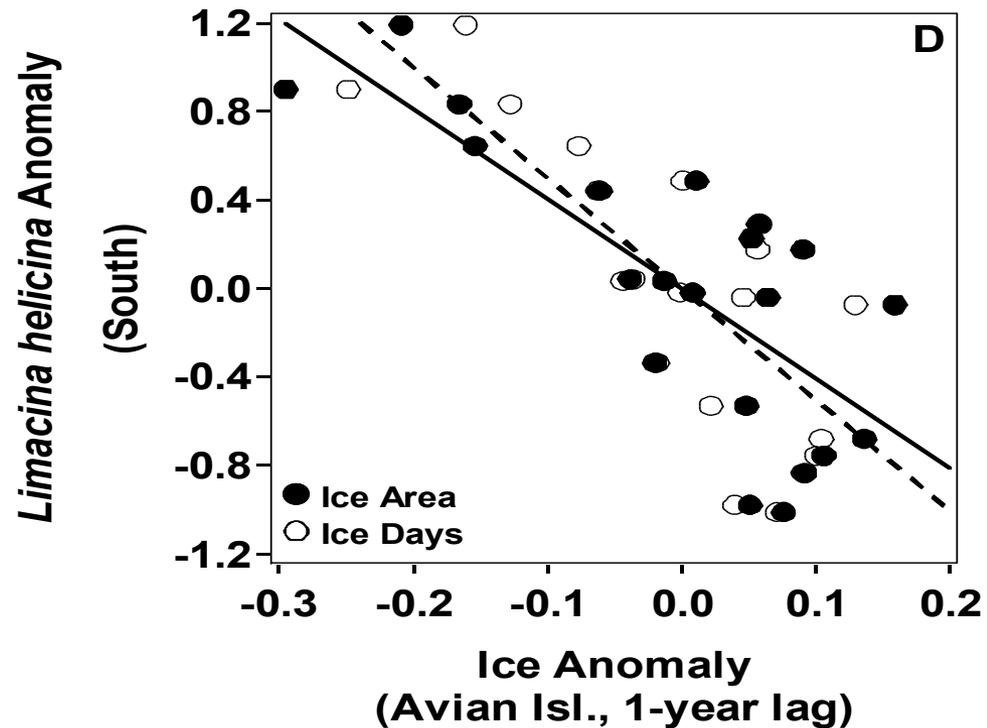
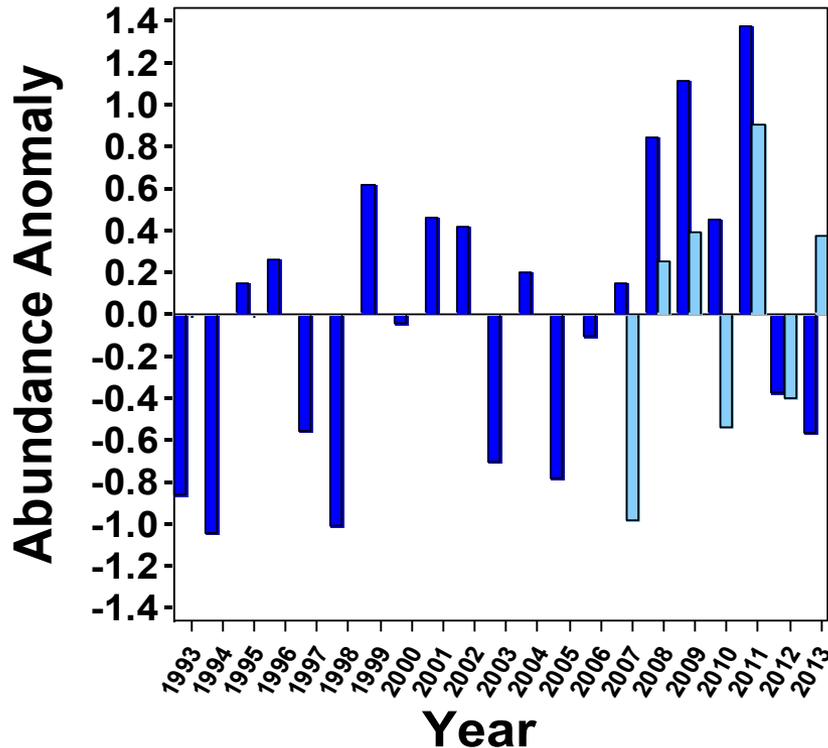
Palmer LTER 1993-2012
No significant surface trends
 $p\text{CO}_2$, DIC, Alk, Ω

