

NACP/OCB Interim Coastal Carbon Update Synthesis

OCB Meeting 2011

Simone Alin, Heather Benway, Wei-Jun Cai, Paula Coble, Marjy Friedrichs, Peter Griffith, Steve Lohrenz, Jeremy Mathis, Galen McKinley, Raymond Najjar

Special thanks to Paula Bontempi and Don Rice



North
American
Carbon
Program



Coastal Synthesis - Regions

- Five regional preliminary budgets
 - East Coast and Gulf of Maine
 - Gulf of Mexico
 - Great Lakes
 - West Coast
 - Arctic



<http://www.nacarbon.org/nacp/>



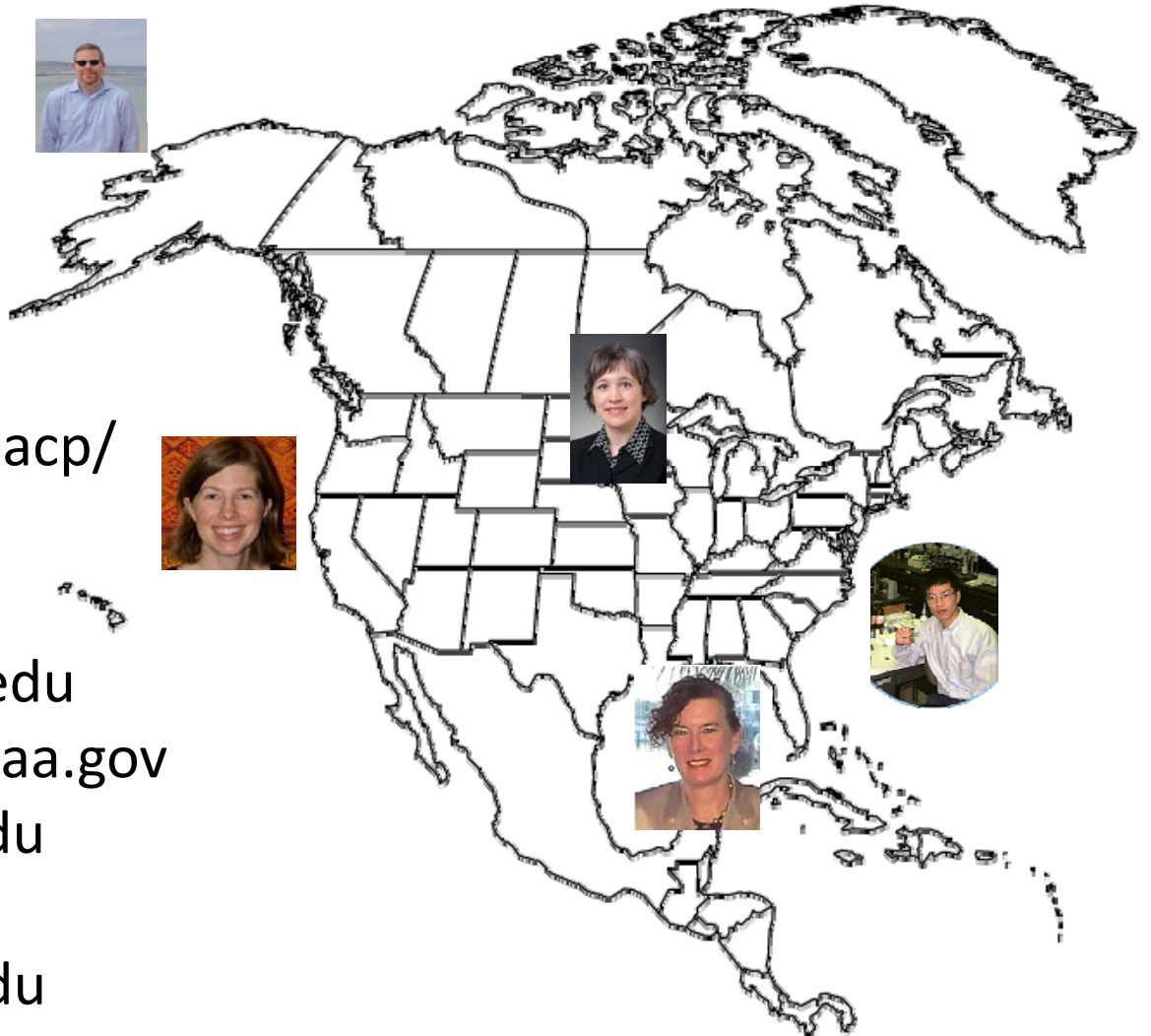
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Galen - gamckinley@wisc.edu

Wei-Jun - wcai@uga.edu

Paula - coble@marine.usf.edu



Fluxes of Interest

Interfacial fluxes:

- Inputs from land of DOC, POC, and DIC
- Air-sea: Exchange of CO₂, rainwater DOC
- Sedimentary fluxes: POC deposition, DOC & DIC exchange, benthic productivity, groundwater, hydrocarbon seeps
- Shelf-break exchange: DIC, DOC, POC

Internal fluxes:

- Primary production
- Respiration
- Net community production

Synthesis Timeline

- Initiated at July 2008 OCB Meeting
- Presentations given in special sessions at the 2009 and 2010 OCB Meeting.
- 2-Day Workshop held before 2010 AGU Meeting
 - At the meeting there were two sets of breakout groups
 - Process and Regional
 - Process Groups: River-Estuary Fluxes, Cross-Shelf Exchange, Sediment Burial, Primary Productivity and Respiration, and Air-Sea Exchange

Synthesis Timeline

Each breakout group had a set of questions:

Process

- What are the processes involved (e.g., river discharge, sediment bed load transport, tidal influence, estuarine recycling, etc.) in river-estuary fluxes?
- Can individual measurements for cross-shelf exchange be scaled up spatially and temporally and how well is the process or sub-process parameterized (for models)?
- What are the processes involved in sediment burial (e.g., bioturbation, erosion, resuspension, etc.)?

Region

- What data sets are readily available and what is the quality?
- What projects are coming on-line that will provide important data in the near future?
- What kinds of numerical models exist (Box vs. 1D vs. 3D) and what processes do they include?

Synthesis Timeline

- It was decided in San Francisco that we need regionally focused working group (<10 people) and that some regions (East Coast and West Coast) should be further divided.
- We also decided that we need help with data organization. Peter Griffith (peter.c.griffith@nasa.gov) will be advertising soon for a postdoc/data technician position for his group that will support the coastal carbon synthesis.
- Another full meeting will be held in conjunction with OCB 2012.

