Overview of NOAA wetland science and activities related to Blue C

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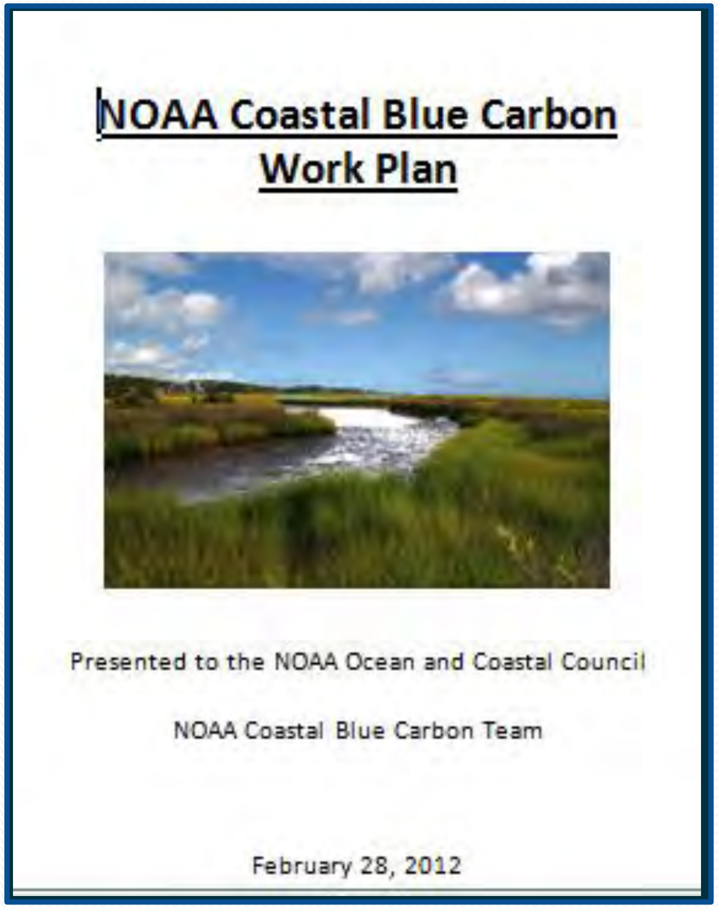
NOAA MISSION

…To conserve and manage coastal and marine ecosystems and resources.

What's NOAA Doing?

- NOAA-wide blue carbon team
- Work Plan: Science and Policy opportunities
- Newly formed blue carbon interagency group to enhance coordination and communication across the federal family


NOAA Coastal Blue Carbon Work Plan

Presented to the NOAA Ocean and Coastal Council

NOAA Coastal Blue Carbon Team

February 28, 2012

Work Plan Goals

- Goal 1: Improve understanding and develop tools for assessing carbon services of coastal habitats.
- Goal 2: Incorporate carbon services as part of NOAA's and other Federal agencies' policies and practices concerning coastal habitats.
- Goal 3: Increase awareness and consideration of coastal habitat carbon services within international policies and programs.

Coastal Blue Carbon Opportunities for Conservation

Address Policy Needs:

- Identification of policies that could address coastal carbon
- Procedures for how to incorporate C services into activities

Address Market Policy Needs:

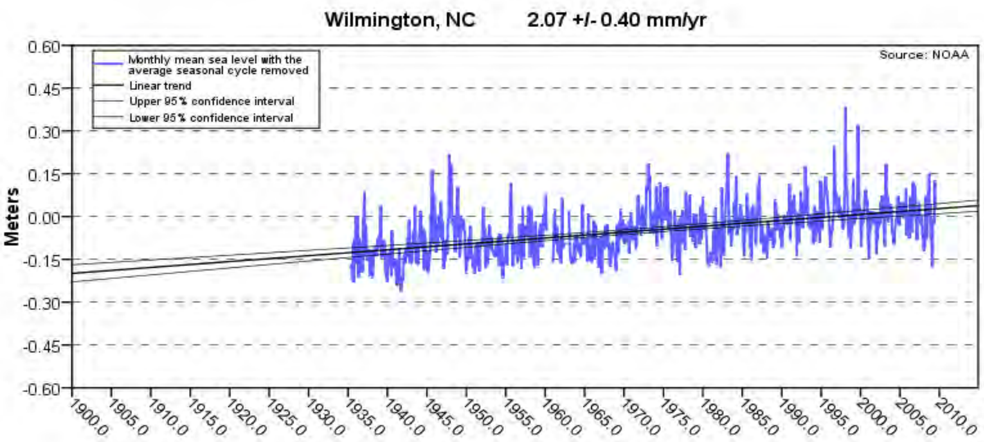
- Protocols for GHG accounting
- Carbon market protocols

Address Science Needs:

- Better estimates of C storage, sequestration, and emissions
- Areal extent of habitats and which are most threatened
- Better understanding of carbon released when habitats are disturbed, or stored in restoration

NOAA Resources to help meet coastal Blue C science needs

- Data collection and monitoring of key variables
  -Habitat distribution, sea level and tides, surface elevation, shoreline erosion (NGS, CO-OPS, Coast Survey)



- Marine Protected Areas
  Natl. Estuarine Research Reserve System (NERRS)
  Sentinel Site Program **Effects of SLR on Coastal Habitats**
  National Marine Sanctuaries (NMS)

- Habitat Restoration—Research and Restoration

- Research
  Intramural (NCCOS, OAR)
  Extramural (Sea Grant, NERRS Sci Coll., CSCOR)

NOAA Coastal Blue C research

- **NERRS SciColl** Role of marshes in sequestering GHG (MA)
- **Sea Grant/NERRS** Oyster reef role in C sequestration (NC)
- **NCCOS** Fringing marsh C sequestration and impact of shoreline stabilization structures (NC)
- **NCCOS** Marsh response to SLR / Estuarine C cycle (NC / DoD funding)

Carbon Management in Coastal Wetlands: A collaborative approach to quantifying GHG flux to support development of a GHG protocol and economic assessment

Funded by the NERRS Science Collaborative

Waquoit Bay NERR, A. Leschen

USGS - Kevin Kroeger, Neil Ganju

Marine Biological Laboratory - Jianwu (Jim) Tang,

Univ. of Rhode Island - Serena Moseman-Valtierra

Florida International University - Omar Abdul-Aziz,

Manomet Center for Conservation Science -Tom Walker

Restore America's Estuaries - Steve Emmett-Mattox, also Steve Crooks, Pat Megonigal, Igino Emmer

NERRS Sci Collaborative Waquoit Bay Project

Methods/Approaches

- Develop a new GHG measurement system to measure CO2, CH4, and N2O fluxes in situ, both vertically and laterally
- Measure GHG emissions and C stocks in order to understand how they respond to changes in (A) N loading, (B) climatic regimes (including temperature), and (C) sea level.
- Develop simple, user-friendly models for robust prediction of GHG emissions and C seq. from wetland ecosystems across a wide range of time (e.g., seasons) and space (e.g., region) scales.
- Develop tools that coastal managers can use to apply that knowledge

Slides courtesy of Lescher, Kroeger, Tang & Moseman-Valtierra

Coastal carbon burial by shellfish reefs

Joel Fodrie, Tony Rodriguez, Jon Grabowski, Niels Lindquist, Mike Piehler, Pete Peterson and Patricia Rodriguez
UNC-CH (IMS)
2012 BEM

Carbon sequestration as an oyster reef ecosystem service?

