Regional Carbon Budgets:
The Pacific-Arctic Region

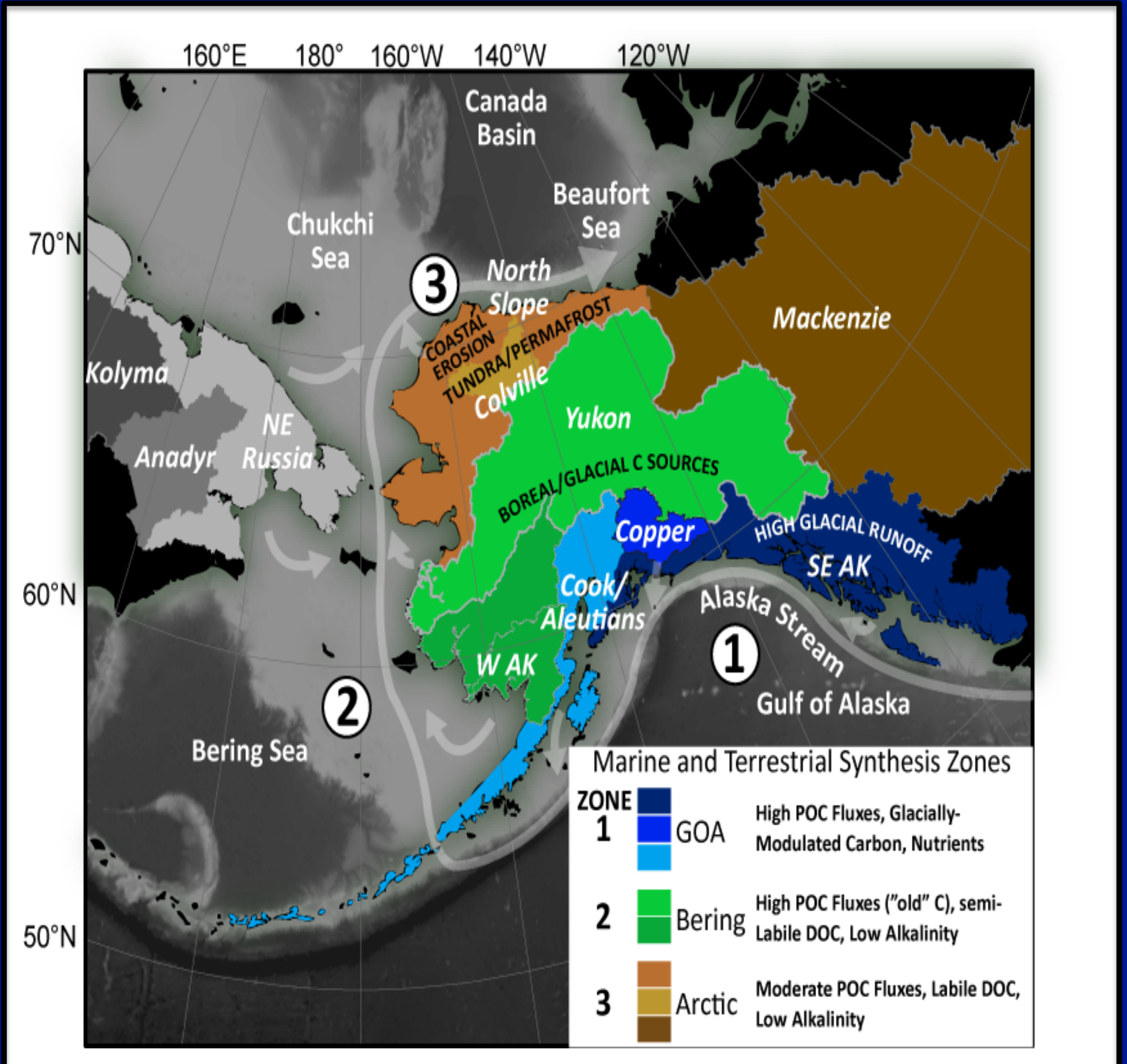
Jeremy T. Mathis, Jessica N. Cross and Wiley Evans

Coastal CARbon Synthesis (CCARS) Workshop

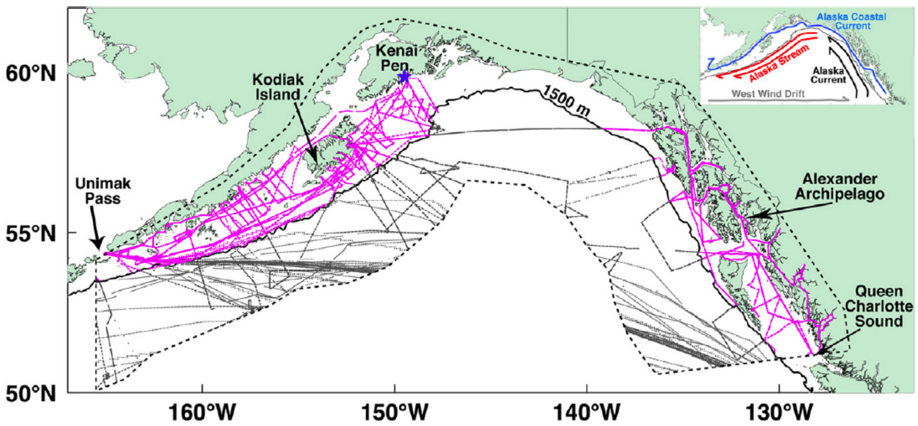
NOAA PMEL Pacific Marine Environmental Laboratory