Carbon budget for the continental shelf of the Eastern United States

R. Najjar, D. Butman, W.-J. Cai, M. Friedrichs,
A. Mannino, P. Raymond, J. Salisbury,
and D. Vandemark

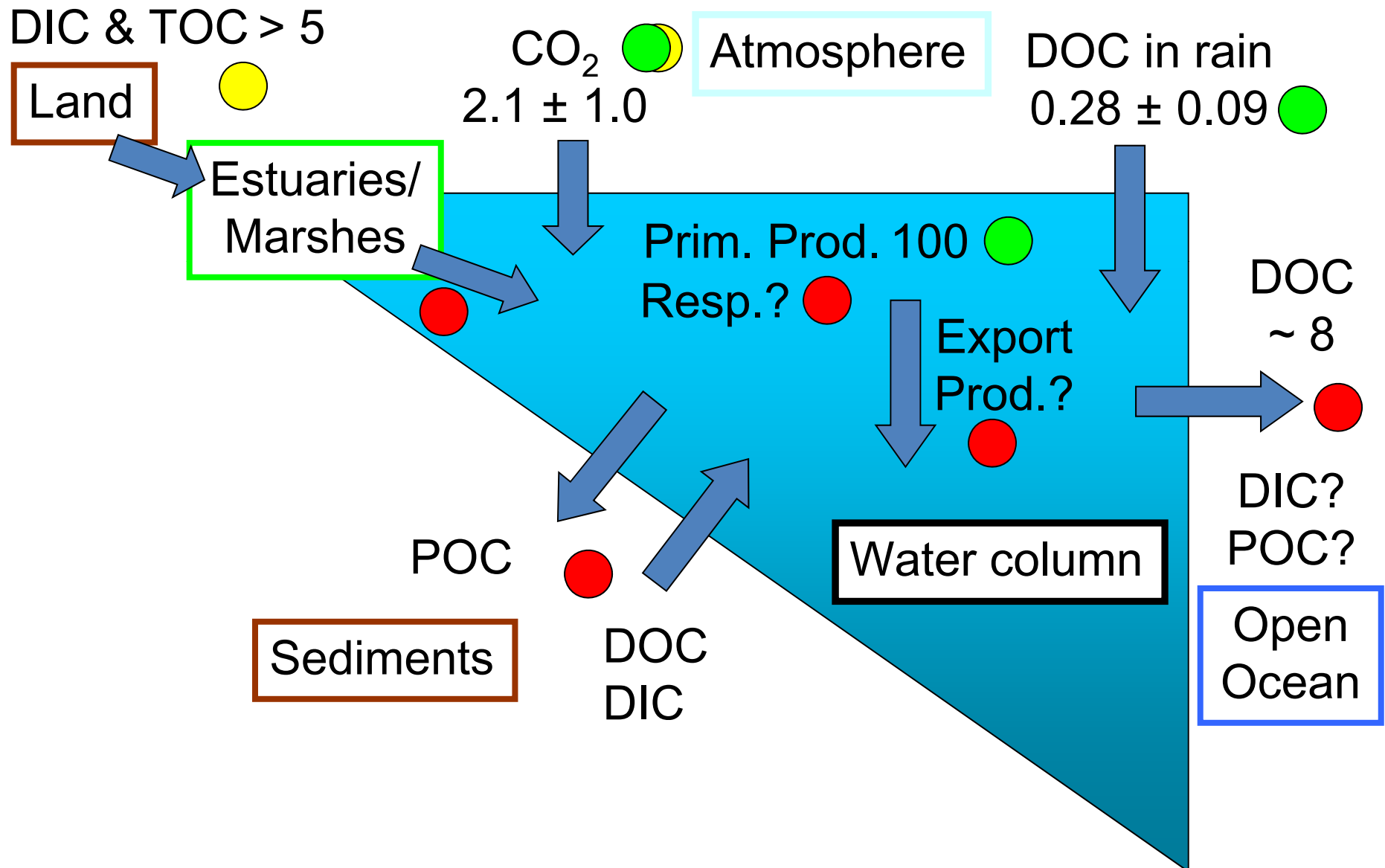
+

B. Boyer, K. Fennel, J. Fuentes, M. Kemp, K. Kroeger, R.
Striegl, and P. Vlahos

2010 Ocean Sciences Meeting
February 26, 2010

East Coast Activities

Shelf-Wide Budget (Tg C yr^{-1})