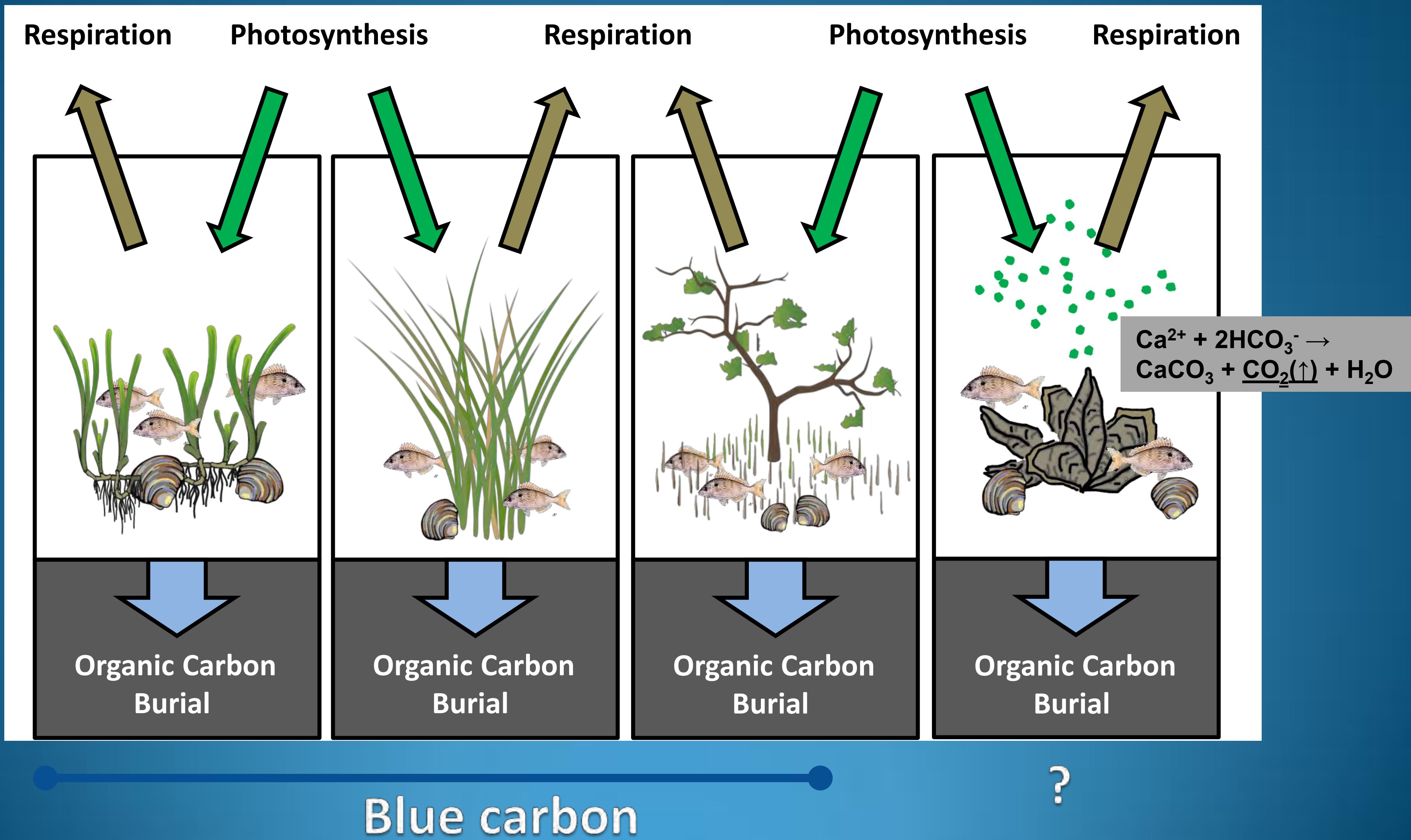
Sea Grant
North Carolina

Albemarle - Pamlico
National Estuary Program

NC NERRS

Slide courtesy J. Fodrie

Can a heterotroph be considered a blue carbon sink?



Slide courtesy J. Fodrie

Summary of blue carbon role for shellfish reefs

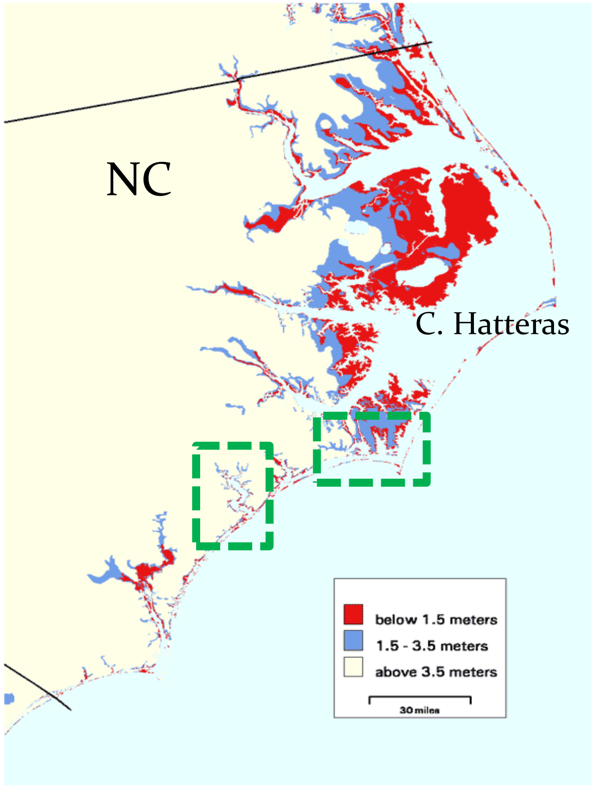
- **Organic carbon burial rates on par with other blue carbon sinks, particularly in intertidal reefs assoc w/ saltmarsh.**

- **In intertidal-sandflat reefs, however, the formation and burial of calcium carbonate results in significant net CO_2 release.**

- **Should blue carbon status be awarded to shellfish reefs (or a subset of them?)?**

Slide courtesy J. Fodrie

Coastal Wetland Research in NC Relevant to wetland C sequestration



NOAA Shoreline stabilization Fringing salt marsh and intertidal oyster reefs; 'living' shorelines

DCERP1 Multi-investigator, interdisciplinary study of the New River Estuary (NC) to support ecosystem management of Marine Corps Base Camp Lejeune

NCCOS (Currin, Fonseca), UNC-CH (Paerl, Peterson, Piehler, Rodriguez), VIMS (Anderson, Brush), Duke (Christiansen, Halprin), USC (Morris)

DCERP2 Climate change impacts on the estuarine C cycle
5-yr project to begin in 2013 at MCBCL

Above plus M. Kirwan, B. McKee

- **Marsh erosion**
- Marsh response to SLR across salinity/tidal gradients
- Field measures of elevation:biomass
- **Dredging as C management issue**

Estuarine shoreline stabilization

Fringing marshes often unaccounted for in wetlands inventory due to narrow width (<25 m)

Threatened by SLR and development, recent focus of restoration and stabilization efforts

GOAL: Develop and assess shoreline stabilization approaches which incorporate salt marsh and oyster reefs

Contribution of estuarine shoreline erosion to wetland C loss

NC marsh shorelines estimates average -0.25 m yr^{-1}

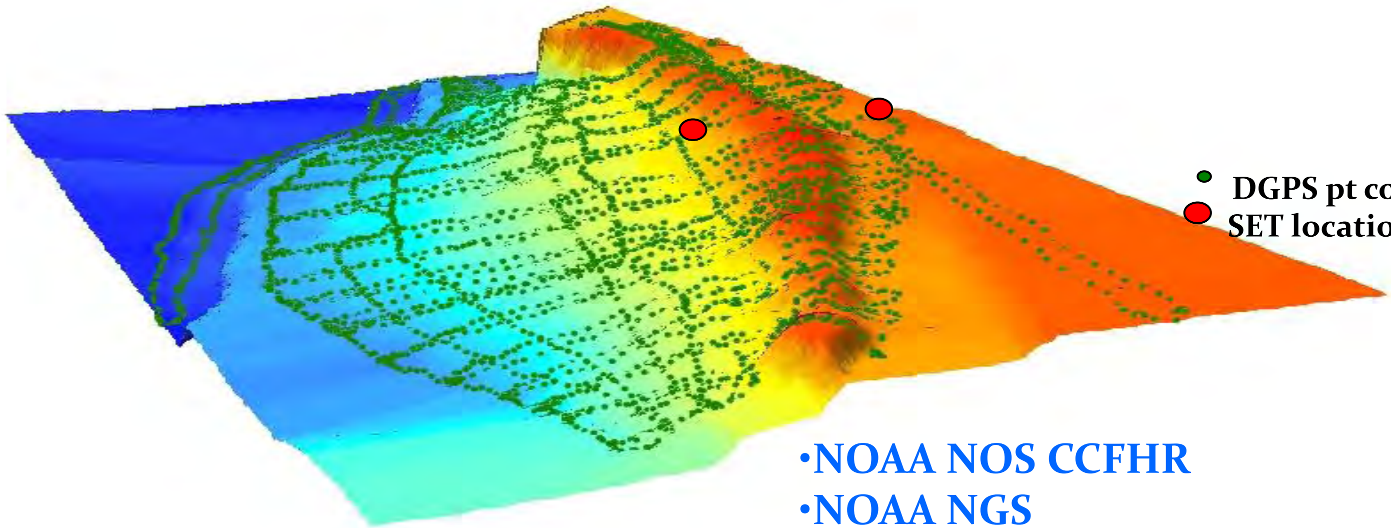
- Riggs & Ames 2008, Cowart et al. 2011, DCERP1 Currin & Fonseca

