An update on the North American Coastal CARbon Synthesis (CCARS)

Arctic
Jeremy Mathis

Great Lakes
Galen McKinley

West Coast
Simone Alin
Sam Siedlicki

Gulf of Mexico
Paula Coble
Steve Lohrenz

East Coast
Wei-Jun Cai
Marjorie Friedrichs
Raymond Najjar

Support Scientist: Maria Herrmann

OCB
Heather Benway

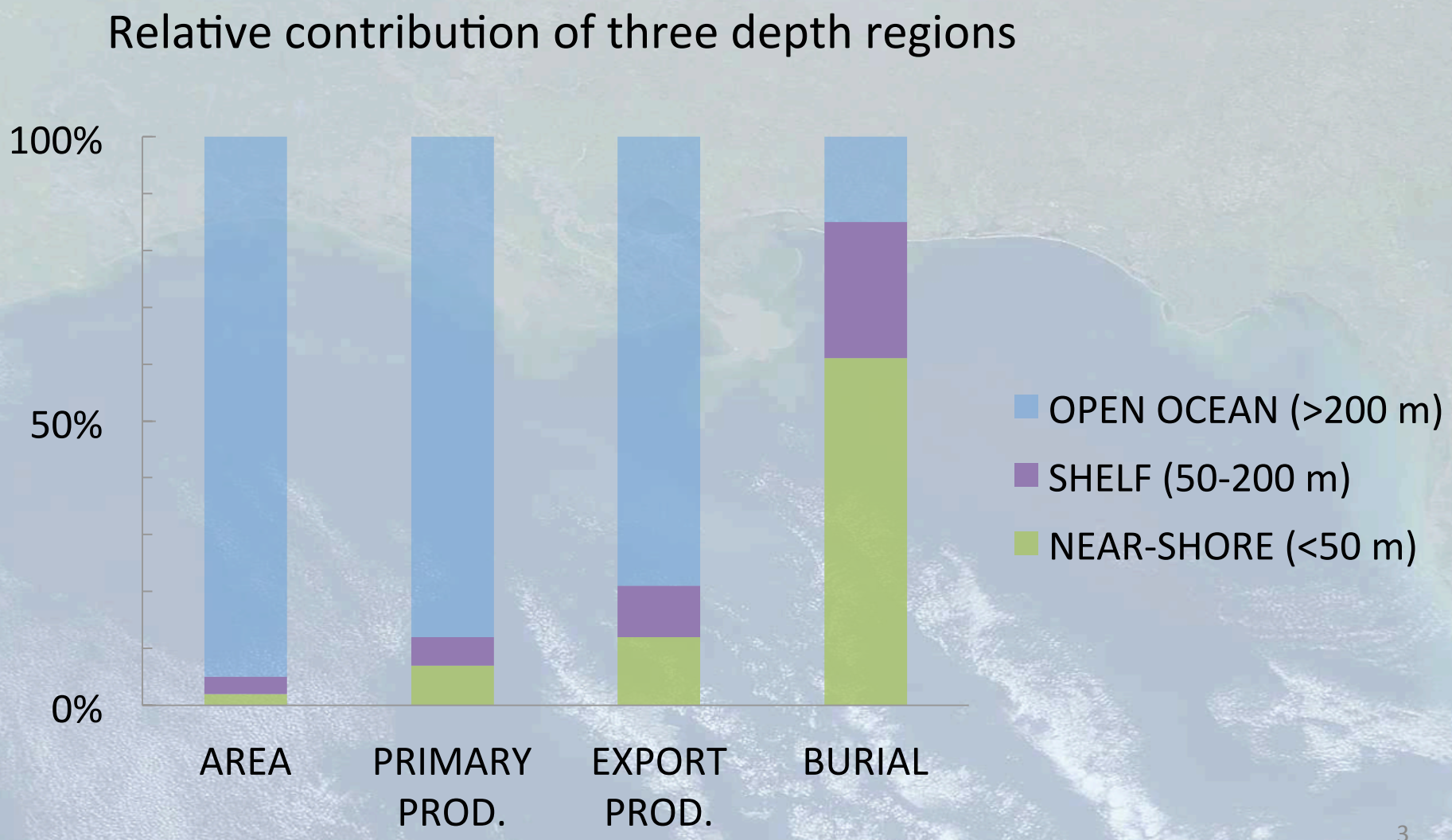
NACP
Peter Griffith

NACP PIM5 26 January 2015

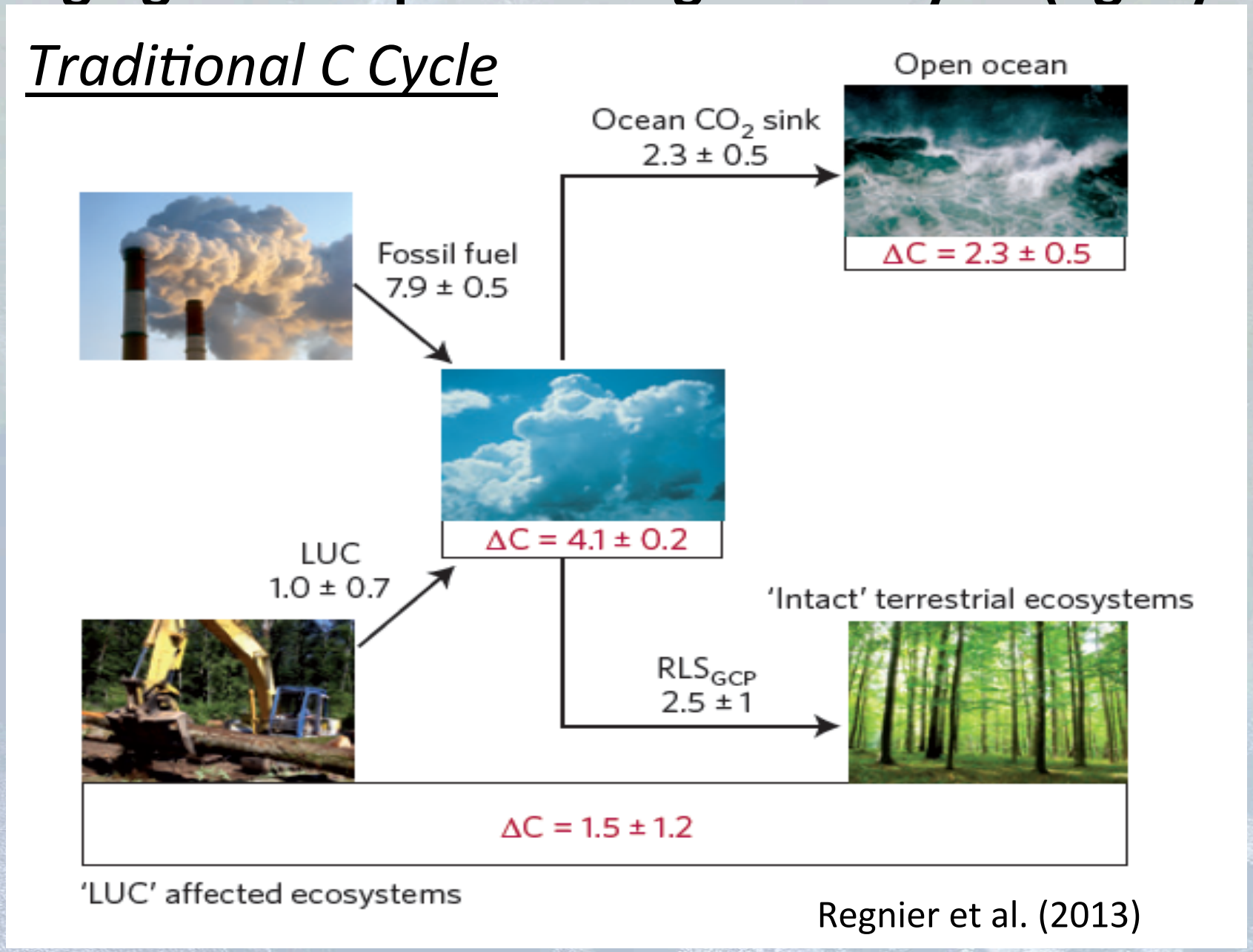
Outline

- Historical perspective and motivation
- CCARS timeline
- 2014 final workshop
- Science plan

Global modeling of ocean C fluxes: Dunne et al. [2007]