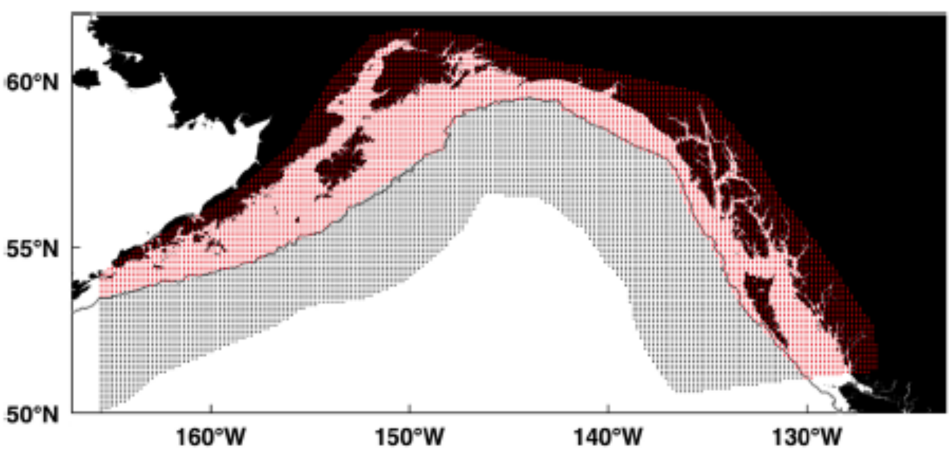
UAF UNIVERSITY OF ALASKA FAIRBANKS

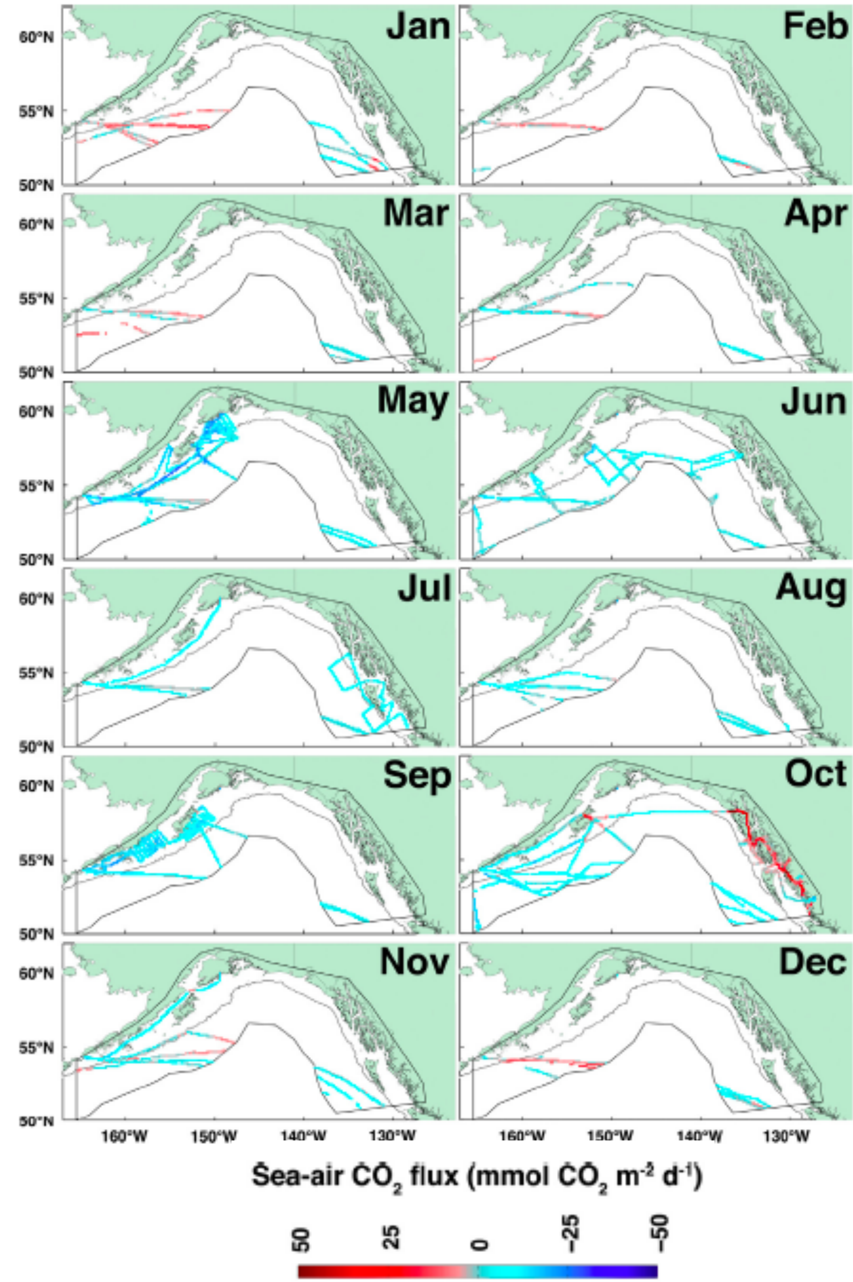
Overview of the Pacific-Arctic Region



Gulf of Alaska CO_2 Flux Synthesis







Estimates showed substantial atmospheric CO_2 uptake between **14 and 34 Tg C yr^{-1}**.