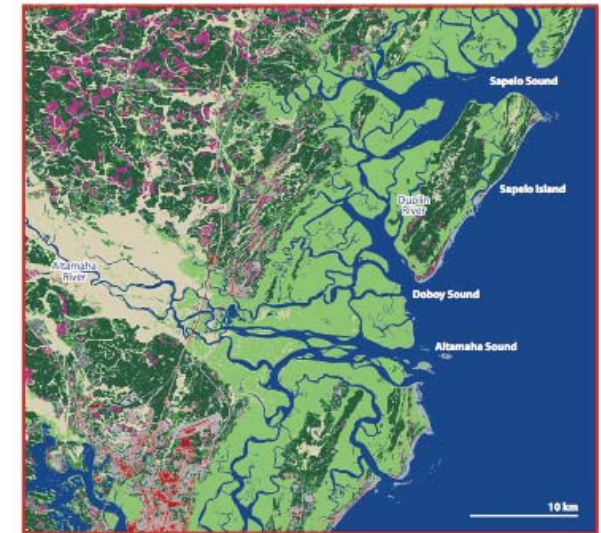


East Coast Activities

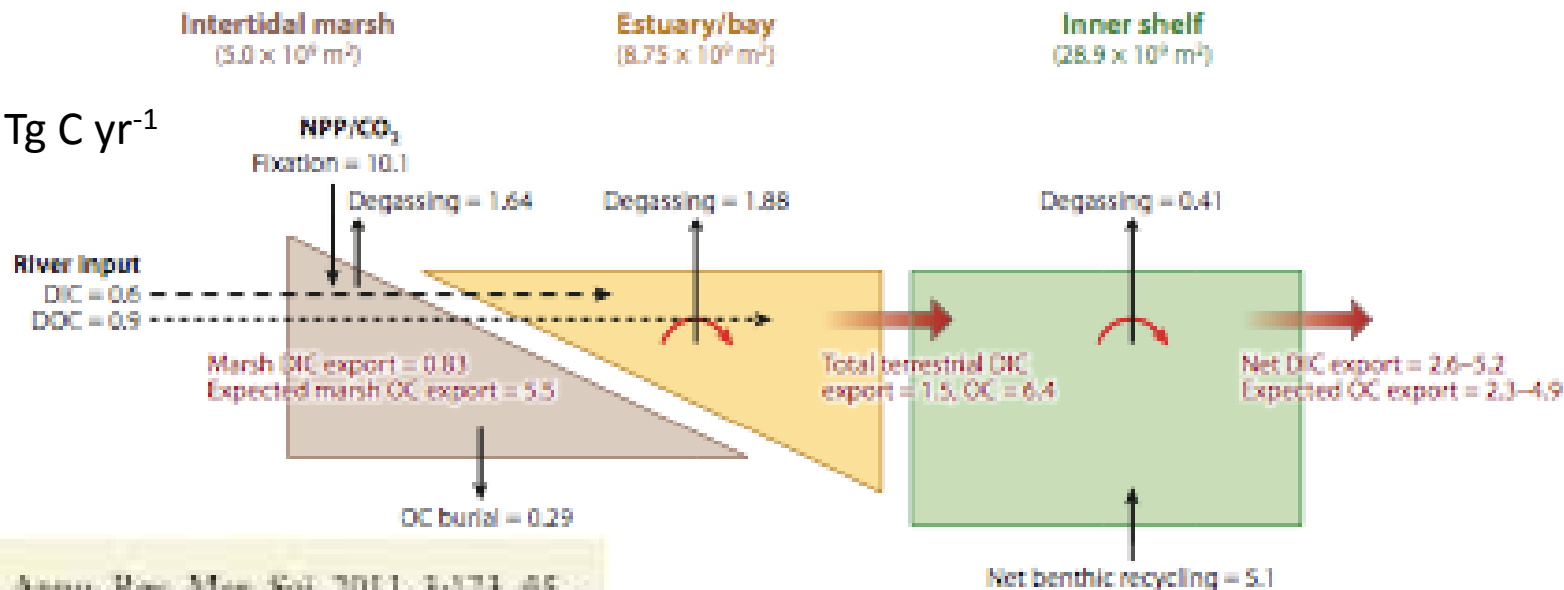
Estuarine and Coastal Ocean Carbon Paradox: CO₂ Sinks or Sites of Terrestrial Carbon Incineration?

Wei-Jun Cai

Department of Marine Sciences, University of Georgia, Athens, Georgia 30602;
email: wcai@uga.edu



Tg C yr⁻¹



Annu. Rev. Mar. Sci. 2011. 3:123–45

U.S. East Coast Carbon Synthesis Workshop

Organizers: Ray Najjar, Marjy Friedrichs, Wei-Jun Cai

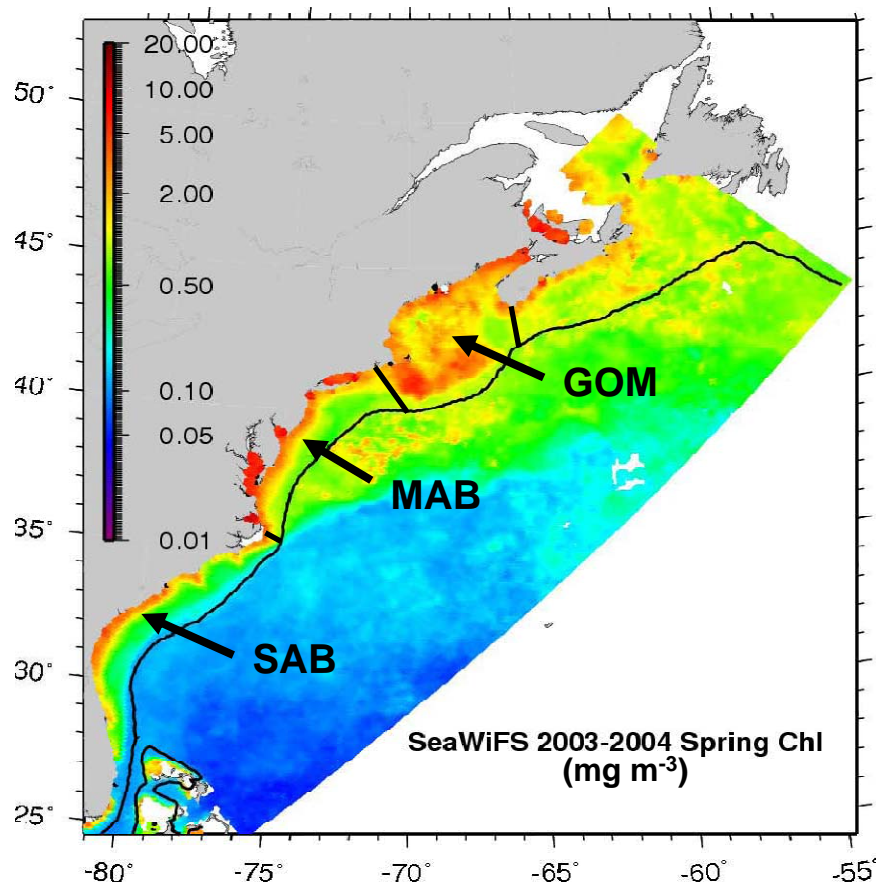
Tentative Dates: **19-20 January 2012**

Tentative Location: **Virginia Institute of Marine Science
Gloucester Point VA**

Objectives

Quantification of carbon budget processes in each of the three subregions, including:

- Primary productivity
- Respiration
- Air-sea CO₂ flux
- Burial
- River inputs
- Off-shelf fluxes



If interested in participating, please contact:
Ray Najjar (najjar@meteo.psu.edu)
Marjy Friedrichs (marjy@vims.edu)
Wei-Jun Cai (wcai@uga.edu)

U.S. West Coast Carbon Synthesis Workshop

Organizers: Simone Alin and Burke Hales

- Sub-regions (north, central, south) meet separately by telecon and have 1 physical meeting with most involved members of each group.
- First telecons scheduled (July 28th at noon and August 2nd at 2 pm)
 - Contact Simone (Simone.R.Alin@noaa.gov) or Burke (bhales@coas.oregonstate.edu) if interested in joining
- ~10 people/region
- Meeting will be held later in the year likely in Seattle.