Estimated 12,000 miles estuarine shoreline in NC

- Marsh 10-85% by county, use overall 33% est.
- Marsh area eroded annually = 160 ha = 95,000 MgC

Shoreline Research Tools

High resolution Digital Elevation Model of salt marshes



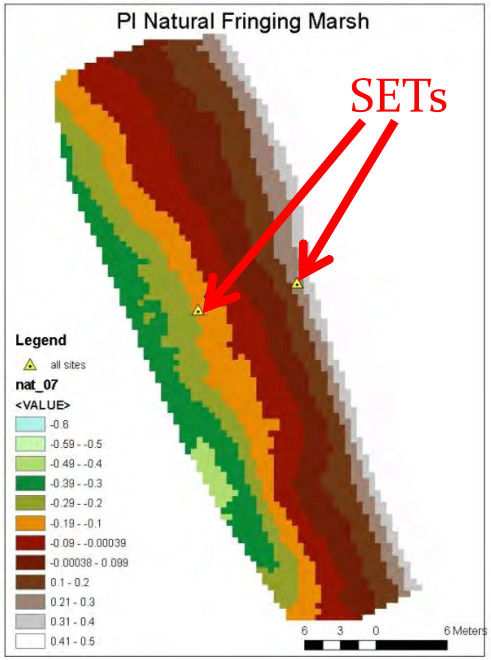
- NOAA NOS CCFHR
- NOAA NGS
- NOAA COOPS