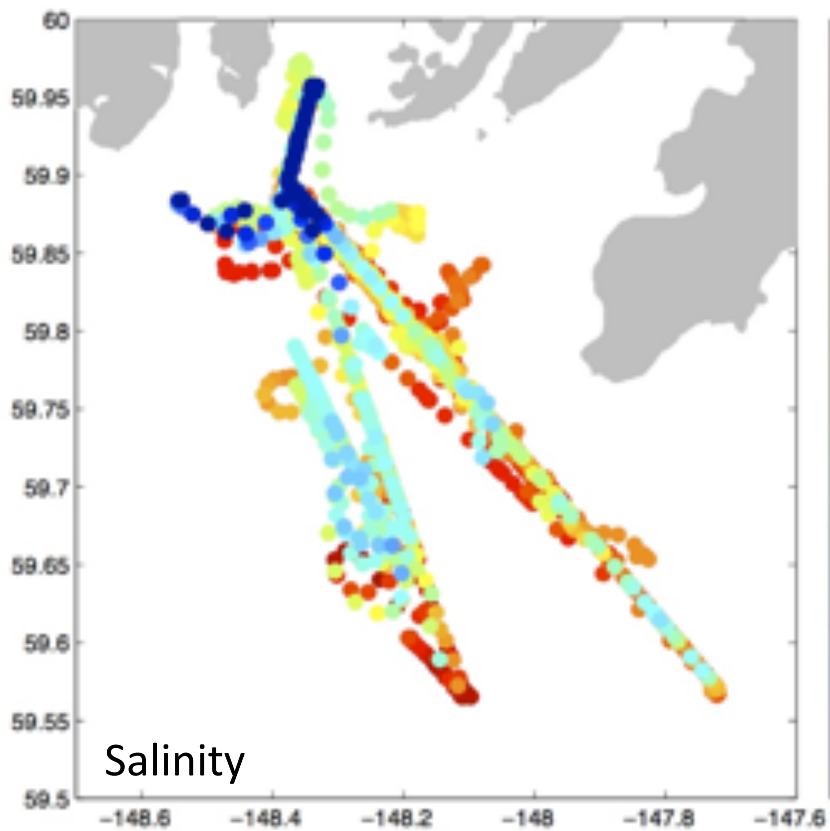
Evans and Mathis, 2013

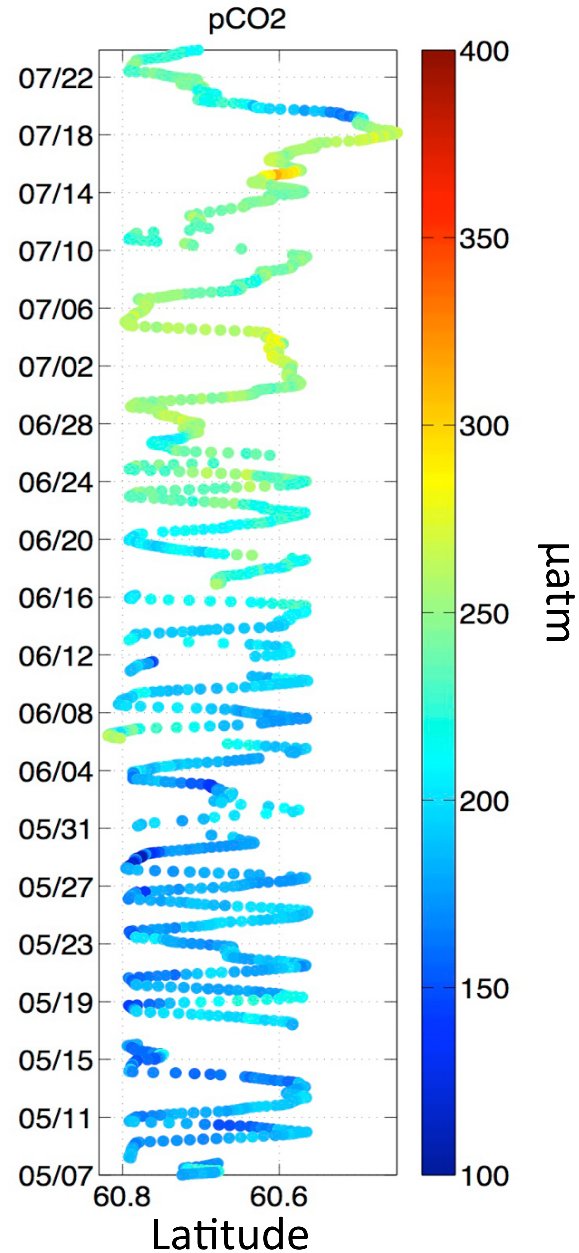
Enhancing and Expanding the Observations

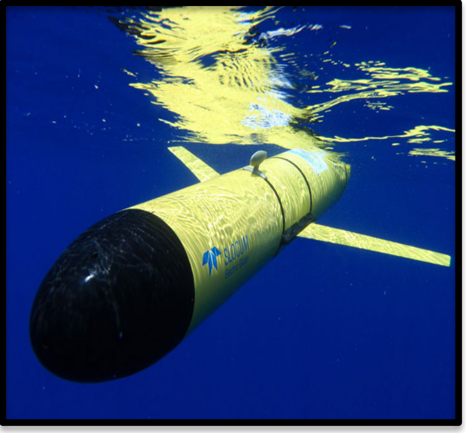
PMEL Carbon Wave Glider

Autonomous platforms could increase our observational coverage by several orders of magnitude.