West Coast Activities

New Observations



Surface buoy with MAP CO₂ System, SAMI pH, ISUS nitrate, and SBE 16+

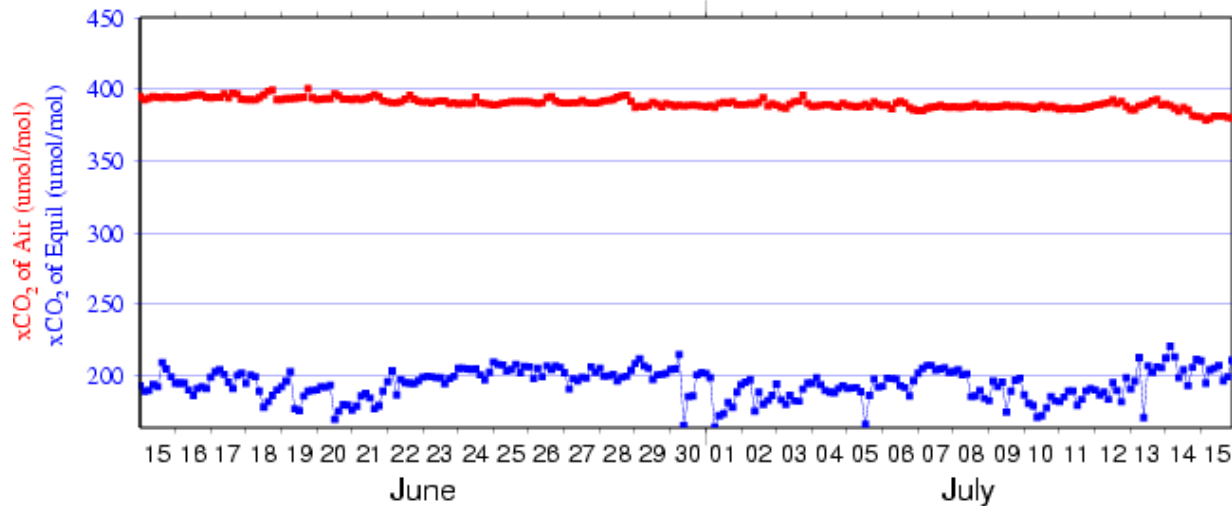


Bottom package with SAMI pH and $p\text{CO}_2$, ISUS nitrate, and SBE 16+

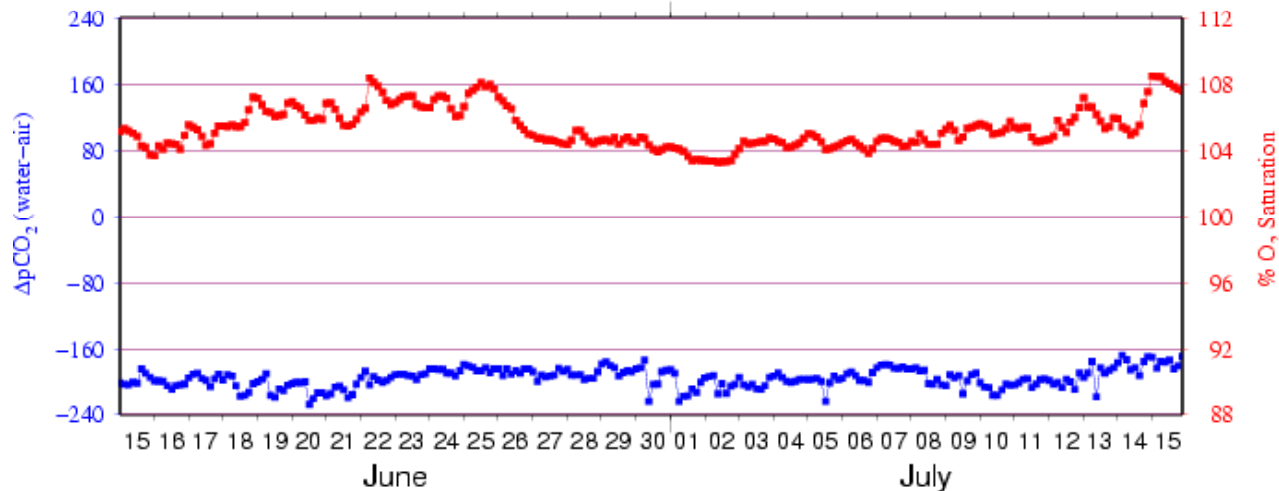


West Coast Activities

$x\text{CO}_2$ in Air and Seawater @ GAKOA (149W,60N)
(Date: 2011-06-15 to 2011-07-15)



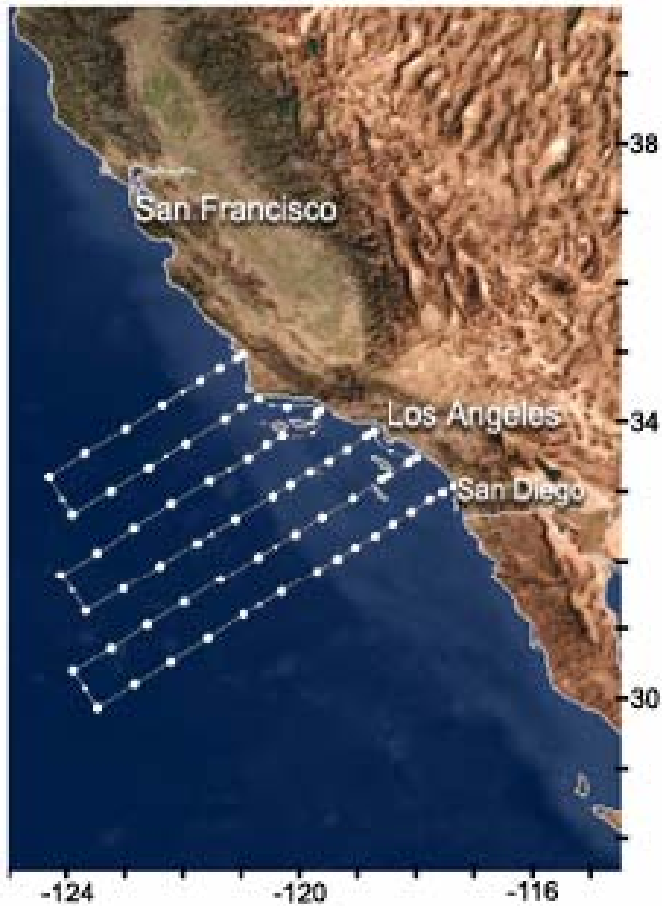
$\Delta p\text{CO}_2$ and Percentage Saturation of Oxygen @ GAKOA (149W,60N)
(Date: 2011-06-15 to 2011-07-15)