DGPS OPUS base station

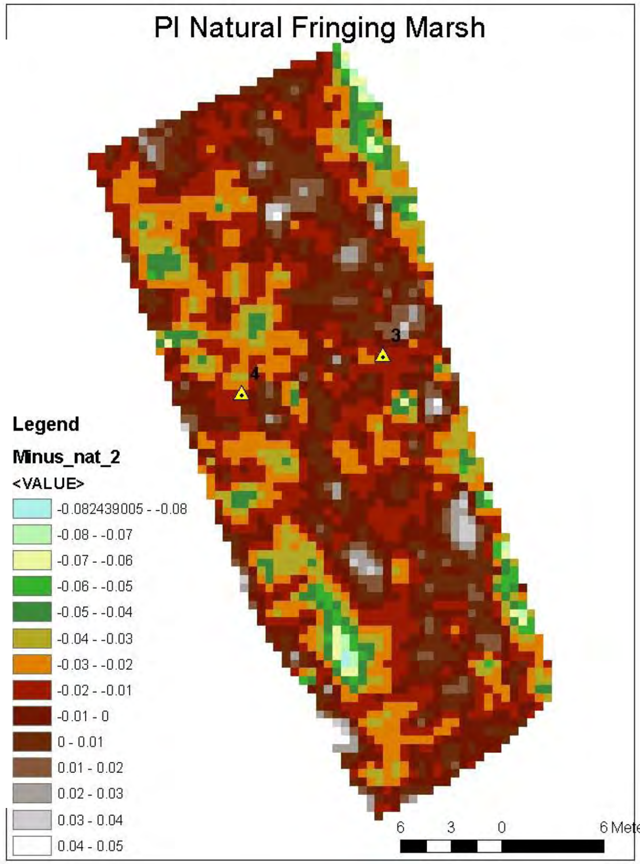
RTK GPS rover


Tide gauge installation

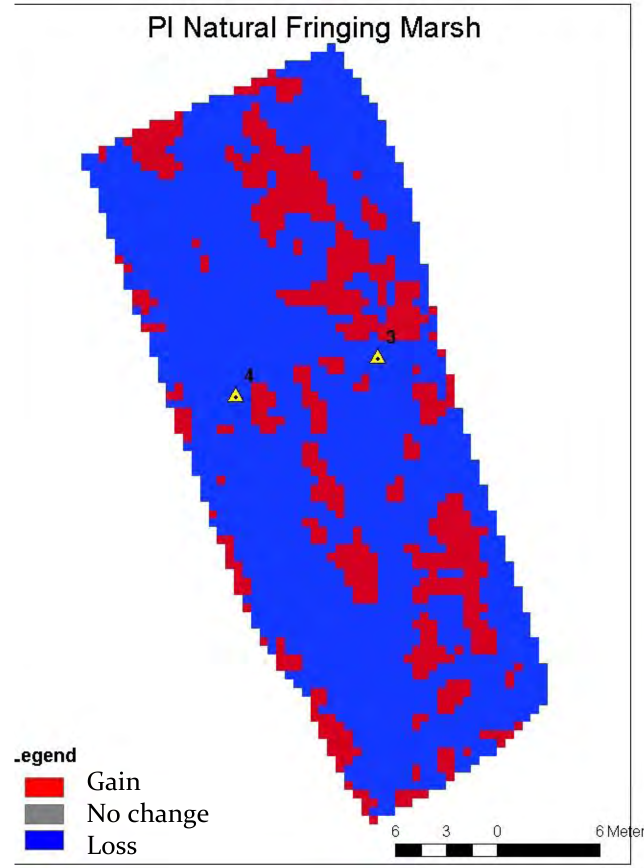
2007 DEM



2007-2010 DEM change analysis

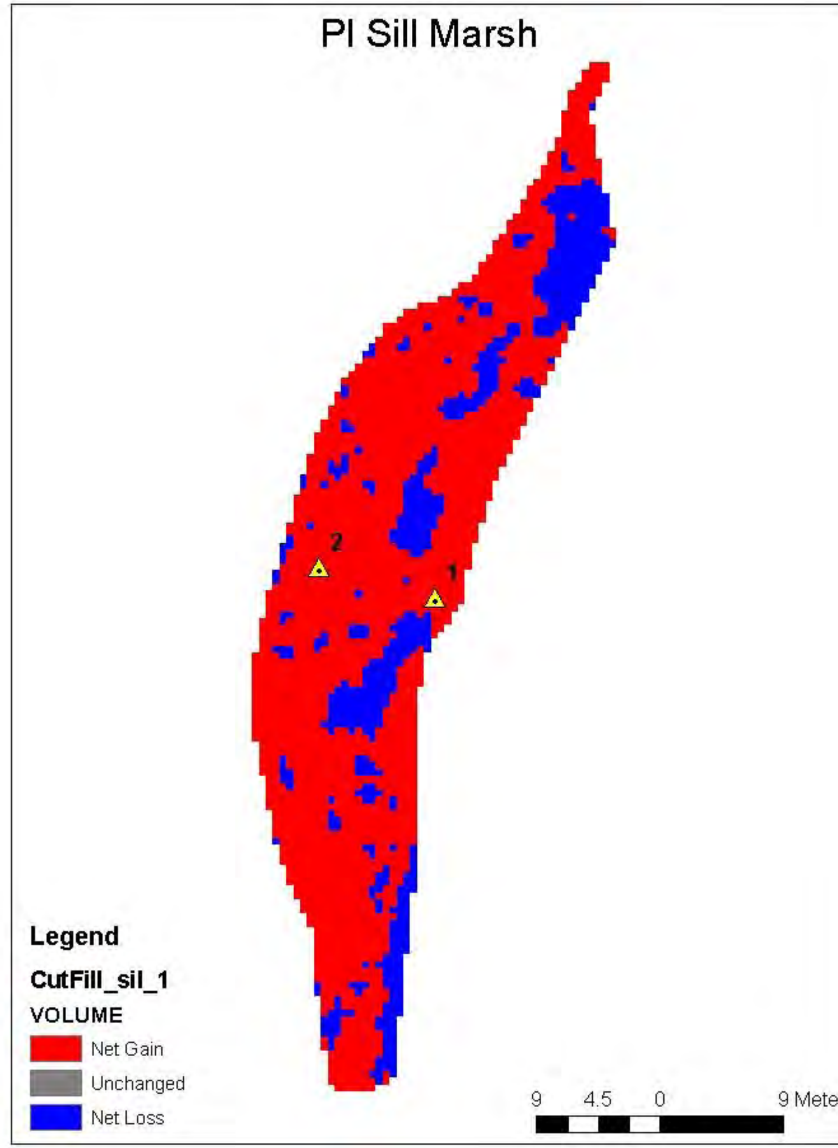


2007-2010 DEM cut-fill



DEM change analysis shows loss of marsh elevation at lower edge and increase in elevation at upper edge

Total area = 670 m² Net Volume Change = -8.3 m³ Mean loss = - 0.01 m elevation

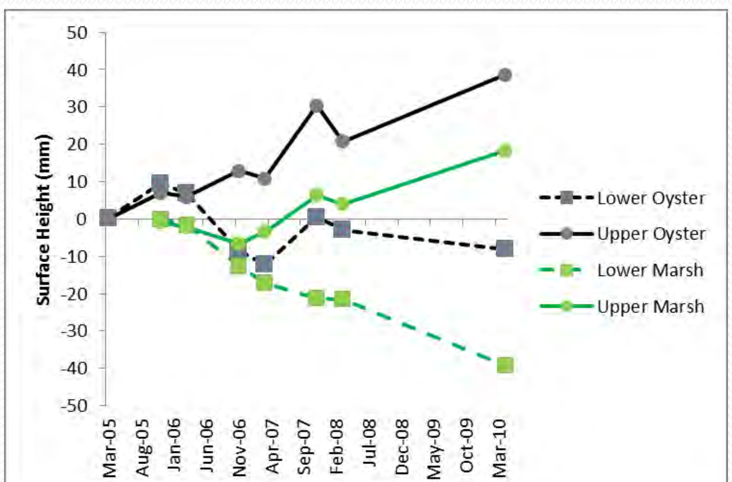


Total area = 740 m^2 Net Volume Change = 10.4 m^3 Mean gain = 0.01 m elevation

Shoreline Stabilization and Fringing Salt Marshes
Results informing C sequestration science

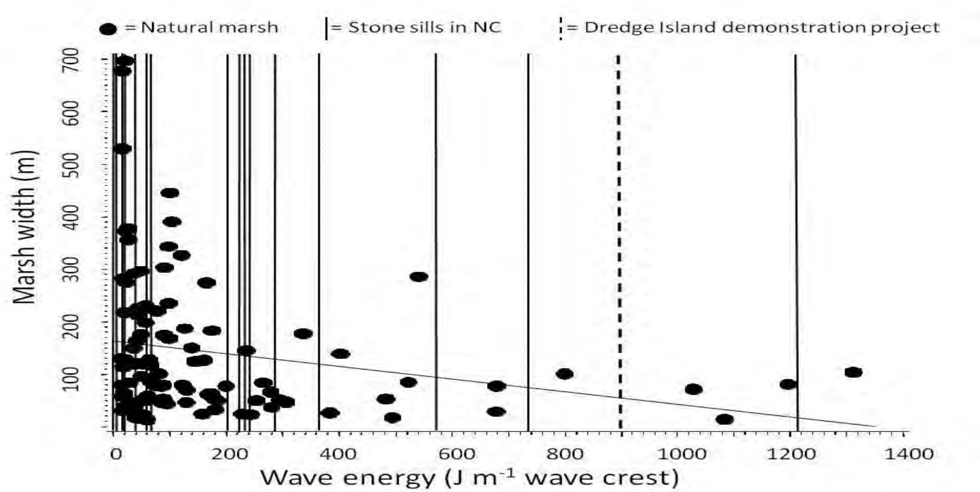
SET Results Fringing Salt Marshes

Marsh	Elevation	mm/yr	n (SETS)
Natural	Lower	-6.93* C	4
Natural	Upper	0.45 B	4
Sill	Lower	4.11* A	4
Sill	Upper	4.18* A	4



- Fringing marshes losing elevation, not 'keeping up'
- Marsh sills increase sediment accretion rates, but tradeoff in ecosystem services
- Fringing oyster reefs reduce erosion at edge , increase deposition in interior
- Marker horizon and sediment analysis show mineral sediment accretion

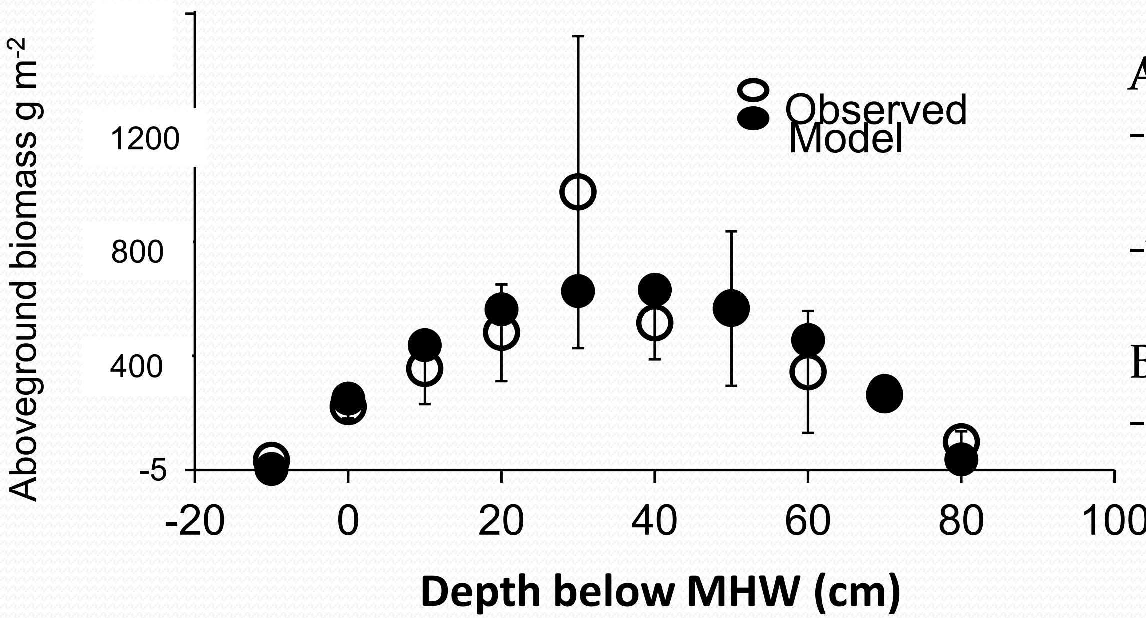
Shoreline Stabilization and Fringing Salt Marshes
Results informing C sequestration science