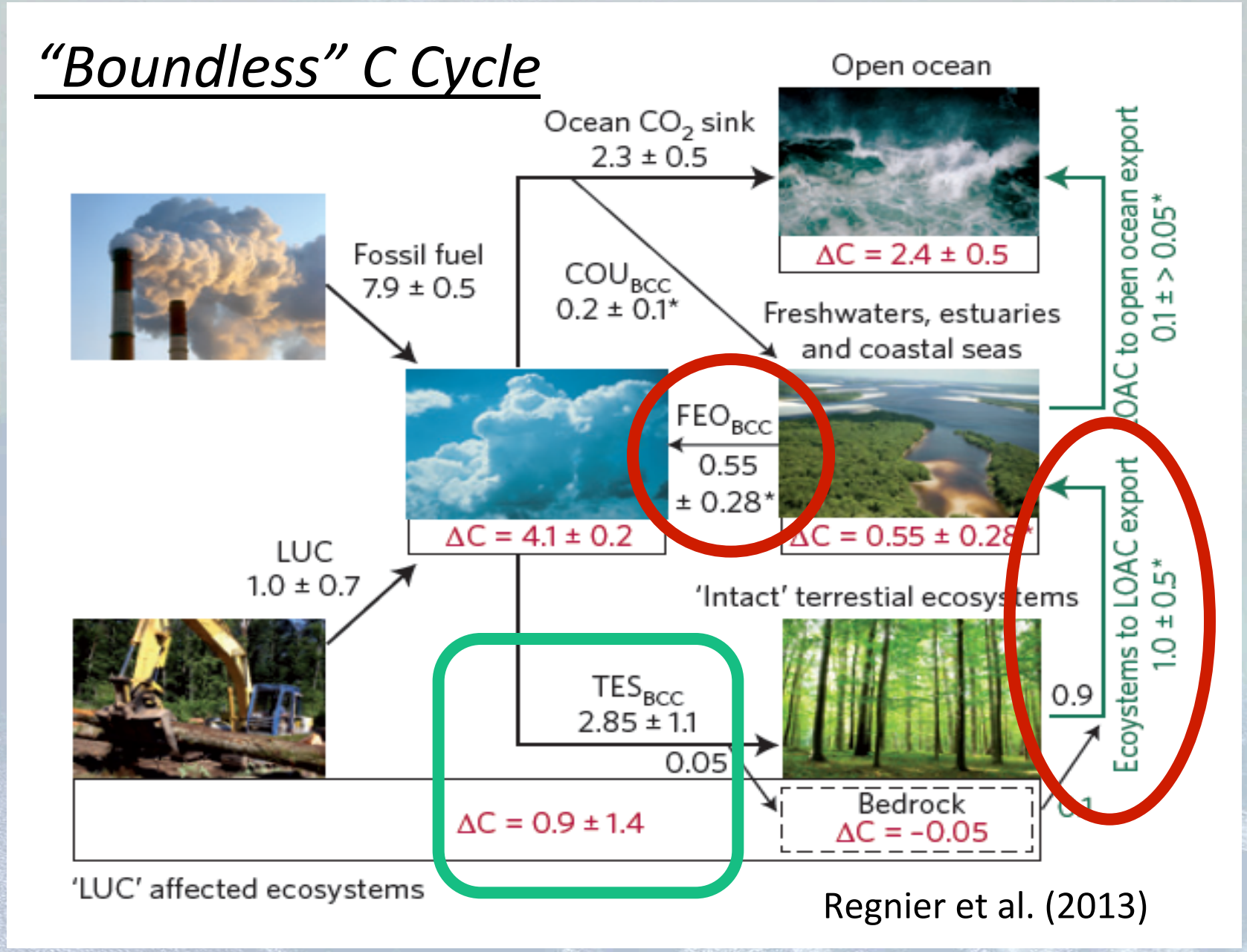


Changing view of perturbed global C cycle (Pg C yr^{-1})



Regnier et al. (2013)

Changing view of global C fluxes (Pg C yr^{-1})



Regnier et al. (2013)

Important issues related to carbon cycling in the coastal zone

- Carbon sequestration
- Eutrophication
- Harmful algae
- Hypoxia
- Acidification
- Wetlands Loss
- Fisheries