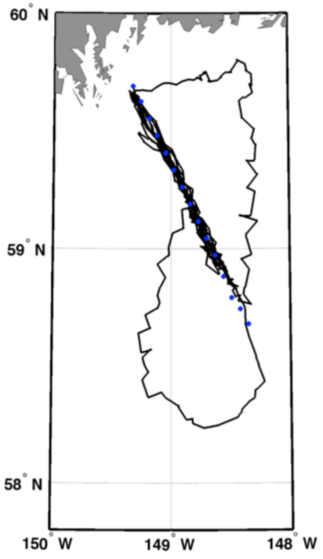
The PMEL Carbon Wave Glider



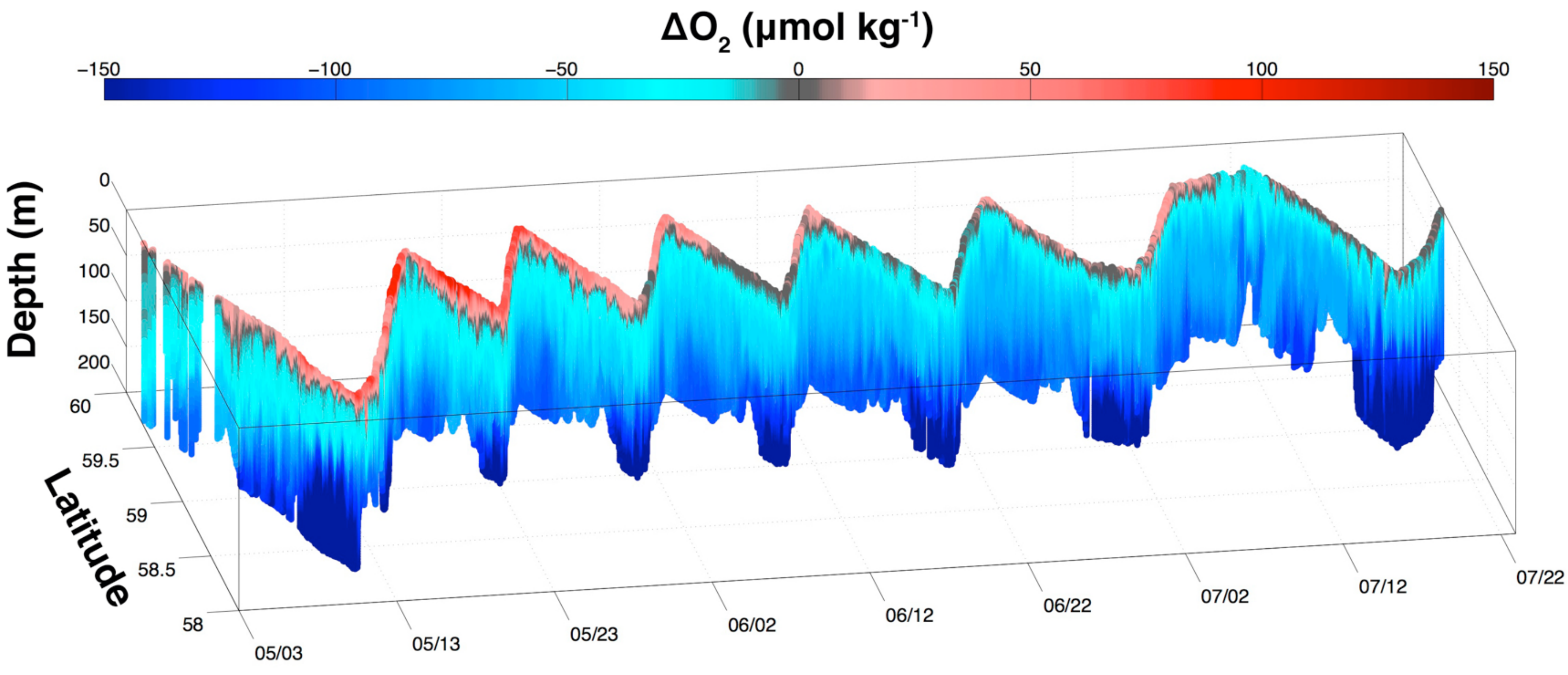




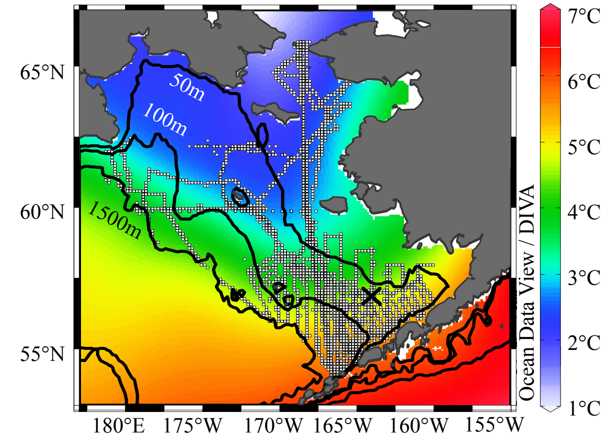
The PMEL Slocum Glider



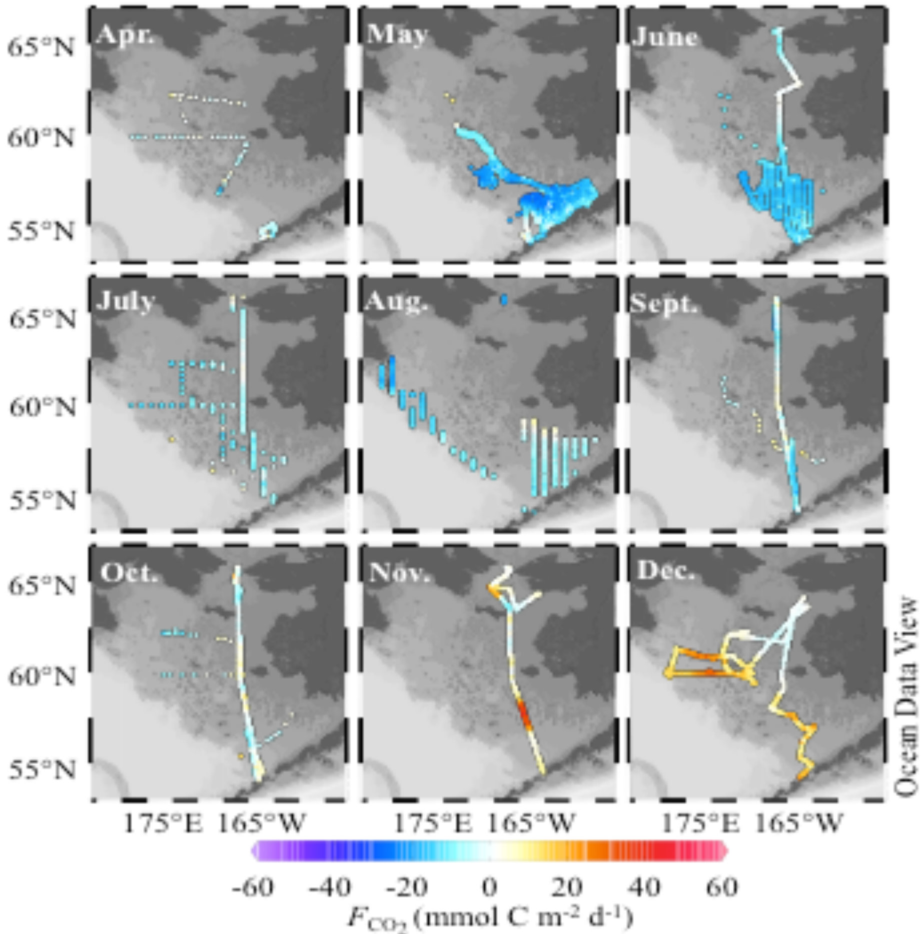
We can use the DO data from the gliders to estimate NCP at the surface and respiration at depth.