Define wave energy settings occupied by salt marsh to guide restoration

Erosion rates not well-correlated with wave energy

Marsh sills placed in low-wave energy settings

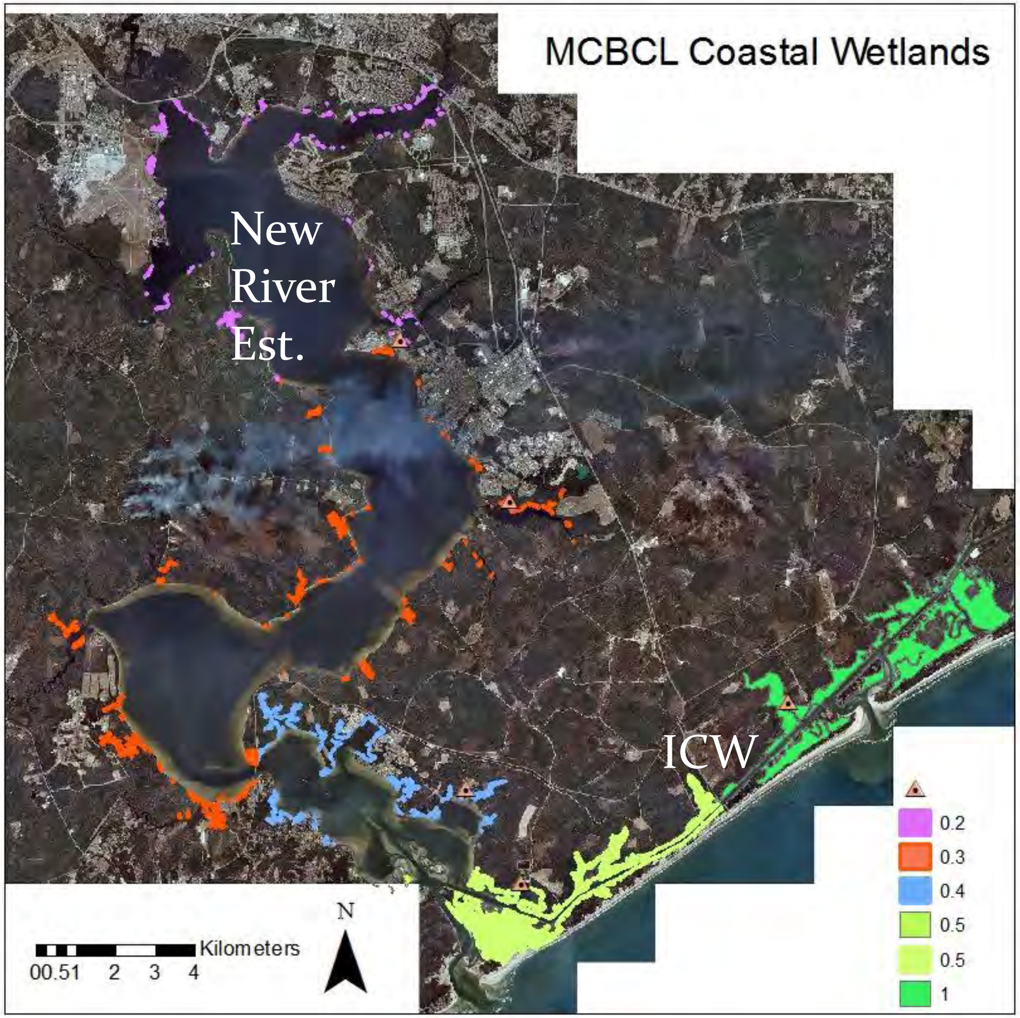


Aboveground *Spartina* biomass
-in situ determination

-wider tide range distribution

Belowground *Spartina* biomass
-significant increase with elevation

DCERP1
Marsh response to SLR
Factors affecting shoreline erosion
- **military training, ICW, wind waves, boat wakes, shoreline type**



NRE marsh shoreline
Marsh 28 km
Sed bank w/ fringe 4 km

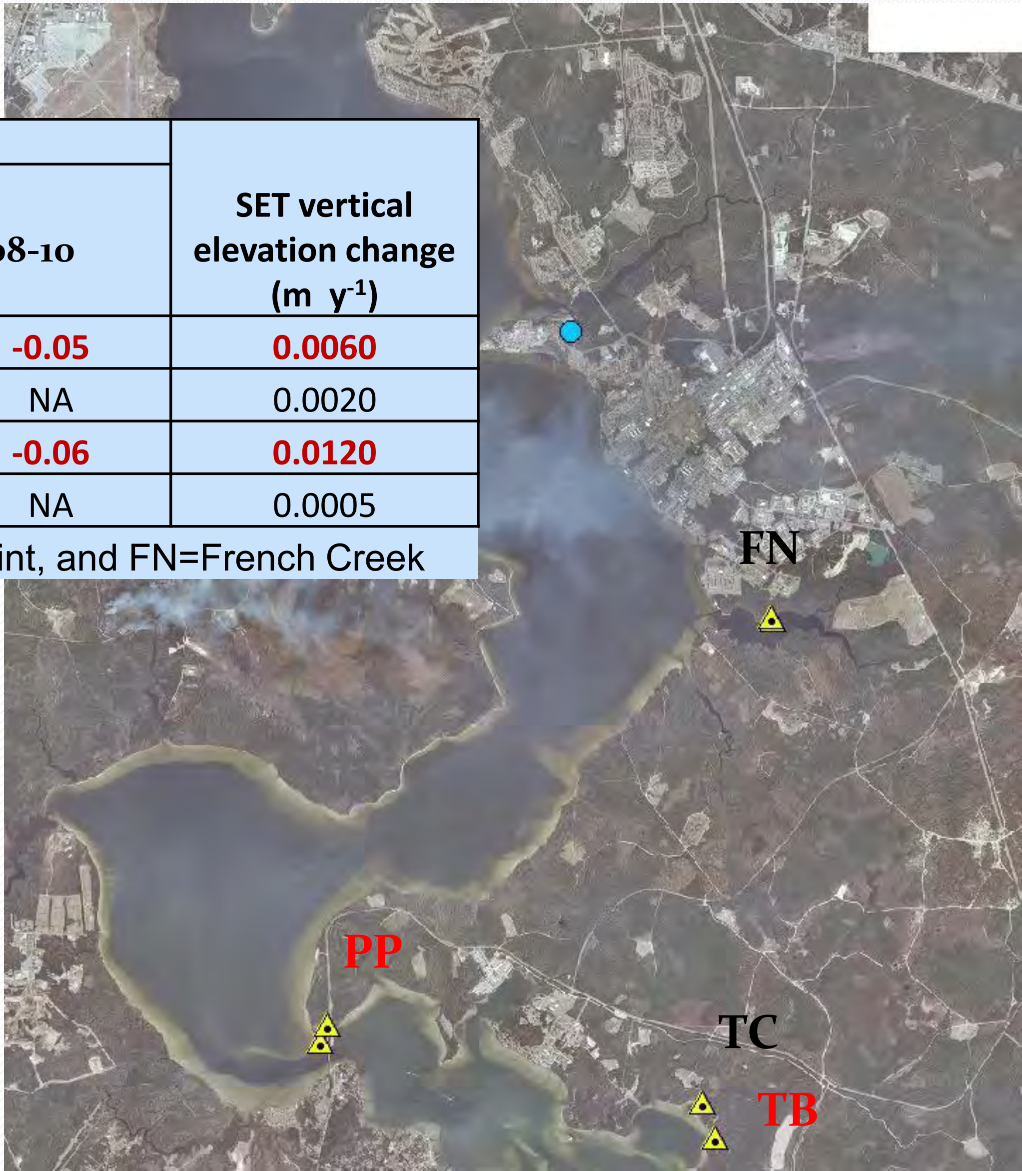
ICW marsh shoreline 40 km

Estimated astronomic tide range (m)