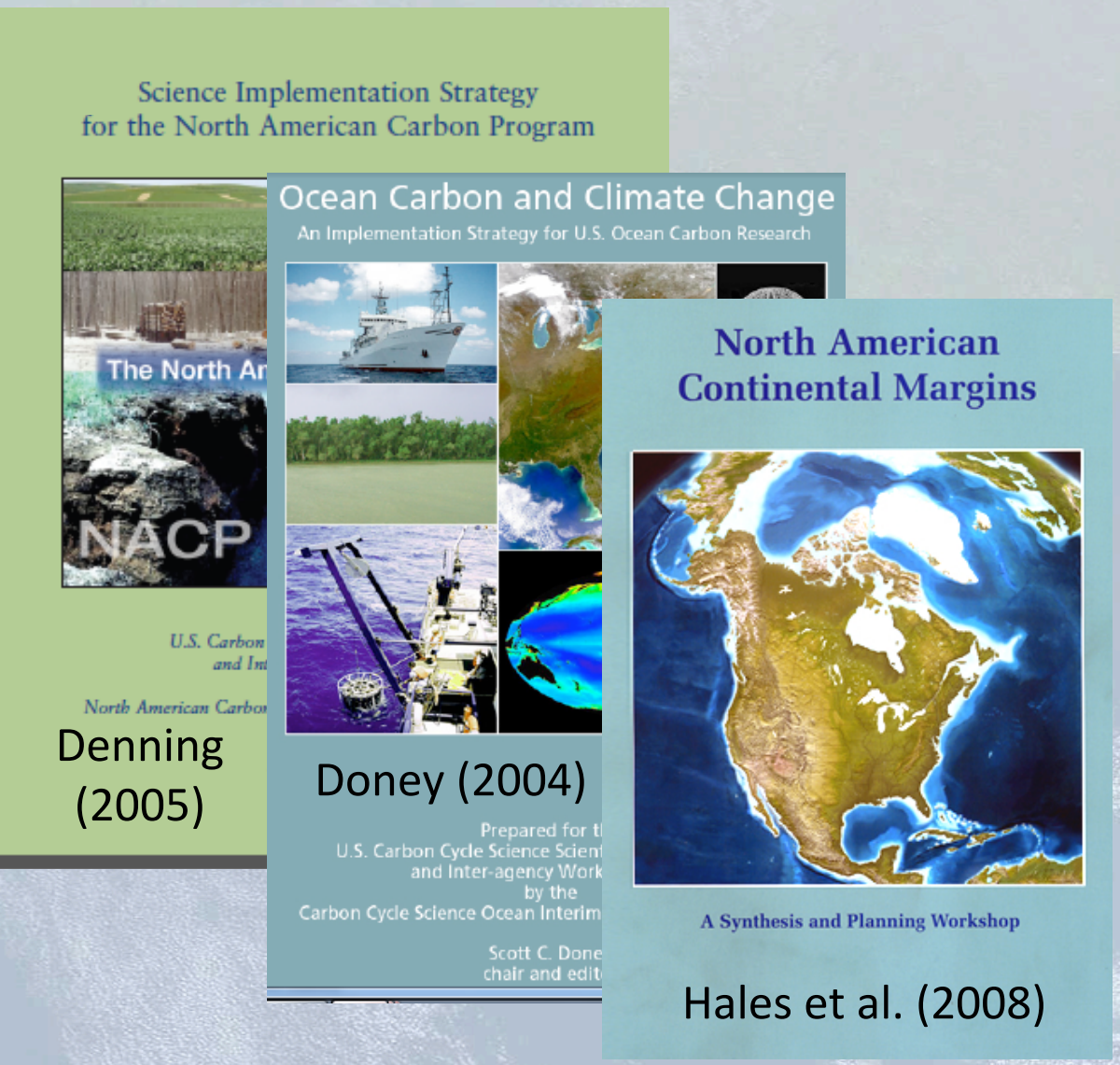
Carbon is the <u>common currency</u> for describing many of these issues.

But understudied …

Better constraints on coastal carbon cycle = better understanding of these issues.

A difficult problem … boundaries are messy

Importance of coastal margins highlighted in several reports



Denning (2005)

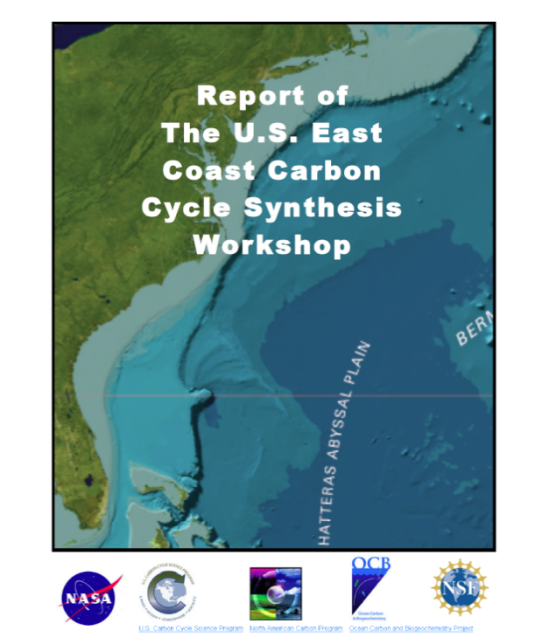
Doney (2004)