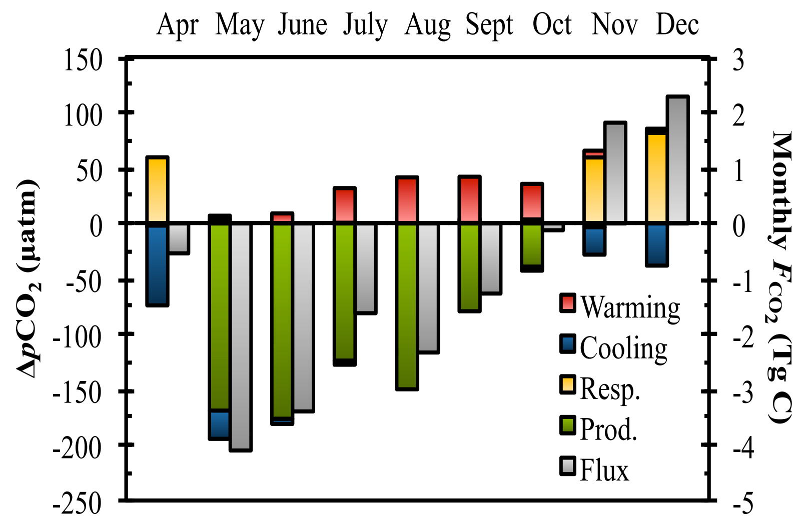


Bering Sea CO_2 Flux Synthesis



Monthly sea-air CO_2 flux for the Bering Sea shelf





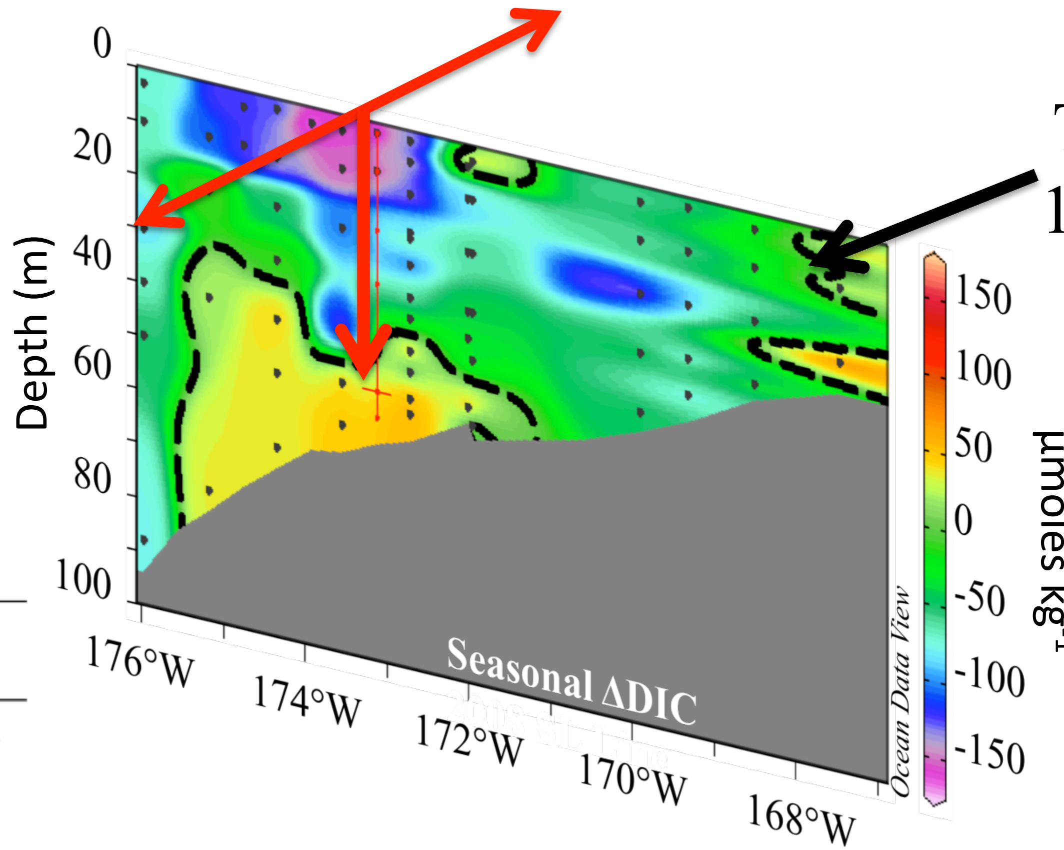
Area-weighted monthly average fluxes and flux drivers for the Bering Sea shelf.

We estimate that the average annual Bering Sea CO2 sink is **<u>~6.6 Tg C yr^{-1}</u>**.

Cross et al., in press (JGR-Oceans)

Bering Sea Carbon Budget

- Resolved carbon inputs in the Bering Sea in 2008 and 2009



NCP :
~100 Tg yr^{-1}

Domain	2008 NCP Tg C yr^{-1}	2009 NCP Tg C yr^{-1}
NC	20.7 ± 5	−13.5 ± 11
SC	12.5 ± 4	4.1 ± 7
Total	33.1 ± 6	−9.4 ± 13
NM	27.4 ± 8	32 ± 27
SM	20.6 ± 8	43.6 ± 27
Total	48 ± 11	75.6 ± 38
SO	20.2 ± 3	31 ± 9

Cross et al., 2012, DSRII, 65-70

	Yukon[b]	Kuskokwim[c]
DOC (μmoles kg^{-1})	900 ± 7.0	199.8
DIC (μmoles kg^{-1})	1480 ± 4.2	–

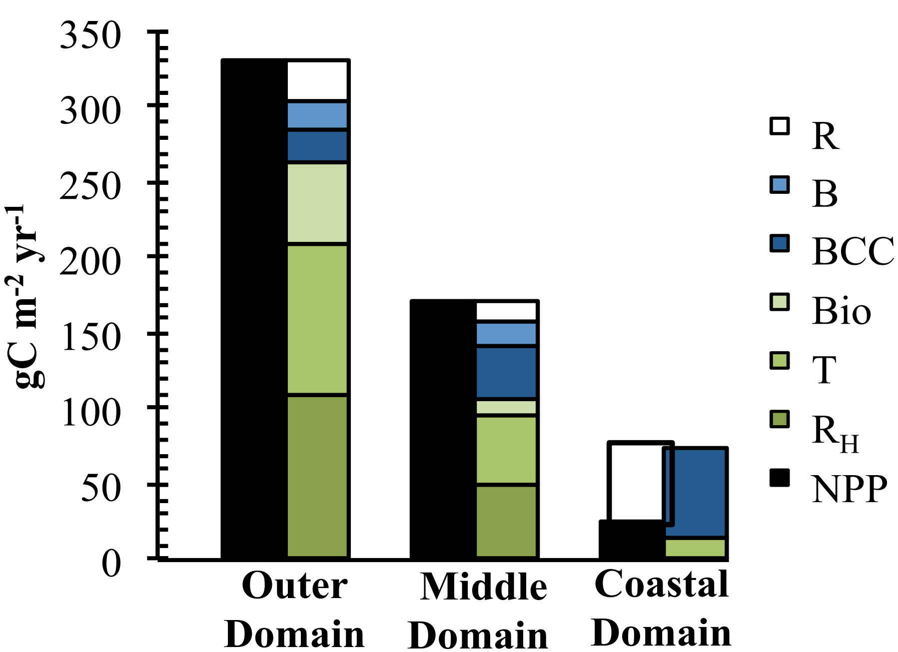
Mathis et al., 2011a; JGR, 116(C2), From Striegl et al., 2007 and Wang, 1999.

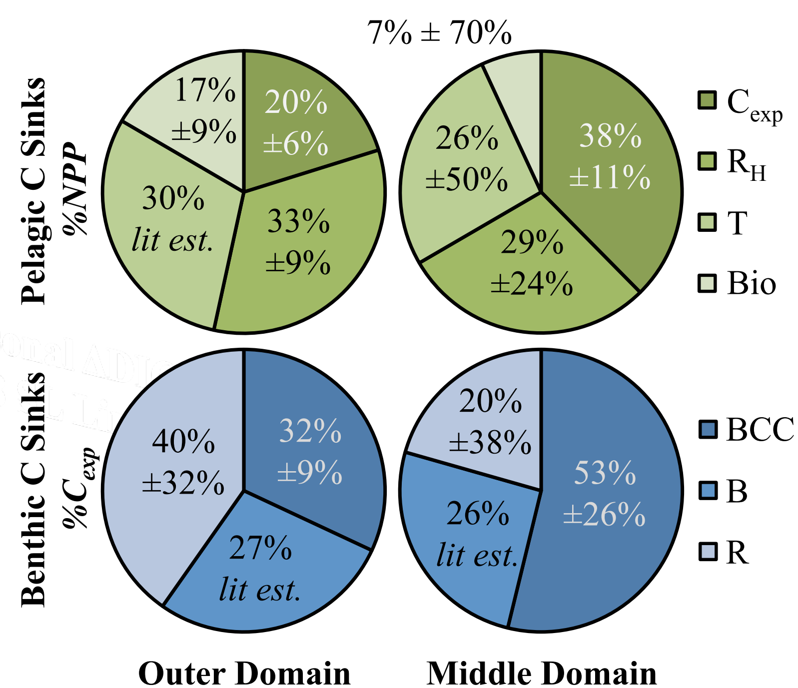
Bering Sea Carbon Budget

Regional carbon budget partitioned **NCP** by **pelagic** and **benthic** sinks:

Pelagic
Respiration (R_H)
Assimilation (Bio)
Lateral Transport (T)
Vertical Transport (C_{exp})

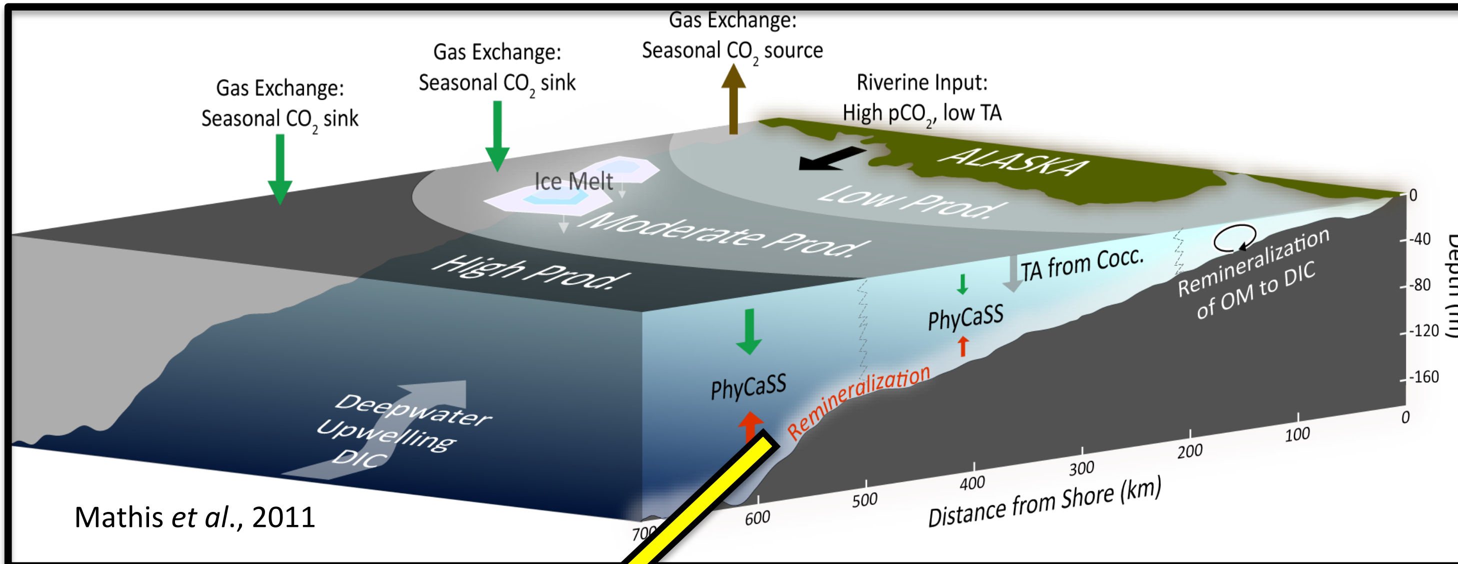
Benthic
Sed. Comm. Cons. (BCC)
Burial (B)
Transport + Respiration (R)