First full dataset in
May 2012

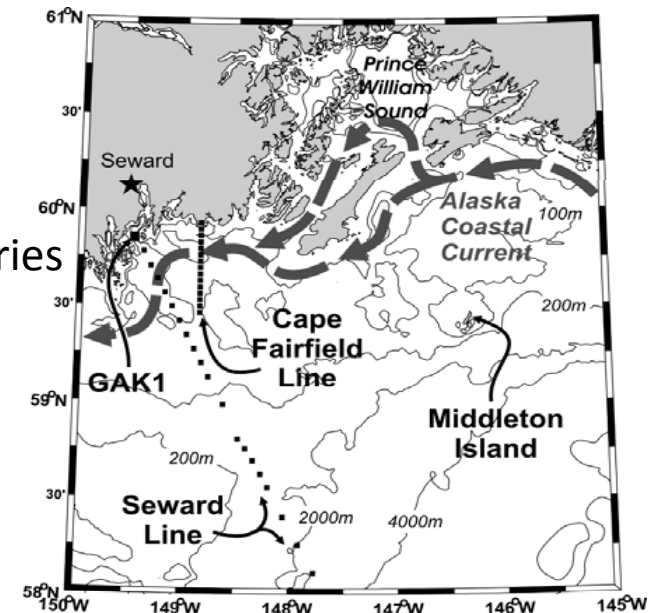
<http://pmel.noaa.gov/co2/story/GAKOA>

West Coast Field Activities

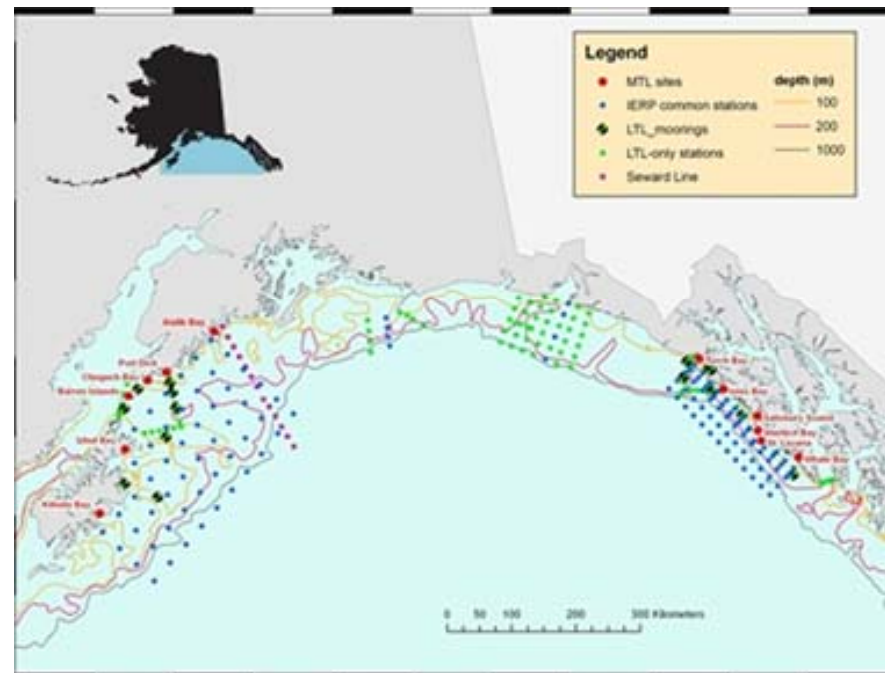


California Cooperative
Oceanic Fisheries
Investigations (CalCOFI)

Gulf of Alaska Time Series



GOA-IERP program



A Preliminary Carbon Budget for the Gulf of Mexico

Paula G Coble, Lisa L Robbins, Kendra L Daly,
Wei-Jun Cai, Katja Fennel, Steven E Lohrenz

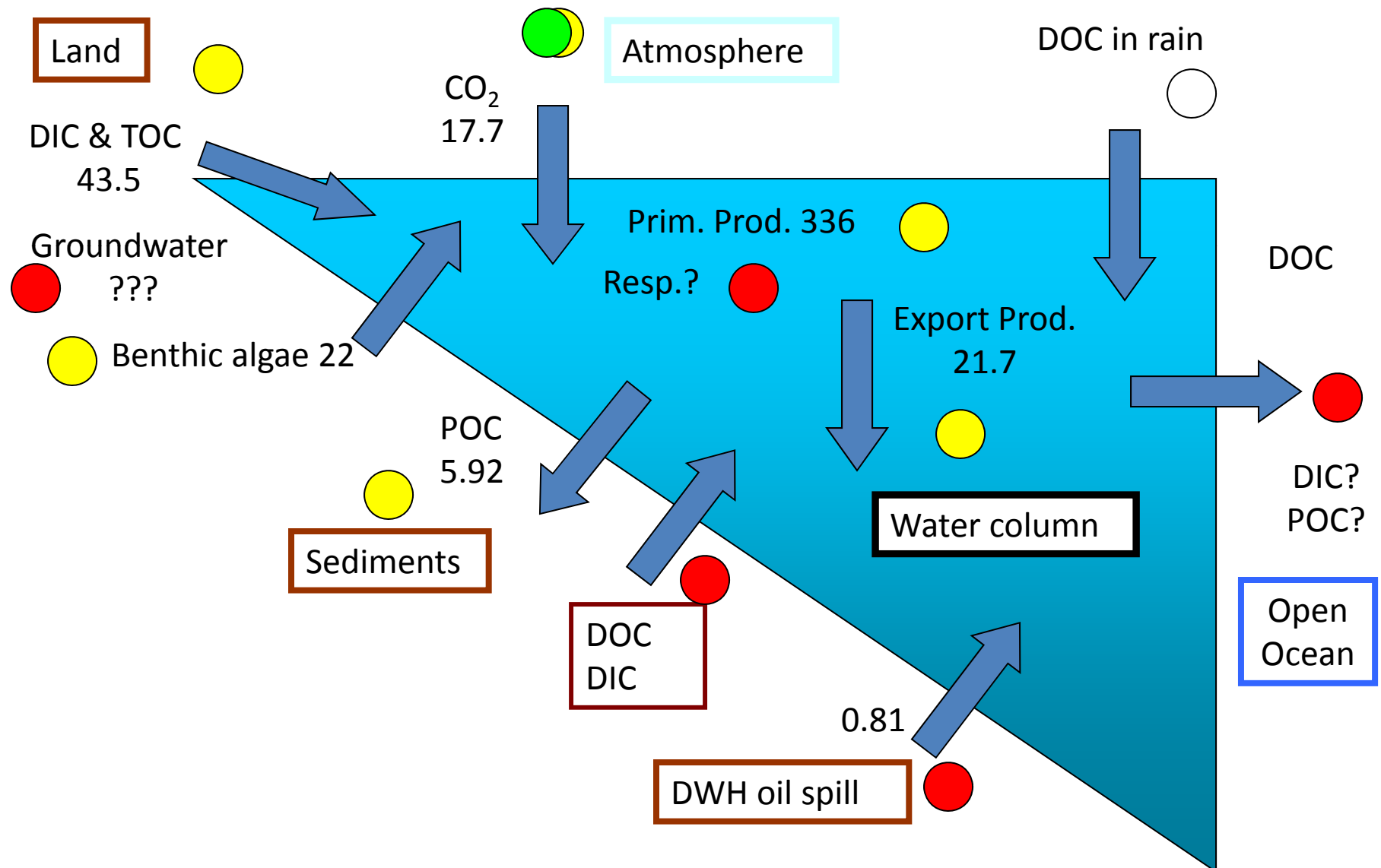
2010 Ocean Sciences Portland, OR Feb. 26, 2010

