Climate Change at the Land-Sea Interface

Chuck Hopkinson
GA Sea Grant College Program and UGA Dept. of Marine Sciences

This presentation builds on work conducted at LTER and NERR sites on the east coast and an earlier presentation of M. Alber’s at an NSF-mini-symposium
The Land-Sea Interface

Difficult to study CLIMATE CHANGE without also considering equally important other aspects of global change.

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<tr>
<th>Land</th>
<th>Atmos</th>
<th>Sea</th>
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<td>Water</td>
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<td>Sediment export</td>
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Which in turn affect vulnerability of both natural and human systems at the land-sea interface.
Freshwater inflow effects

Freshwater Inflow
- Quantity
- Timing
- Quality

Estuarine Conditions
- Transit Time
- Salinity
- Sediment
- Dissolved Materials
- Particulate Materials

Estuarine Resources
- Species Distribution
- Foodweb Structure
- Primary and Secondary Production

Alber 2002
LUC - N Input to the Altamaha River Watershed

Schaefer & Alber 2007b
Land Use Effects - Altamaha River estuary

- NO₃+NO₂: 3.5x increase from 1950s to present
- PO₄: 2x increase from 1950s to present
- Chlorophyll a: 6x increase from 1950s to present

Data: 1950s: Larry Pomeroy, Present: LMER/LTER
Water Quality at Skidaway

NO₃

PO₄

DON

Chl a

Verity 2000 a,b
Waquoit Bay: N Loading and Eelgrass Loss

Costa in Valiela et al. 1992
LUC & freshwater inflow effects

Freshwater Inflow
- Quantity
- Timing
- Quality

Estuarine Conditions
- Transit Time
- Salinity
- Sediment
- Dissolved Materials
- Particulate Materials

Estuarine Resources
- Marsh : Water ratio
- Marsh elevation
- Primary and Secondary Production

Alber 2002
LUC and Sediments: erosion related to Ag Land

Potomac – top
Susquehanna – bottom
Land use change following colonial period resulted in rapid estuarine infilling and marsh creation

mid-March 1992 Color Infrared photograph

Peat Isopachs from McCormick 1969

Dark marsh regions highlight low elevation marshes that flood on every high tide and which have yet to completely infill
Relative Sea Level

LTER Ecotrends

**PIE**

\[ y = 0.0026x - 5.22 \]

\[ R^2 = 0.85 \]

**VCR**

\[ y = 0.0033x - 6.59 \]

\[ R^2 = 0.83 \]

**GCE**

\[ y = 0.0029x - 5.87 \]

\[ R^2 = 0.79 \]

**FCE**

\[ y = 0.0022x - 4.48 \]

\[ R^2 = 0.86 \]
Marsh grass response to sea level

Morris et al. 2002

Increased flooding

Mean High Water Level (cm)
140 142 144 146 148 150

Net Aboveground Primary Production (g m⁻² yr⁻²)
0 200 400 600 800 1000 1200 1400 1600

$r^2=0.47$
p<.07
slope=124 g/cm
SLR, Plant Production, and Sediment Accretion

- Sediment accretion on the marsh is a function of plant density and flood frequency & duration. Here we see that expt’ly increased plant prod leads to increased accretion.
- Note that the marsh was not able to keep up with the rapid rate of SLR prior to 2000. 0.8-1.0 cm/yr is probably about the limit in this area.

VCR marsh area increased 8.2% (1940-1991)

Kastler and Wiberg 1996
Slamm model showing effects of SLR on salinity distribution and species / habitat distribution

Mean - Max IPCC scenario:
Salt marsh: -20 - -45%
Brackish marsh: +10 - -1%
Tidal fresh: +1 - -39%%

Craft et al. 2009, EPA project
NEXT STEPS: Status, Trends, Predictions. Developing a national network to assess wetland persistence

Land use (impervious surface)

Landscape setting (geology, topography)

Ocean use (dikes, dredging)

Precipitation
Temperature
Sea Level Rise
Storm Frequency

Tidal exchange

Sediment supply/quality
Erosion

Inland forest structure

Intertidal wetland persistence

Freshwater inflow (water quality)

Plant production Decomposition

Carbon sequestration
Denitrification
Climate regulation
Wildlife habitat
Food web support
Storm protection

Search for support:
NEON
NOAA
NERR
LTER
Other?

Hopkinson, Alber, Lugo
Gradients
- sediment availability
- tidal range (0.3 – 8 m)
- precipitation (20-182 cm/yr)
- temperature (4-26 °C)
- salinity (20-90 psu)
Experiments and more
Many thanks to those who have provided data and slides for this presentation.
Questions?

Helpful Input From:
PIE: Anne Giblin, Jim Morris, Chuck Hopkinson
VCR: Karen McGlathery, Linda Blum, Bob Christian, Mark Brinson, Jose Fuentes
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North Inlet NERR: Jim Morris
Waquoit NERR: Ivan Valiela
Skidaway/Wilmington River: Peter Verity