Marsh Edge Erosion vs Interior Surface Accretion

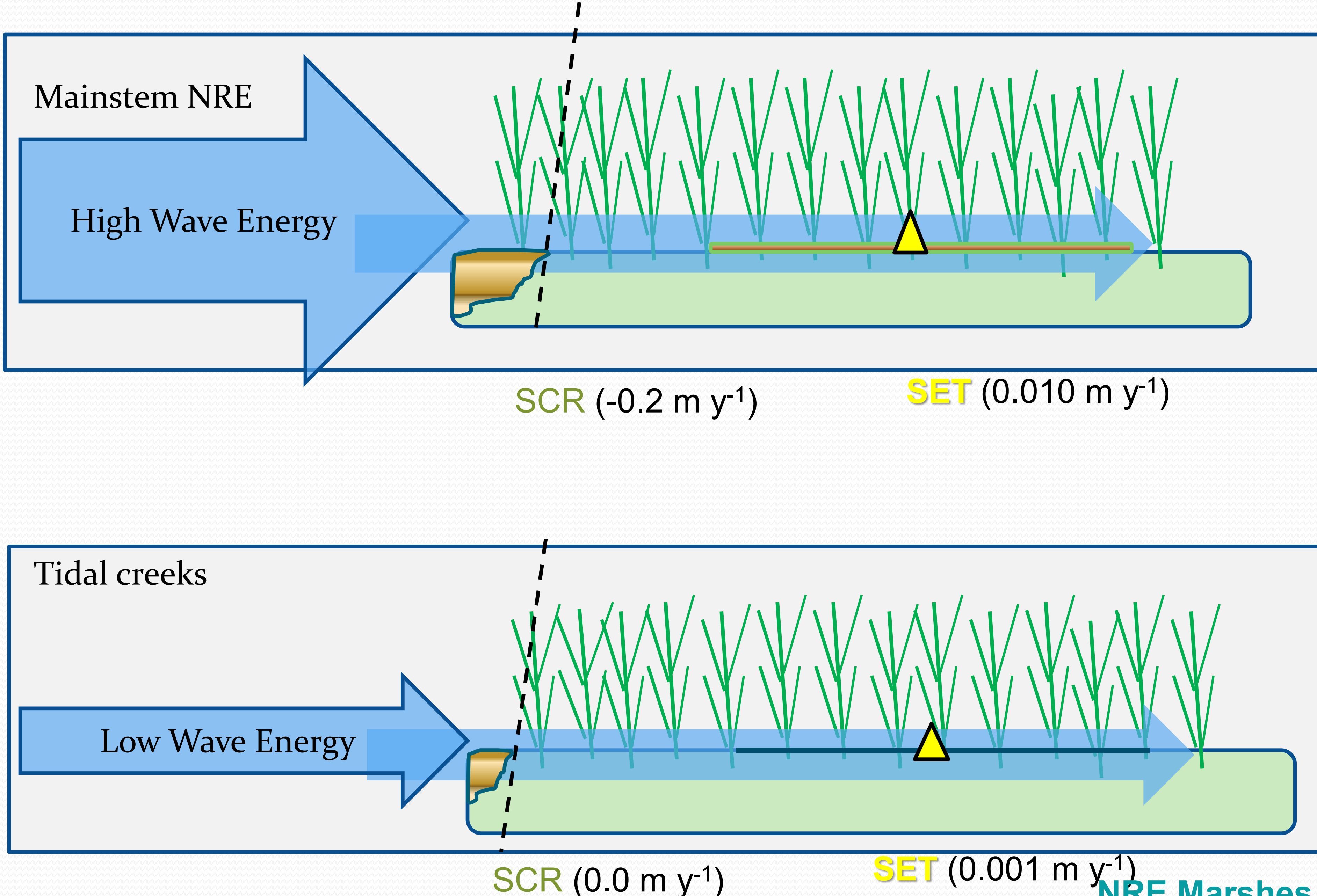
Location[1]	SET	RWE	SCR (m y^{-1}) 1956-2004	1989-2004	2008-10	SET vertical elevation change (m y^{-1})
TB	**41**	**122**	**-0.05**	**-0.18**	**-0.05**	**0.0060**
TC	42	1	0.13	0.36	NA	0.0020
PP	**43**	**264**	**-0.11**	**-0.44**	**-0.06**	**0.0120**
FN	46	3	-0.01	0.08	NA	0.0005

1 TB=Traps Bay, TC=Traps Creek, PP=Pollocks Point, and FN=French Creek



- Shoreline marshes in different wave energy settings exhibit contrasting patterns in horizontal erosion and vertical accretion

SET and DEM-calculated shoreline erosion data combine to support marsh edge model