GulfCarbon: A Comprehensive Study of Carbon Dynamics in the Northern Gulf of Mexico

Steven E. Lohrenz, Wei-Jun Cai, Kevin Martin, Sumit Chakraborty,
Sarah Epps, Kjell Gundersen, Wei-Jen Huang, Yongchen Wang

GOM Activities

Shelf-wide budget (10^{12} g C yr⁻¹)



GOM Carbon Synthesis Workshop

Organizers: Coble, Lohrenz, Daly, Robbins, and Cai

- Initial planning for regional workshop is underway.
- Telecons will start soon with a workshop in October or November 2011.
- Contact Paula (coble@marine.usf.edu) for more information.

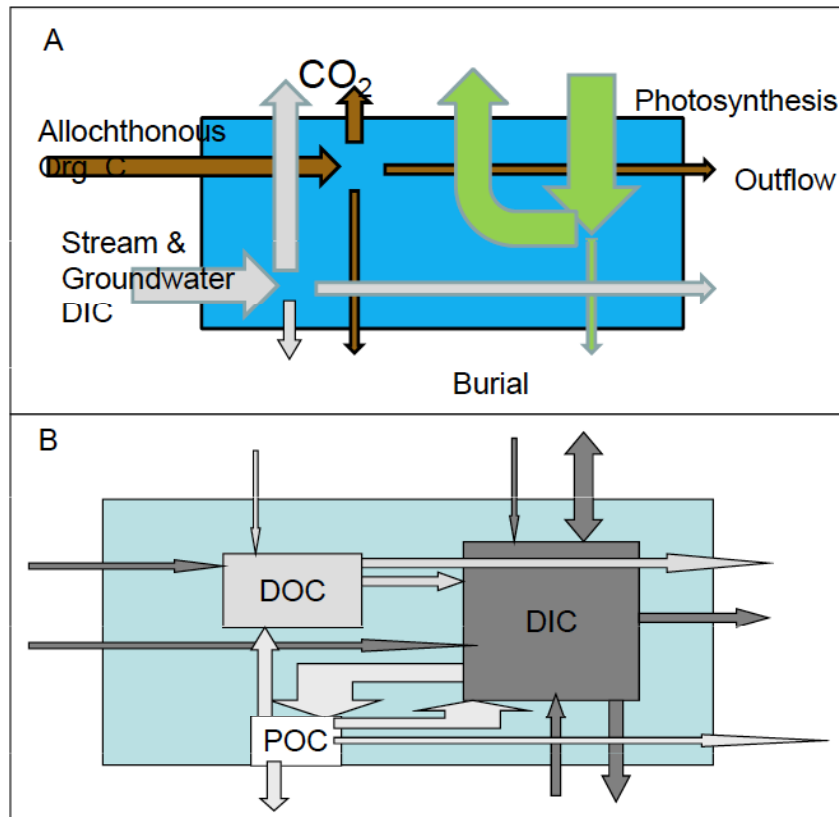


Preliminary Carbon Budgets for the Laurentian Great Lakes

By Galen McKinley, Noel Urban, Val Bennington, Darren Pilcher, Cory McDonald
OCB Newsletter, Vol.4, no. 2 (spring/summer 2011)



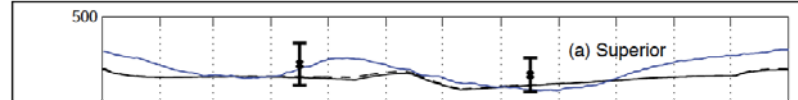
Account for internal
processes, input,
outputs:
FLUX = 2.3 TgC/yr
(source)



Carbon inputs and
outputs only:
FLUX = 0.12 TgC/yr
(source)

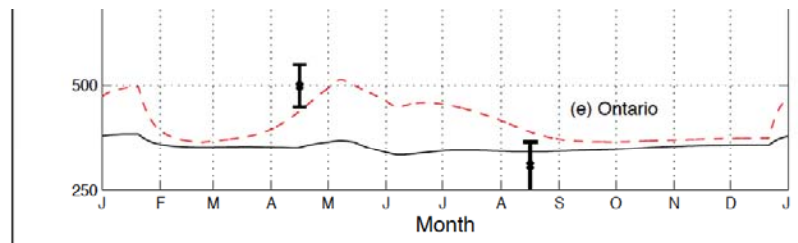
McKinley et al. 2011; Urban et al. (in prep)

Great Lakes Carbon Budget: Simple, 2-Box Models



GREAT LAKES CARBON BUDGET SUMMARY:

- CO_2 source = 0.1 - 10's TgC/yr
- Key unknowns
 - NPP and R – mean values, spatial distribution
 - Surface pCO_2 – temporal evolution
- Winter observations, satellite algorithms critically needed