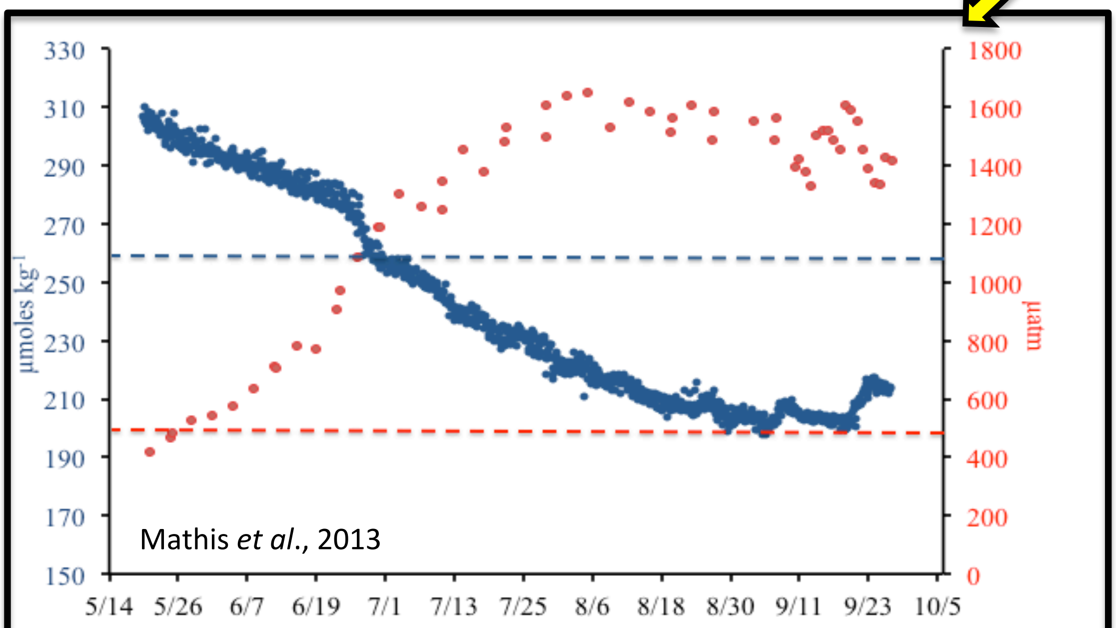




Cross et al., 2014, DSRII, In Press

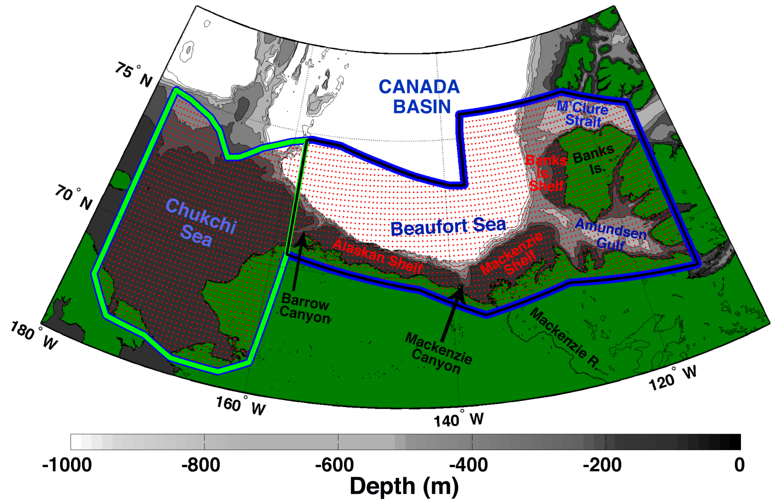
Bering Sea Carbon Budget

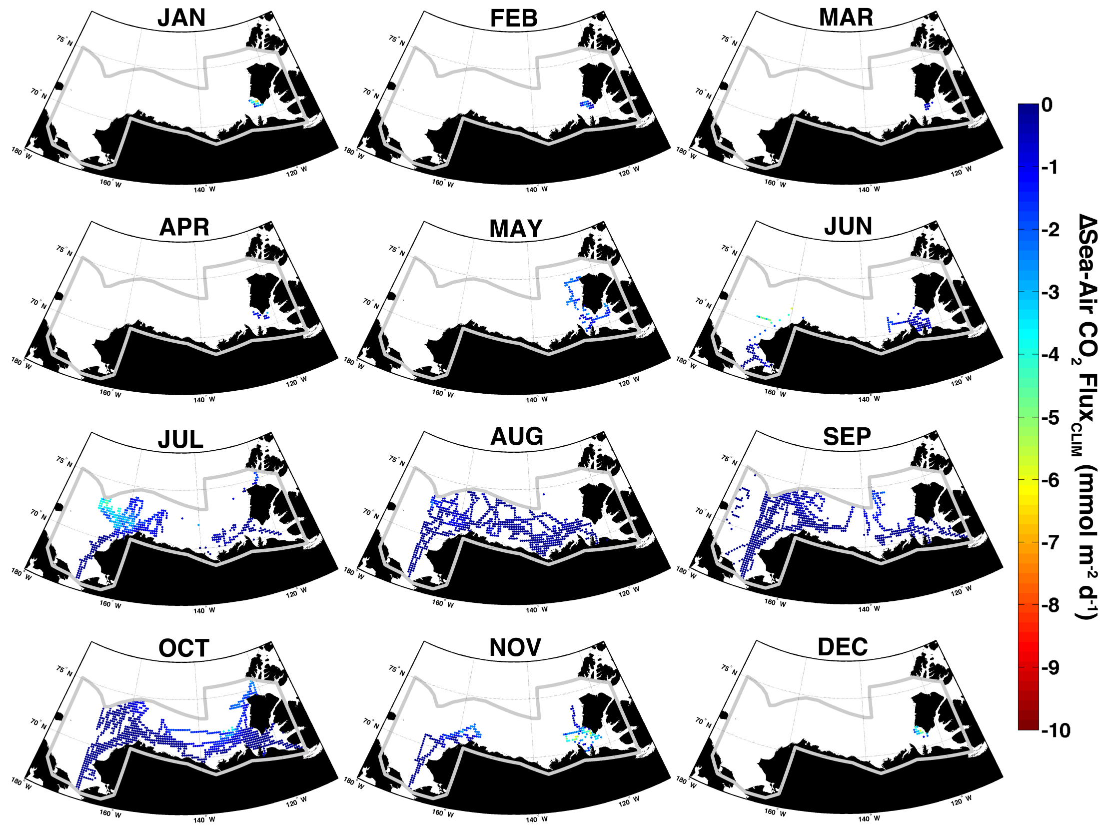




Using autonomous sensors near the bottom, we have been able to constrain the respiration signal in the SE Bering Sea.