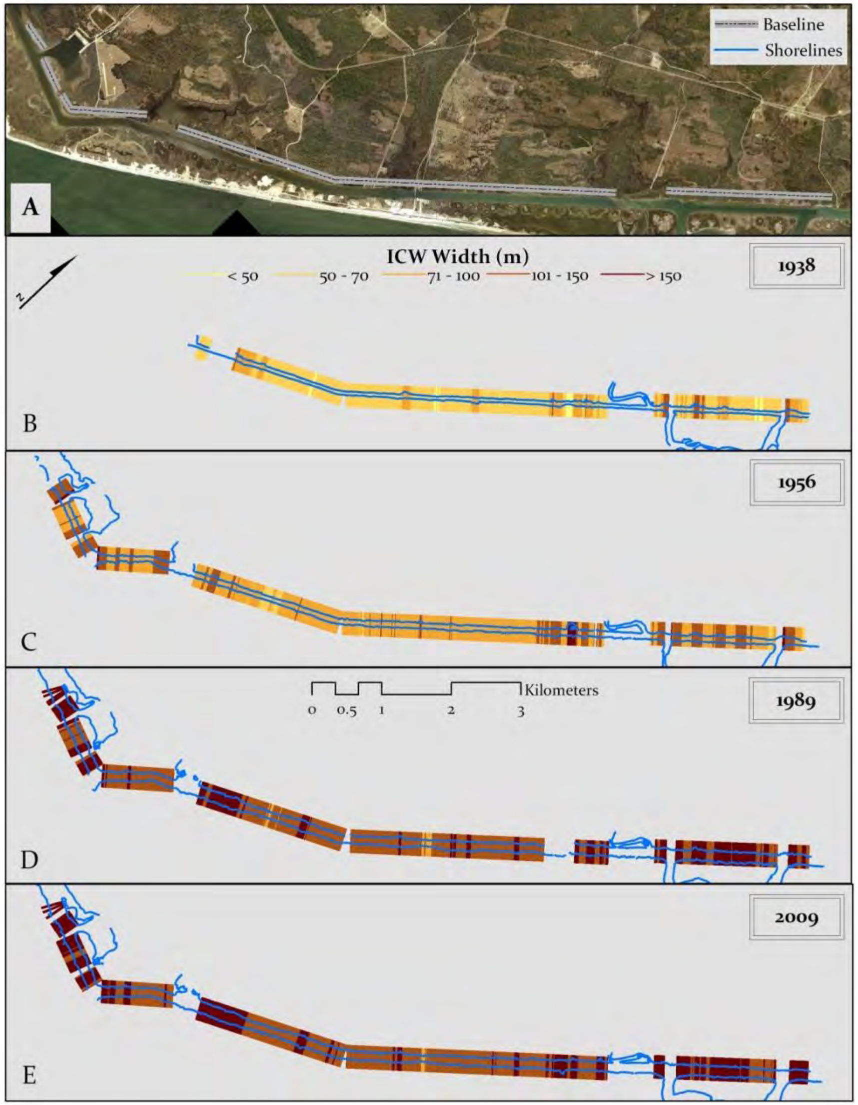


NRE Marshes

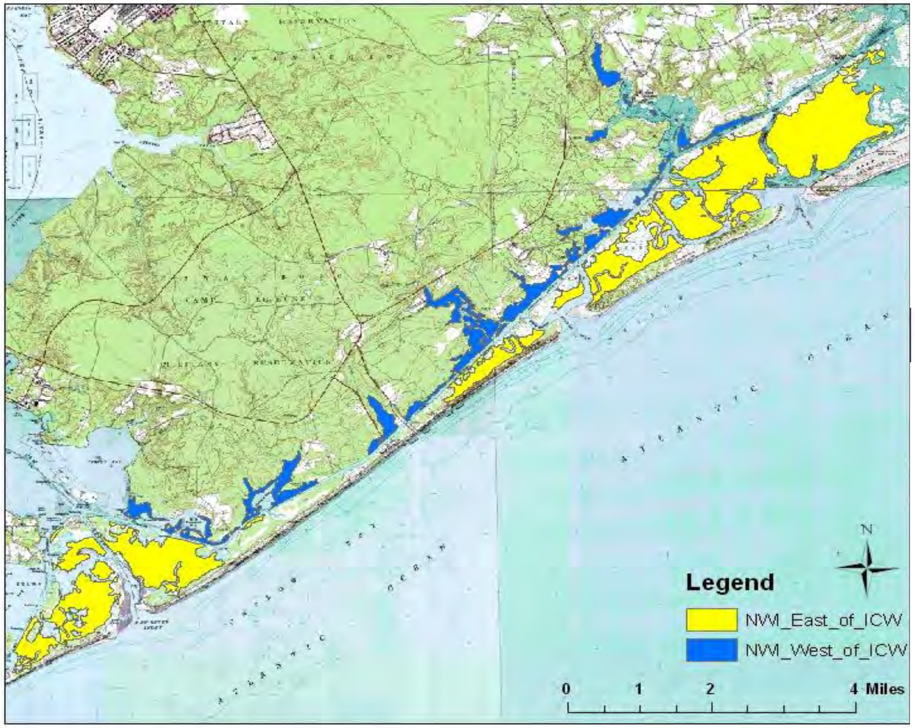
Impact of ICW on Salt marsh habitat

ICW as a Sediment Trap

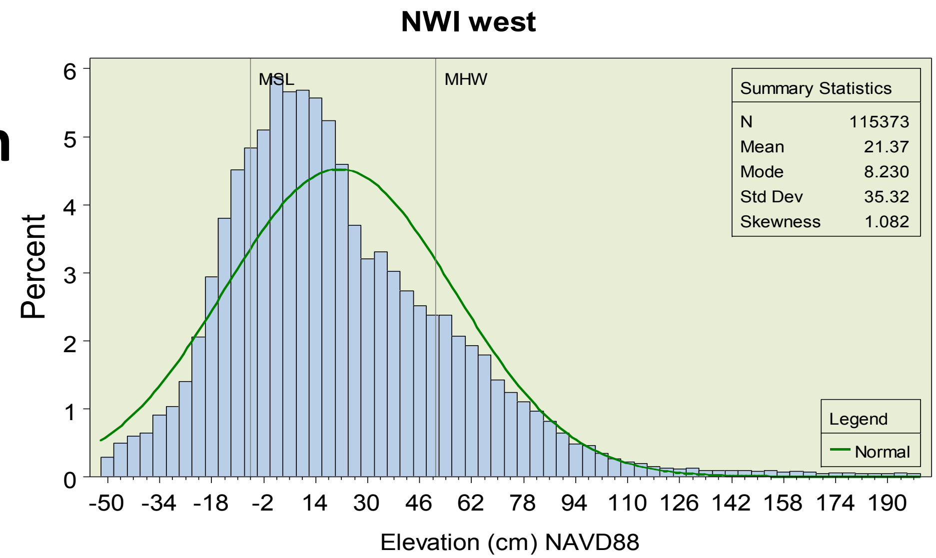
- ICW width doubled 1938-2009, from 70 m to >140 m
- Shoreline is 75% salt marsh
- Maintenance dredging using boxcut
- Initial erosion rate -0.4 m y^{-1}
- Post 1989 erosion rate -0.2 y^{-1}
- Boat wakes are source of wave energy