McKinley et al. 2011, Atilla et al. 2011

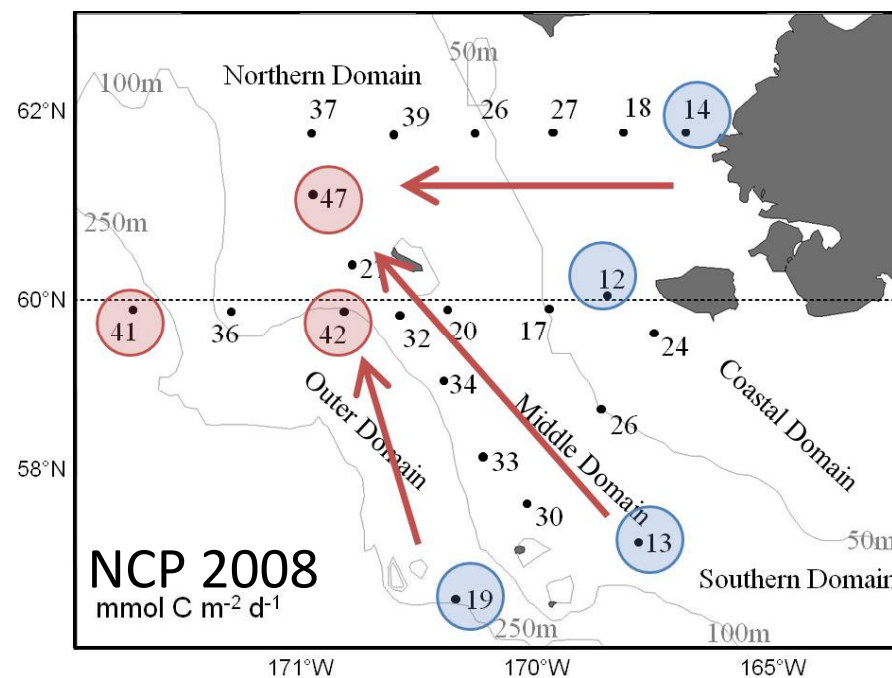
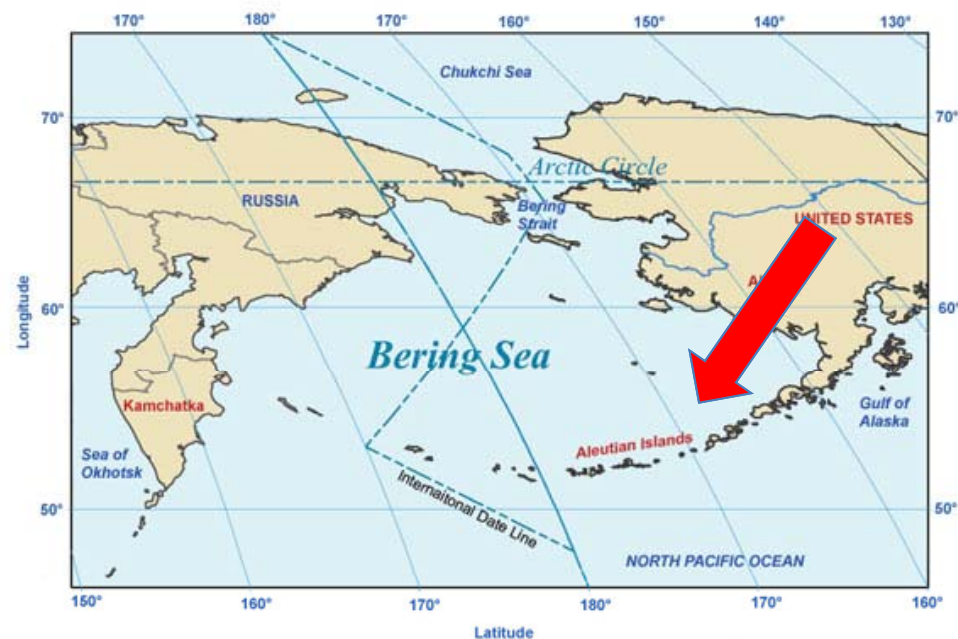
Table 1. Summary of Great Lake characteristics. Relative magnitude with respect to Lake Erie in parentheses.

Lake	Surface Area (m ²)	Hydrologic Residence Time (yr)	Mean depth (m)	Max. depth (m)
Superior	8.21x10 ¹⁰ (3.2)	174 (67)	150 (7.7)	406 (6.3)
Michigan	5.78x10 ¹⁰ (2.2)	104 (40)	85 (4.5)	282 (4.4)
Huron	5.96x10 ¹⁰ (2.3)	21 (8.2)	59 (3.1)	229 (3.6)
Erie	2.57x10 ¹⁰ (1.0)	26 (1.0)	19 (1.0)	64 (1.0)
Ontario	1.90x10 ¹⁰ (0.7)	7.3 (2.8)	86 (4.5)	244 (3.8)

Bering Sea Activities

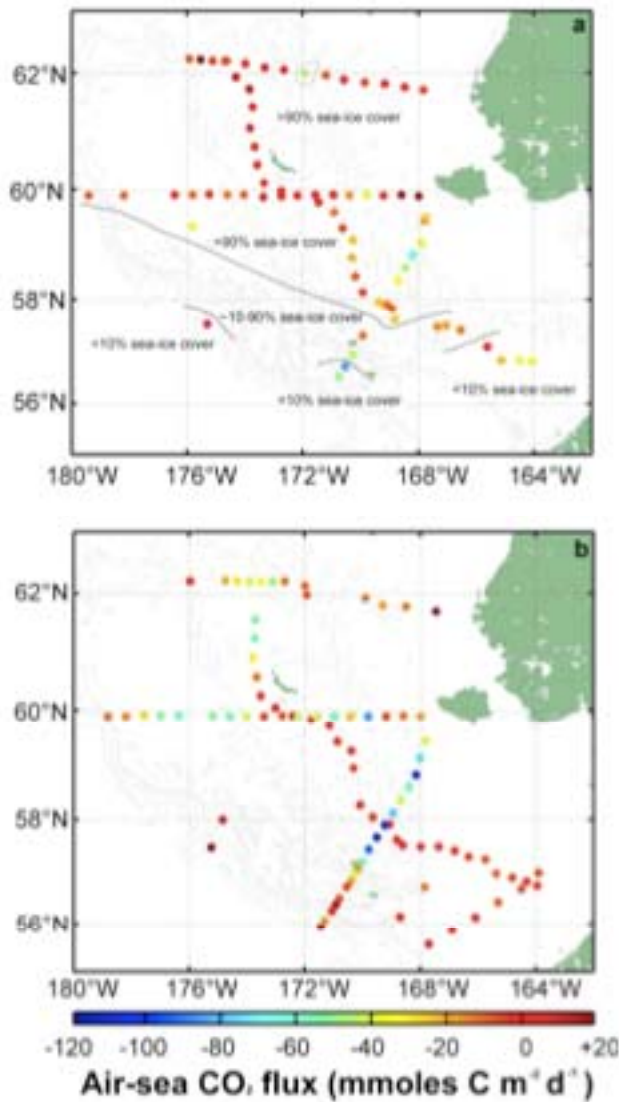


- Surface buoy with MAP CO₂ System, SAMI pH, ISUS nitrate, and SBE 16+.
- Bottom package with SAMI pH and pCO₂, ISUS nitrate, and SBE 16+



