Modeling Sea-Level Rise in Coastal Wetlands: Understanding Potential Impacts and Their Implications for Management on Cape Cod
Four scenarios with estimates of SLR by 2100

Project Objectives

Understand potential for coastal wetland **habitat conversion/loss** under multiple scenarios of SLR

Identify and assess opportunities for and barriers to **marsh migration**

Engage stakeholders to better incorporate wetlands into **adaptation strategies** and planning efforts
Resilient Habitat: Tidal marsh advances landward as sea level rises.
Four scenarios with estimates of SLR by 2100

*United States National Climate Assessment (Parris et al. 2012), adjusted for local subsidence*

<table>
<thead>
<tr>
<th>Projected Scenario</th>
<th>Total Sea Level Rise (Boston)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td>0.249 m (0.82 feet)</td>
</tr>
<tr>
<td>Intermediate Low</td>
<td>0.706 m (2.32 feet)</td>
</tr>
<tr>
<td>Intermediate High</td>
<td>1.385 m (4.54 feet)</td>
</tr>
<tr>
<td>Highest</td>
<td>2.164 m (7.10 feet)</td>
</tr>
</tbody>
</table>

**Project Timescale**

- 2011
- 2030
- 2050
- 2070
- 2100

**Models used:**

- Sea-Level Affecting Marshes Model (SLAMM)
- Marsh Equilibrium Model (MEM)*
Cape Cod
SLAMM Project Panels
Cape Cod
SLAMM Project Panels
Average annual change in area by decade* from 2011-2100 for Cape Cod project panels.

**Macrotidal areas***

**Microtidal areas***

**Time Period (Decade) for Select SLAMM Classes**

- Dry Land
- Open Ocean
- Estuarine Open Water
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Transitional Marsh
Potential Salt Marsh Trends from 2011-2100
Cape Cod | Intermediate High SLR Scenario

• > 3500 ha increase in reg-flooded marsh (low marsh zone), 225% ↑

• > 5500 ha decrease in irreg-flooded marsh (high marsh zone), 87% ↓

• Total loss of approximately 2000 ha of salt marsh, 25% ↓

• Marshes draining to Vineyard and Nantucket Sounds are potentially more susceptible to loss from SLR than those draining to Cape Cod Bay (i.e., tidal range sensitivity).
Potential Upland Marsh Migration w/in 100 ft Buffer

South Shore | 2030-2100
Intermediate High SLR Scenario

D R A F T

North River, Marshfield
Land Use / Land Cover Distribution of Potential Migration Areas

SLR Scenarios:
- Low: 103 ha
- Int Low: 177 ha
- Int High: 425 ha
- High: 772 ha

Legend:
- Forest
- Agricultural
- Golf Course
- Residential
- Other*

DRAFT
Marsh Migration Potential

*For illustrative purposes only

Lidar DEM

- 12 m
- 5 m
- 2 m

Marsh-Upland Border

--- 2011
--- 2100
Marsh Migration Potential
*For illustrative purposes only

Select SLAMM Classes
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Tidal Flat
Cape Cod
SLAMM Project Panels

Chase Garden Creek
Chase Garden Creek

Dennis

Intermediate High SLR
Static accretion

Select SLAMM Classes

- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

Impervious Surface

2011
Chase Garden Creek
Dennis
Intermediate High SLR
Static accretion

Impervious Surface

Select SLAMM Classes
- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

2030
Chase Garden Creek
Dennis
Intermediate High SLR
Static accretion

Select SLAMM Classes

- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

Impervious Surface

2050

D R A F T
Chase Garden Creek

Dennis

Intermediate High SLR
Static accretion

Select SLAMM Classes

- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
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Impervious Surface

2070
Chase Garden Creek
Dennis
Intermediate High SLR
Static accretion

Select SLAMM Classes
- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh
Marsh Migration Potential
Intermediate High SLR
Static accretion

Select SLAMM Classes
- Impervious Surface
- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

Marsh-Upland Border
- 2011
- 2100
Select SLAMM Classes

- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

Marsh-Upland Border

- ~ 2011
- ~ 2100
Marsh Migration Potential
Intermediate High SLR
Static accretion

Lidar DEM
- 10 m
- 5 m
- 0.5 m

Marsh-Upland Border
- 2011
- 2100

Impervious Surface
Cape Cod
SLAMM Project Panels

Nauset Marsh
Select SLAMM Classes

- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

Nauset Marsh
Eastham
Intermediate High SLR
Static accretion
Nauset Marsh
Eastham
Intermediate High SLR
Static accretion

Select SLAMM Classes
- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh

Impervious Surface

2030
Nauset Marsh
Eastham
Intermediate High SLR
Static accretion

Select SLAMM Classes

- Upland
- Tidal Swamp
- Trans. Marsh/Scrub-Shrub
- Regularly-Flooded Marsh
- Irregularly-Flooded Marsh
- Non-tidal Swamp
- Inland Fresh Marsh
Nauset Marsh
Eastham
Intermediate High SLR
Static accretion

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- Non-tidal Swamp
- Inland Fresh Marsh

Impervious Surface

2070

DRAFT
Select SLAMM Classes

- Upland
- Tidal Swamp
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- Regularly-Flooded Marsh
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- Non-tidal Swamp
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Nauset Marsh
Eastham
Intermediate High SLR
Static accretion

Impervious Surface

2100
Potential Wetland Distribution by 2100 Under Four SLR Scenarios
Parkers River, Yarmouth

Low ~ 0.8 ft
Int Low ~ 2.3 ft
Int High ~ 4.5 ft
High ~ 7.1 ft
Anticipated Outcomes

• Outreach & Education
• Policy
• Land Conservation & Management
• Restoration
• Species Conservation
• Blue Carbon Accounting
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Photo: Delaware DNREC
Anticipated Outcomes

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Illustration: Mass Audubon
Photo: David Johnson
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Illustration:
The Blue Carbon Initiative’s Coastal Blue Carbon
Next Steps

• Project website
  – Final SLAMM report
  – Overview and highlights
  – Additional data analyses and summaries
• Esri Story Map and MORIS web tools
• Stakeholder meetings
• Long-term monitoring projects
  – Remote sensing and field-based
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- MassDEP
- Woods Hole Group

Data Contributors
- MBL/PIE LTER
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- MassDOT
- MA DER
- Waquoit Bay NERR
- NOAA (CO-OPS)
- Woods Hole Group
- University of South Carolina – Jim Morris

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James Morris, University of South Carolina – MEM 5.4.1

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