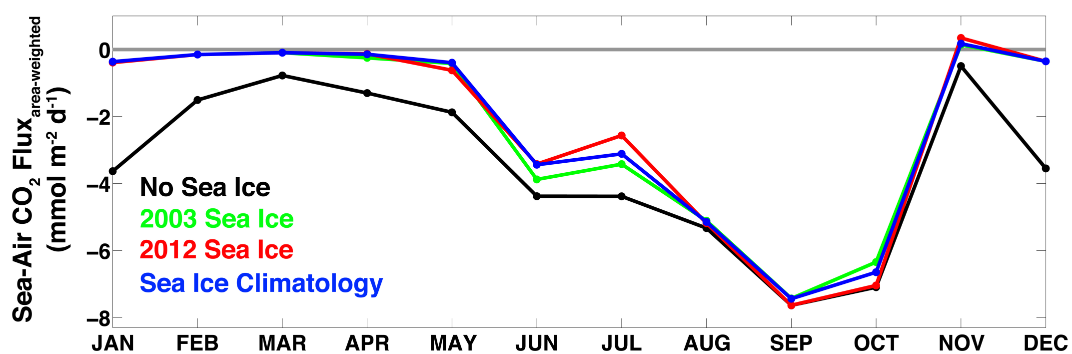
Western Arctic CO_2 Flux Synthesis





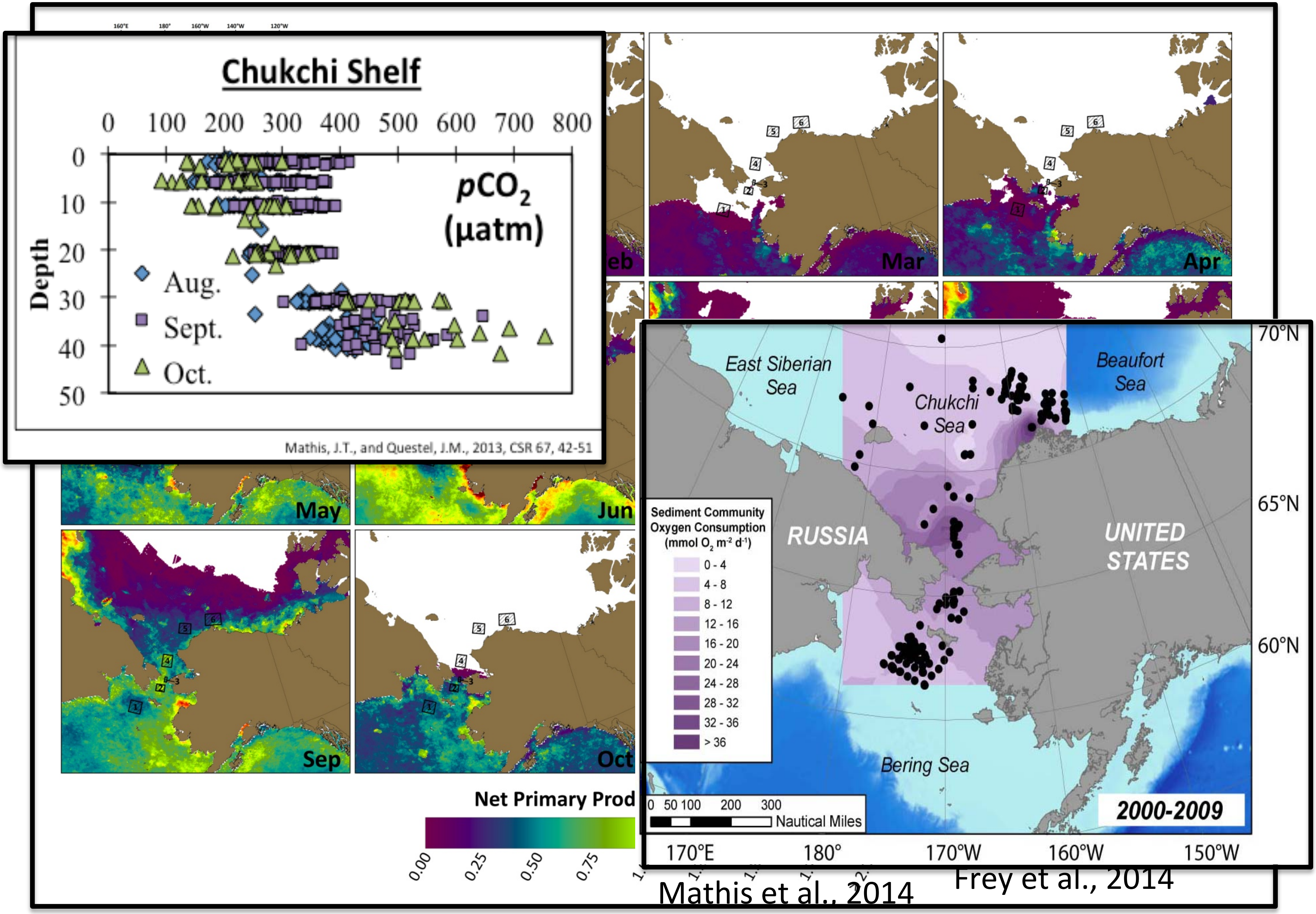
(1) Synthesized available 2003-2012 data for western Arctic coastal ocean

(2) First comprehensive data-based carbon sink estimate for this region of **12 Tg yr^{-1}**

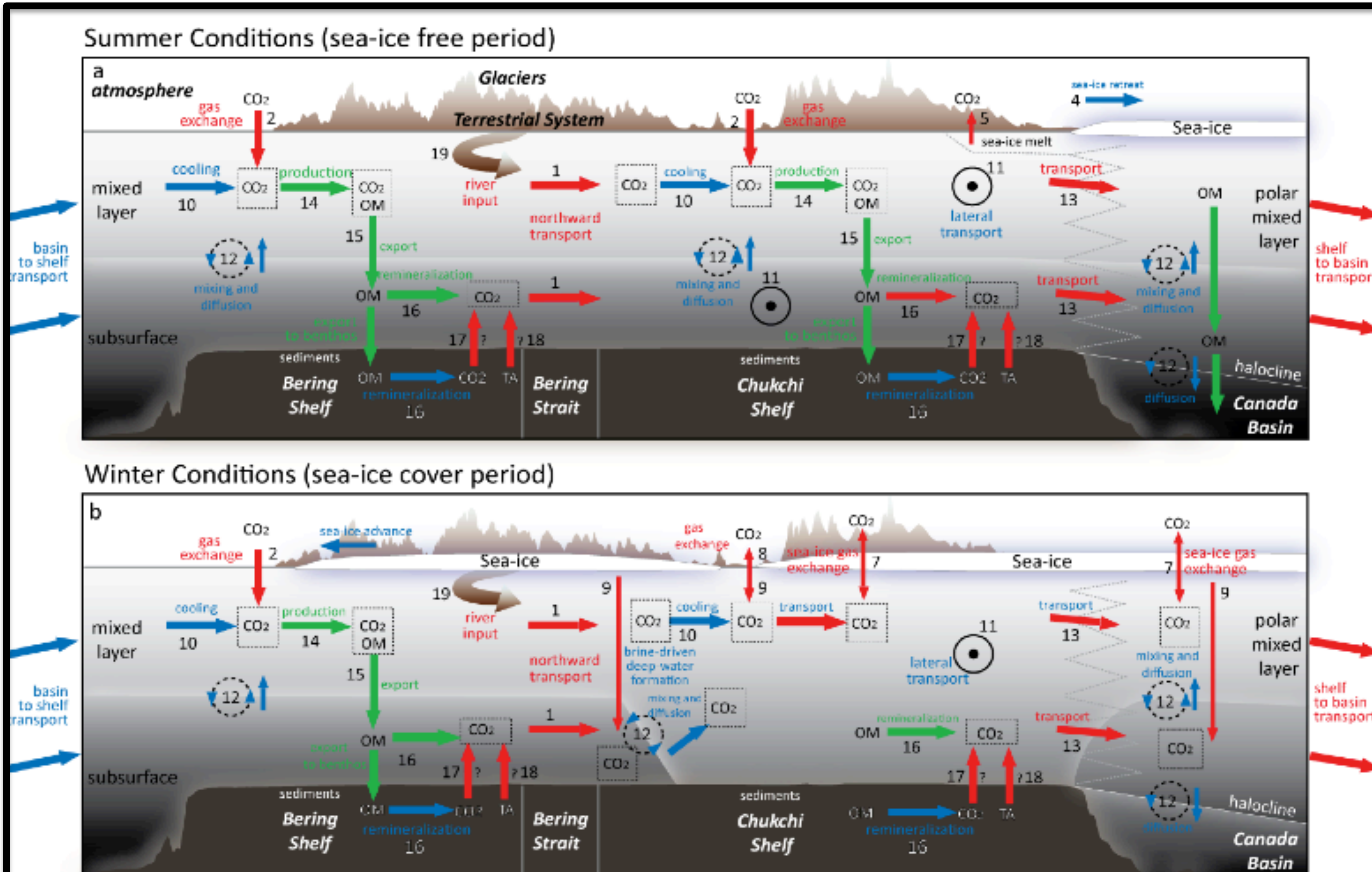


Evans et al., in prep. (Continental Shelf Research)

Western Arctic Carbon Budget



The Coupled Bering-Chukchi Sea Carbon Budget



Mathis et al., 2014

Summary of Uncertainties in the Pacific-Arctic Region

Low   Medium   High

	Gulf of Alaska	Bering Sea	Western Arctic
Input from Land	High	Medium	Medium
Air-Sea CO_2 Flux	Low	Low	Low
Primary Production	Medium	Low	Medium
Respiration	Medium	Medium	Medium
Sediment-Water Interface	High	Medium	Medium
Cross-Shelf Exchange	High	High	High