LDEO Surface $p\text{CO}_2$ 1999-2013
Significant surface trends in
central region in Fall and Spring
 $p\text{CO}_2$ 2.3 \pm 0.7 $\mu\text{atm/y}$

Bopp et al. Biogeosciences 2013

Ocean Acidification versus Sea Ice

Pteropods
Limacina
helicina



Steinberg et al. Deep Sea Res. I 2015, in press

Palmer LTER CO₂ System Analysis

Large-Scale Spatial Patterns

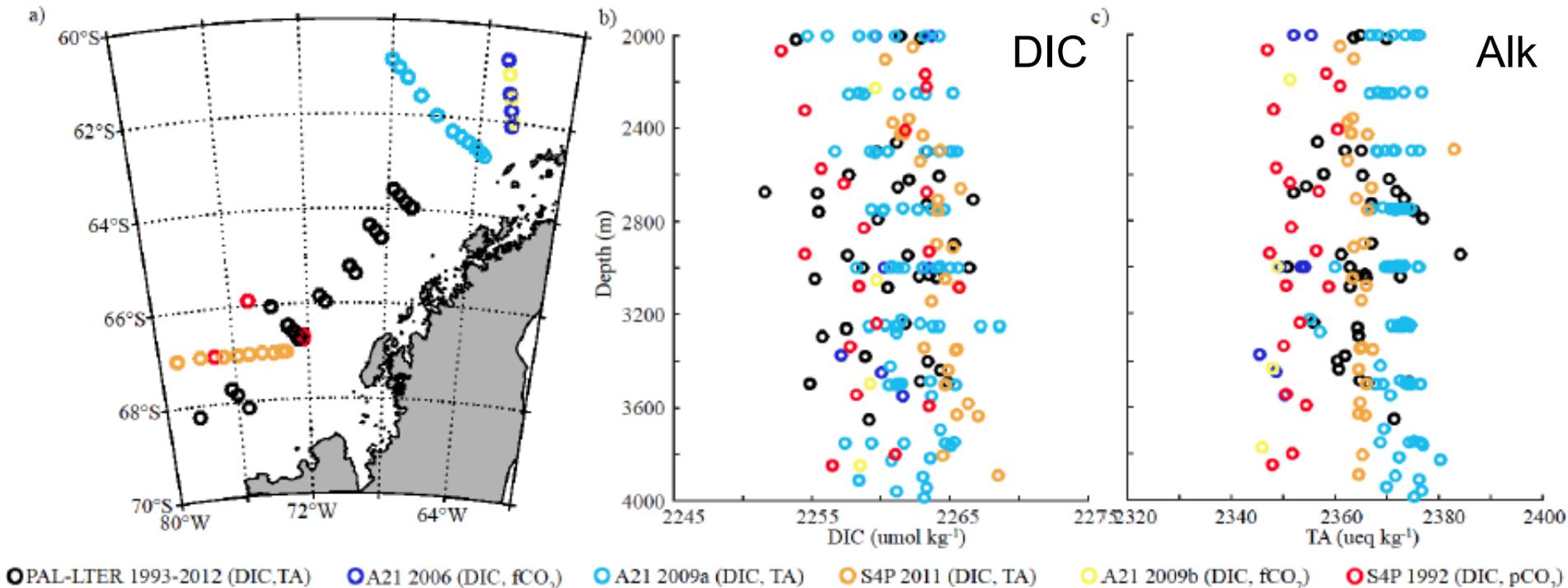
- Near-shore dilution & biological drawdown
 - low DIC & alkalinity
 - high pH & Ω
- Vertical structure controlled by UCDW upwelling, sea-ice, mixing etc.
 - surface saturated for CaCO₃