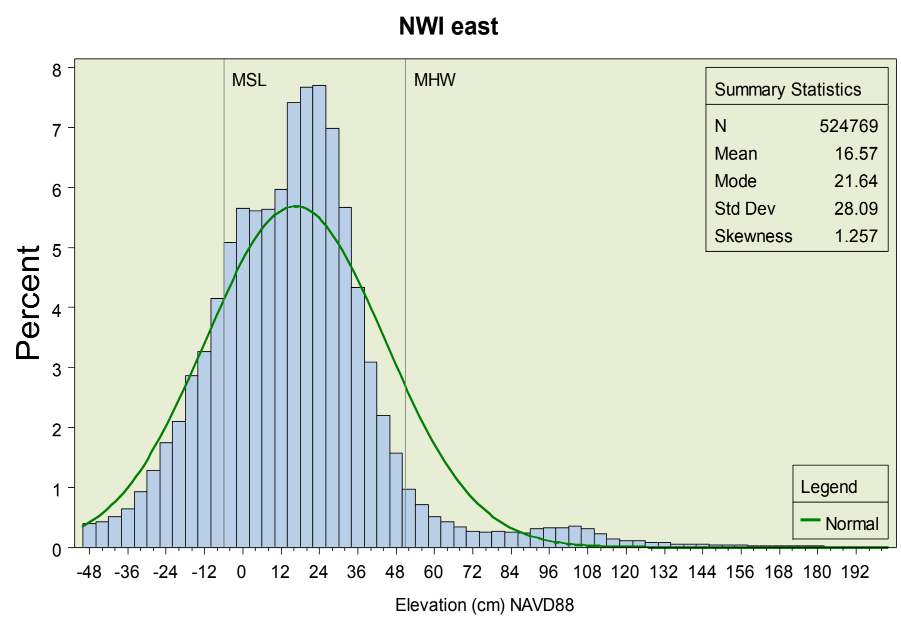


Asymmetry in ICW Marsh Elevation



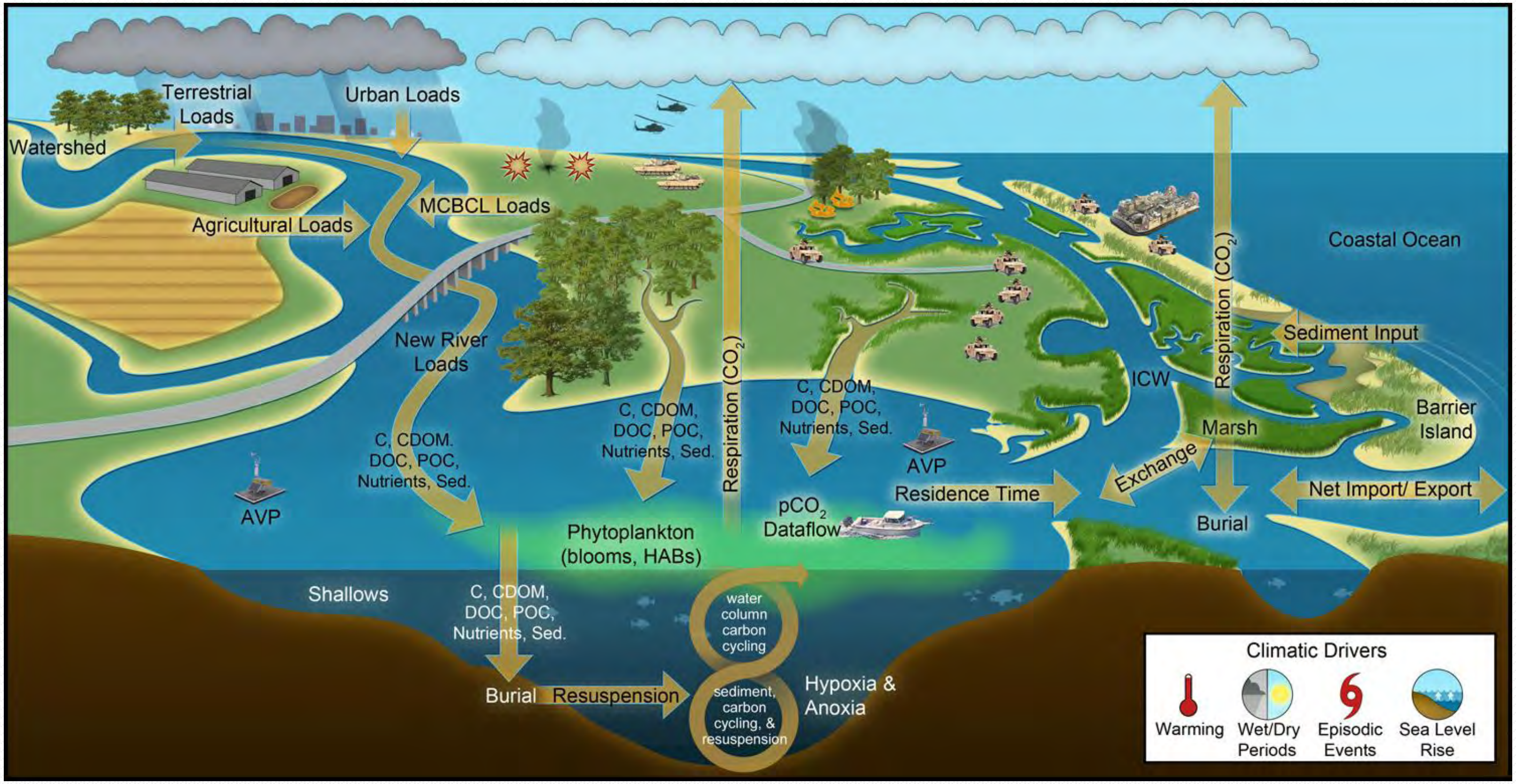
J. Morris, USC





Eastside (back-barrier) overall higher surface elevation than westside (mainland)

DCERP 2 Climate Change and the C cycle



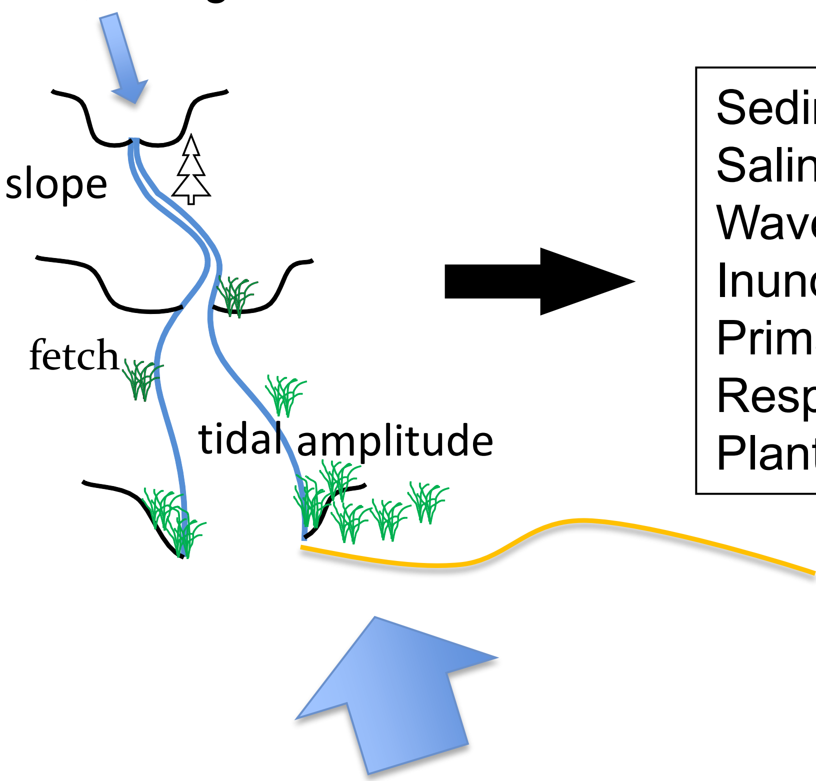
C fluxes, production and burial

Linkages between terrestrial, riverine, estuarine aquatic, wetlands and barrier island C cycles

DCERP 2

Estuarine gradient in variables controlling marsh sedimentation rate and C flux

Flood, drought



SLR, storms

Adapted from Ensign et al. In prep

Sediment flux
Salinity gradient
Wave energy
Inundation
Primary production
Respiration
Plant Spp

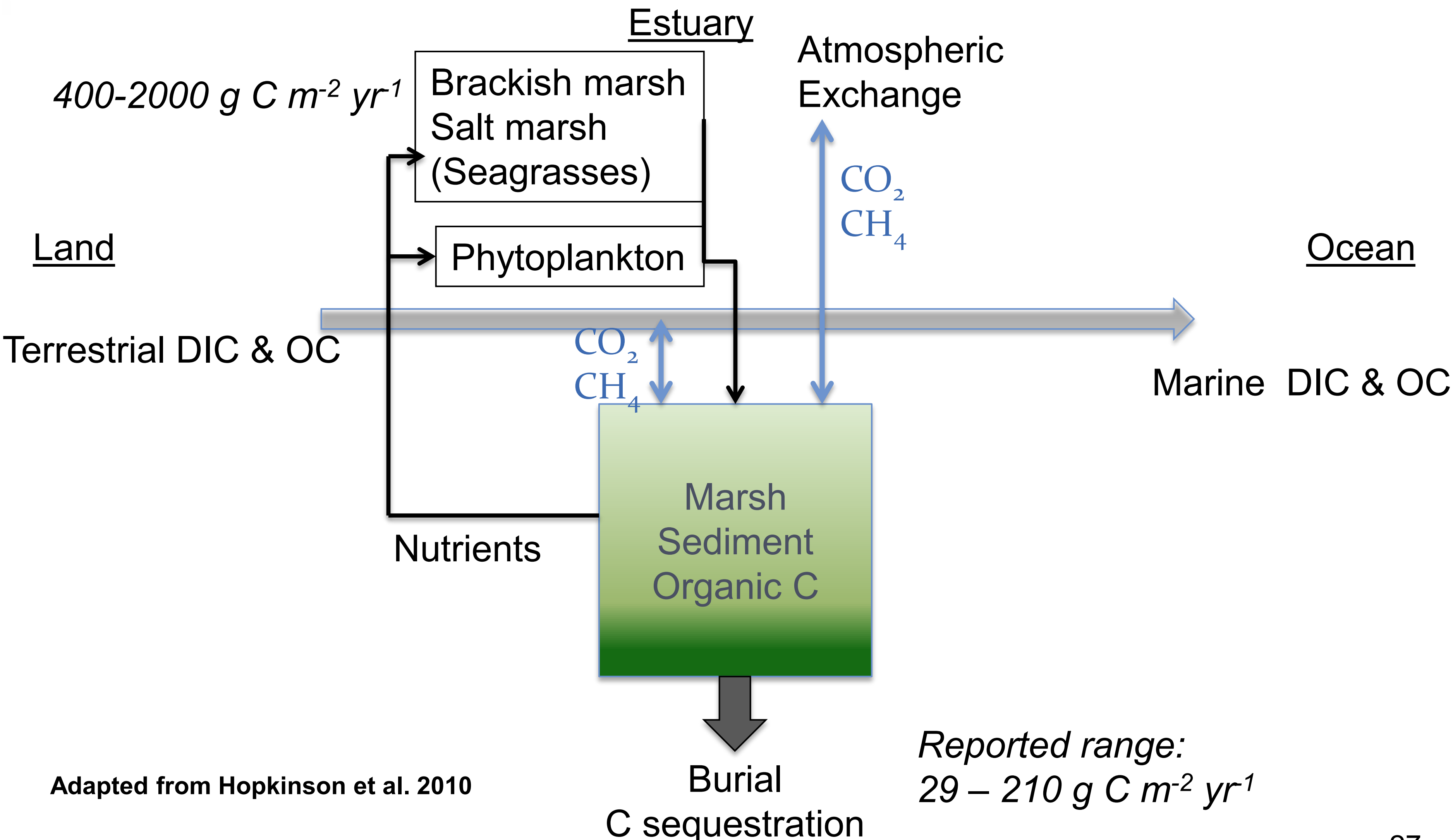
Marsh
Geomorphological
Response

Marsh
Sediment
Organic C

Burial
C sequestration

DCERP 2

Major C pools and fluxes in salt marsh systems



Adapted from Hopkinson et al. 2010

Coastal Blue Carbon

Science

Domestic Policy

International Policy

Interagency Collaboration

Interagency Working Group to meet Thursday

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