Hales et al. (2008)

Need improved estimates of "North American coastal ocean and continental margin air-sea fluxes, land-ocean and coastal open ocean exchange, and biogeochemical cycling … in order to close the carbon budget over North America" (Doney, 2004)

CCARS timeline

- 2009 Initial Breakout at NACP Meeting
- 2010 NASA Community Workshop
- 2010-2012 Preliminary budgets published in OCB Newsletter issues
- 2012 East Coast Workshop + report (Najjar et al., 2012)
- 2013 Gulf of Mexico Workshop + report (Benway and Coble, 2014)
- 2014 West Coast Workshop
- 2014 Community Synthesis Workshop
- 2015 Science Plan



CCARS Community Workshop

August 19-21, 2014

Woods Hole, MA

Goals:

- Present draft coastal carbon budgets for final community refinement
- Develop a community plan for future research to improve our understanding of carbon cycling in coastal waters

CCARS Workshop

- Draft science plan presented before workshop
- 58 participants
- 22 posters
- Presentation and breakouts on processes and regions
- Group discussion
- http://www.whoi.edu/website/ccars

Overarching issues and strategic approaches that were identified

- **Exchanges between tidal wetlands and estuaries are very poorly constrained**
- **There is a need for satellite algorithm development** (pCO_2, primary production, etc.) and better use of relevant satellite products (terrestrial and ocean) in all regions (may require new collaborations)
- **There is a need for improved understanding and focus on mechanisms underlying fluxes** in order to improve representation in models

Overarching issues and strategic approaches (continued)

- **A potentially fruitful measurement approach is the use of sentinel sites** where fluxes are comprehensively constrained, spanning a few different coastal/estuarine typologies that leverage existing infrastructure
- **A need for modeling that links subdomains** (e.g., estuary-shelf, wetland-estuary, benthic-pelagic) and processes (biogeochemistry, hydrodynamics, submerged vegetation)

Immediate Observing Needs

- **Spatial:** Measurements from Mexican and Canadian coastlines; more tidal wetland measurements
- **Temporal:** Winter measurements, event-scale phenomena (autonomous technology)
- **Shelf respiration measurements paired with primary production** (water column metabolism)
- **Gas flux through ice** (Arctic)
- **Submerged aquatic vegetation** (sea grass) productivity along the East coast and Gulf of Mexico
- **Inorganic and organic C system measurements** in the Great Lakes
- **Carbon content in sediments to assess burial rates**
- **Groundwater fluxes** along East Coast and Gulf of Mexico

Science plan

- Currently being drafted
- Expected to agencies in Spring 2015

Thank you

References

Benway, H.M., Coble, P.G. (Editors), 2014. Report of The U.S. Gulf of Mexico Carbon Cycle Synthesis Workshop, March 27-28, 2013. Ocean Carbon and Biogeochemistry Program and North American Carbon Program, 67 pp.

Denning, A. S., 2002, Science Implementation Strategy for the North American Carbon Program. Report of the NACP Implementation Strategy Group of the U.S. Carbon Cycle Interagency Working Group. Washington, DC: U.S. Carbon Cycle Science Program, 68 pp.

Doney, S. (editor), 2004. Ocean Carbon and Climate Change: An Implementation Strategy for US Carbon Research, 108 pp.

Dunne, J.P., Sarmiento, J.L., Gnanadesikan, A., 2007. A synthesis of global particle export from the surface ocean and cycling through the ocean interior and on the seafloor. Global Biogeochemical Cycles 21, GB4006, doi:10.1029/2006GB002907.

Hales, B., Cai, W.-J., Mitchell, G., Sabine, C.L., Schofield, O., 2008. North American Continental Margins: A Synthesis and Planning Workshop. Report of the North American Continental Margins Working Group for the U.S. Carbon Cycle Scientific Steering Group and Interagency Working Group. U. S. Carbon Cycle Science Program, Washington, D. C., 110 pp.

Najjar, R.G., Friedrichs, M., Cai, W.-J. (Editors), 2012. Report of The U.S. East Coast Carbon Cycle Synthesis Workshop, January 19-20, 2012. Ocean Carbon and Biogeochemistry Program and North American Carbon Program, 34 pp.

Regnier, P. and 28 others, 2013. Anthropogenic perturbation of the carbon fluxes from land to ocean, Nature Geoscience, 6, 597–607.