-Seasonal & Temporal Trends

- Seasonal cycle estimated from underway pCO₂ & surface alkalinity-salinity fit
- Large interannual variability (sea-ice, biology)
- Weak or undetectable decadal trends
 - rising Fall & Spring pCO₂ ~matching atmosphere

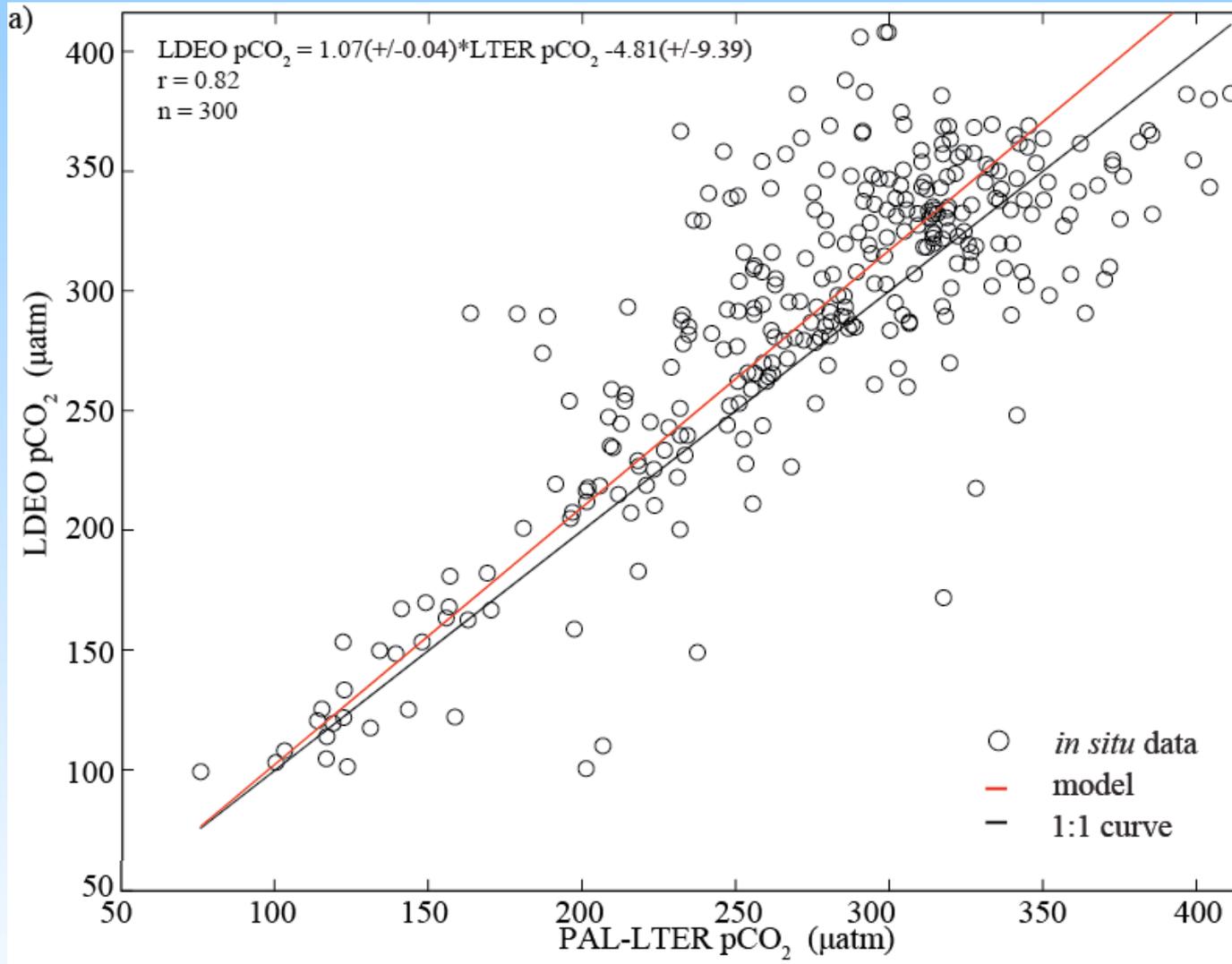
Extra Slides

WOCE Deepwater DIC & Alkalinity Comparisons



- Compares well against other CO₂ system data
 - WOCE deep-water data
 - LDEO underway surface pCO₂