Mathis *et al.*, 2010, Biogeosciences, 7, 1769–1787

Bering Sea Activities

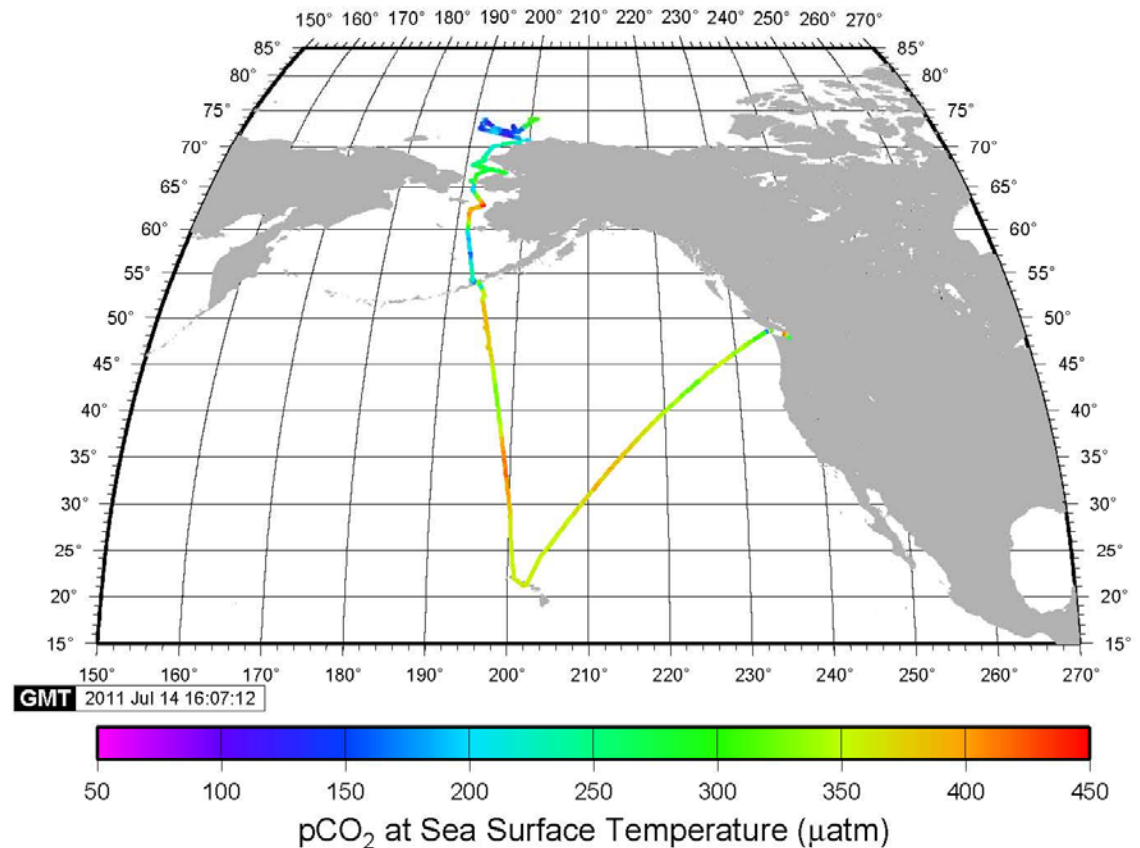


Air-sea CO₂ fluxes on the Bering Sea shelf

N. R. Bates¹, J. T. Mathis², and M. A. Jeffries³

Biogeosciences, 8, 1237–1253, 2011

Seawater pCO₂ Observations from USCGC Healy



T. Takahashi, LDEO (unpublished)

Arctic Activities

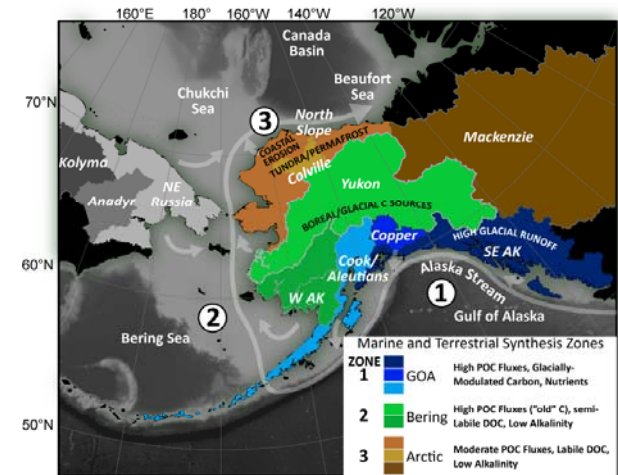
In 2010 - 2011, over 3,000 samples were collected from Bering Strait to the Beaufort Sea for:

- DIC
- TA ($p\text{CO}_2$)
- TOC

Export Production = $\Delta\text{nDIC} - \Delta\text{DOC} - \Delta\text{suspended POC}$

• Δ values in $\mu\text{mol kg}^{-1}$

• (%) is the amount of ΔDIC converted

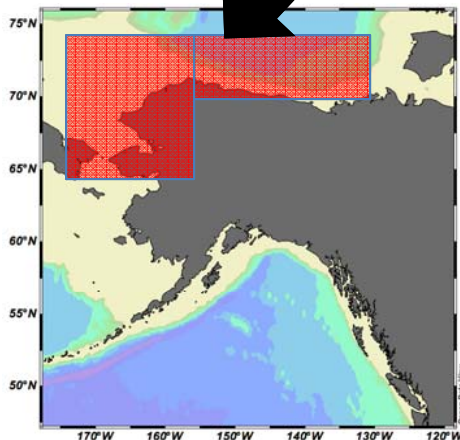


Location	ΔnDIC	ΔDOC	$\Delta\text{suspended POC}$	Export Prod. ($\text{mmol C m}^{-2} \text{d}^{-1}$)*
Central				
Shelf	230	22 (9%)	40 (17%)	104 (74%)
Slope	41	4 (10%)	7 (17%)	15 (73%)
Basin	2	0	0.3 (15%)	0.5 (85%)
Western				
Shelf	86	9 (10%)	14 (16%)	32.5 (74%)
Slope	22	2.5 (11%)	3 (14%)	8 (75%)
Basin	3	0	0.5 (15%)	1.3 (85%)
Eastern				
Shelf	94	11 (12%)	16 (17%)	40 (71%)
Slope	58	6 (10%)	8 (14%)	23 (76%)
Basin	11	0.8 (7%)	1.8 (16%)	3.7 (77%)

* The export production values are consistent with observations taken from sediment traps.

Mathis et al., 2007b

Mathis, Bates, Frey, Juranek, and VanLaningham have a pending OPP proposal to develop seasonal carbon budgets for the region.



Summary

- Progress is being made in each of the five regions
 - West Coast telecons will begin next week
 - Meetings for East Coast and GOM will occur later in the year
 - Great Lakes and Bering Sea/Arctic will be developed opportunistically as funding allows
- Please contact one of the regional leaders if you are interested in participating or have data/model outputs to contribute.
- Advertisement for data technician will be out soon.