Impacts of Seagrass Dynamics on the Coupled Long-Term Evolution of Barrier-Marsh-Bay Systems

Ian Reeves, Laura Moore (UNC Chapel Hill) Evan Goldstein (UNC Greensboro) Brad Murray (Duke) Joel Carr (USGS) Matt Kirwan (VIMS)







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Barriers & Marshes are Naturally Resilient...



Overwash maintains barrier elevation relative to SL

Feedbacks couple rate of marsh vertical accretion with RSLR

...But Can Drown & Collapse



Overwash maintains barrier elevation relative to SL

Feedbacks couple rate of marsh vertical accretion with RSLR

Coupled Dynamics of Barriers & Marsh

Back-barrier marshes affect barrier islands

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Barrier islands affect back-barrier marshes











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Bay









What are the long-term impacts of seagrass dynamics on the coupled evolution of barrier-marsh-bay systems?





A New Data-Driven Model: GEOMBEST++Seagrass



Bay depth & distance from marsh determine habitat

Presence, size, and shoot density of meadow alters:

- Wave height

- Equilibrium depth

Model Evolution

Bay sediment flux (BSF): volume of sediment imported into the back-barrier bay

Export Flux: percentage of suspended sediment exported from the back-barrier bay

t = 100 yr











Seagrass enhances marsh progradation



1. Seagrass Impacts Marsh Width

Meadow redistribution or sequestration of sediment





1. Seagrass Impacts Marsh Width

Shallower equilibrium depth



1. Seagrass Impacts Marsh Width

When export flux = 0...

Mechanism	Effect
Less marsh volume eroded	Decrease lateral erosion
Meadow sequestration of sediment	Increase lateral erosion
Shallower equilibrium depth	Increase lateral erosion



2. Seagrass as Source and Sink



3. Seagrass Effects on Barrier Migration



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Key Findings

1). Seagrass is generally beneficial for adjacent marsh, but may enhance marsh erosion when back-barrier sediment export is negligible

2). Expanding (contracting) seagrass meadows operate as dynamic sinks (sources) of sediment that impact adjacent marsh evolution

3). Seagrass reduces island migration rates in the absence of marsh by filling bay accommodation space

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1. Seagrass & Marsh Width

Shallower equilibrium depth



1. Seagrass & Marsh Width

Mechanism	Lateral Erosion	Progradation
Less marsh volume eroded	Decrease	Increase
Meadow sequestration of sediment	Increase	Increase
Shallower equilibrium depth	Increase	Increase

Back-barrier Evolution

- 1. SL rises & overwash distributed in back-barrier
- 2. Bay sediment flux (BSF) distributed evenly across bay
- 3. Seagrass grows at suitable depths (or dies if too deep)
- 4. Bay bottom erodes/accretes to equilibrium depth
- 5. Marsh edge erodes
- 6. Fixed percentage of suspended sediment is exported from bay
- 7. Remaining sediment deposited on marsh platform and at marsh edge

t = 100 yr