Surface pCO₂ Comparison

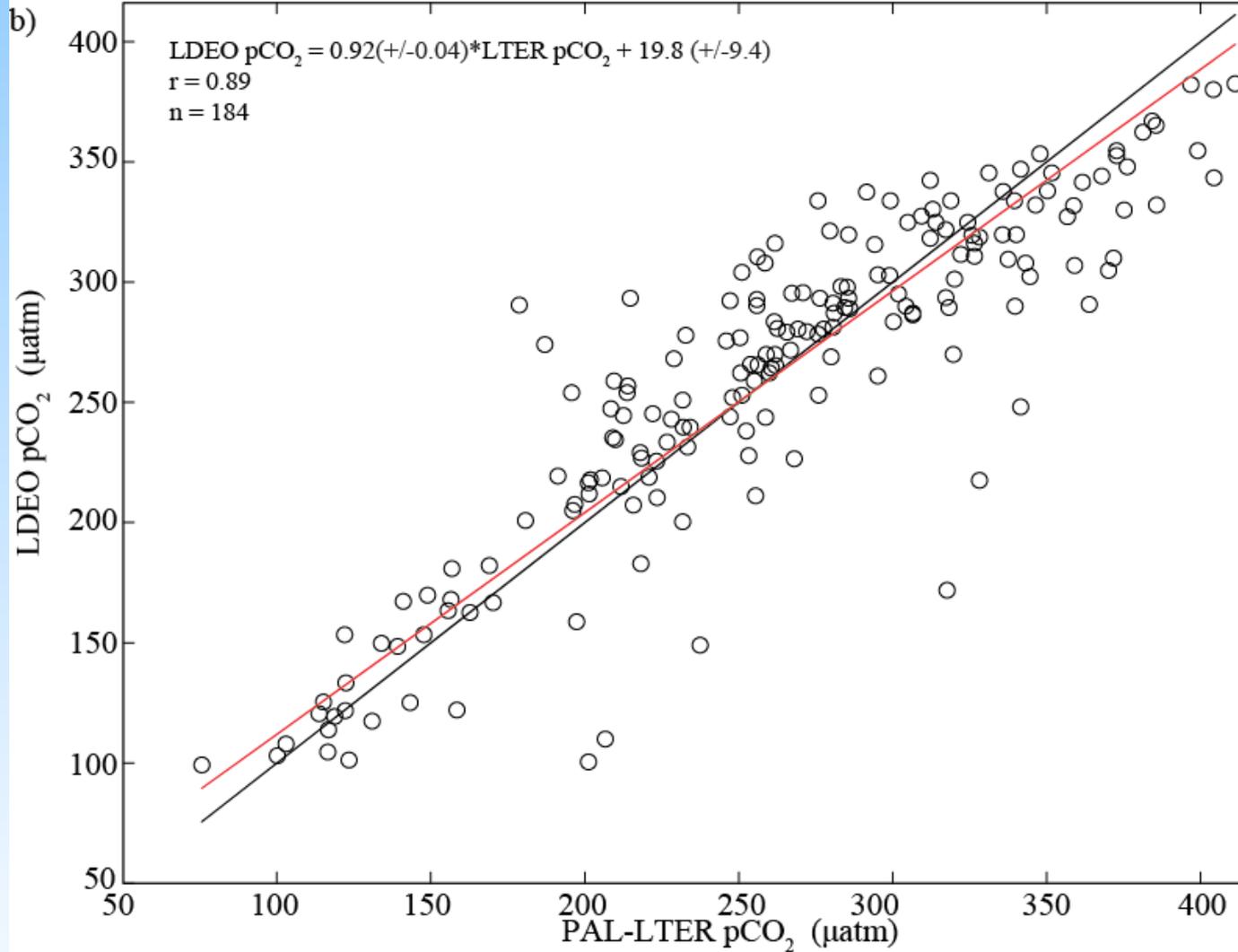


LTER pCO₂
computed from
surface DIC &
alkalinity

Data spatially
matched within
1km

Years 2002,
2005-2012

Surface pCO₂ Comparison

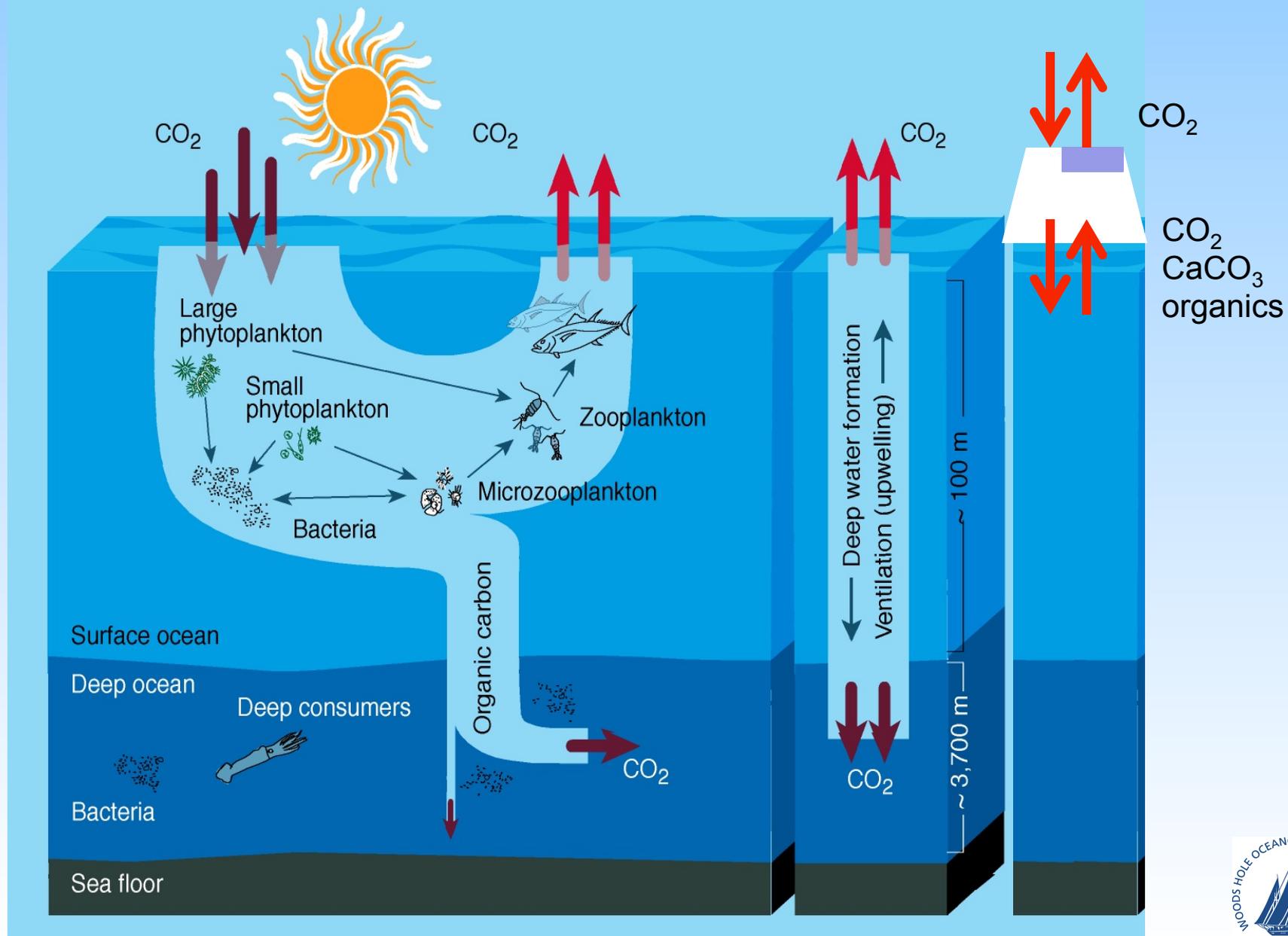


LTER pCO₂
computed from
surface DIC &
alkalinity

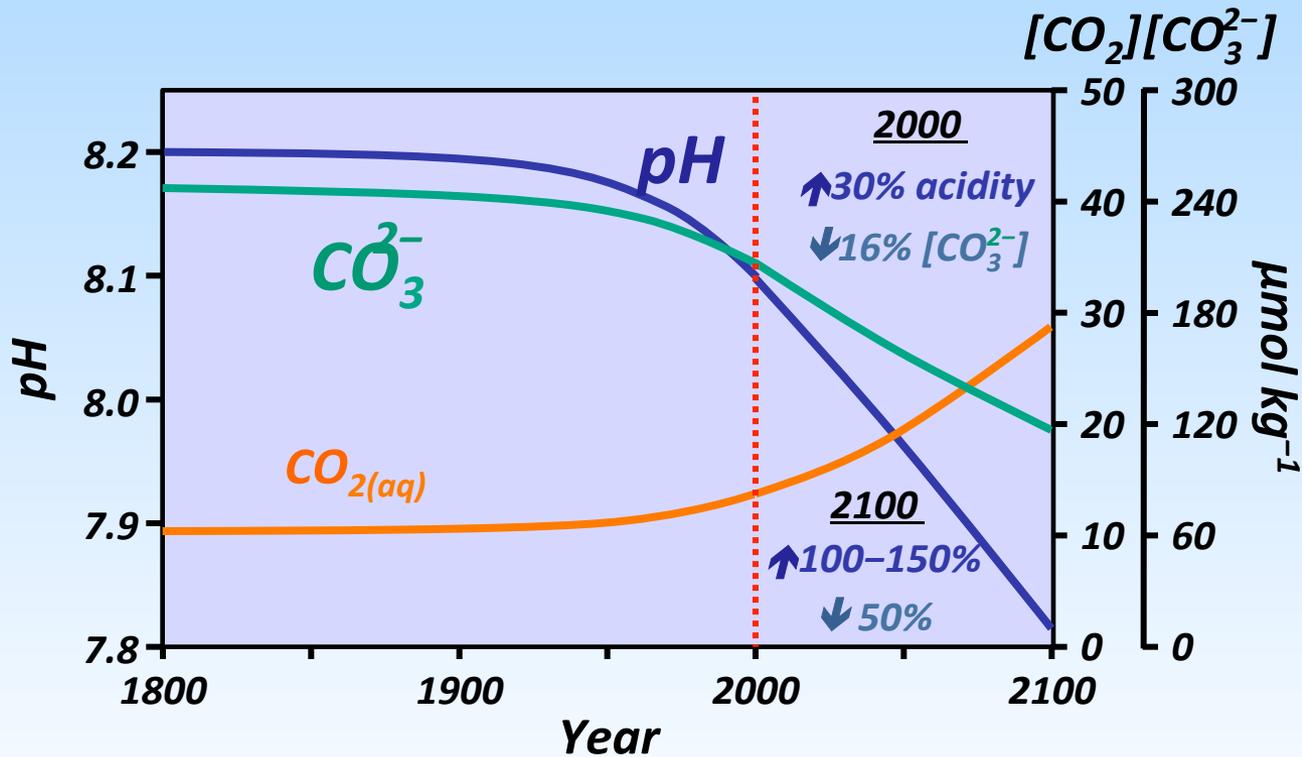
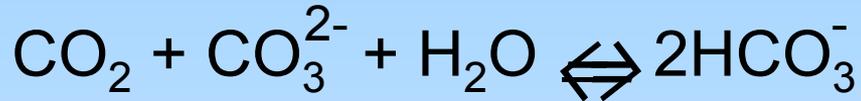
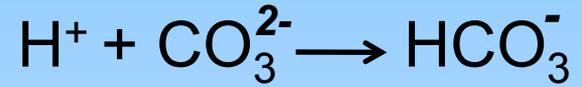
Data spatially
matched within
1km

Years 2011,
2005-2007
larger range

Biological & Solubility Carbon Pumps



Ocean Acidification



Wolf-Gladrow et al. (1999)