Tidal Wetland Restoration: accommodating future sea-level rise in salt marsh restoration projects

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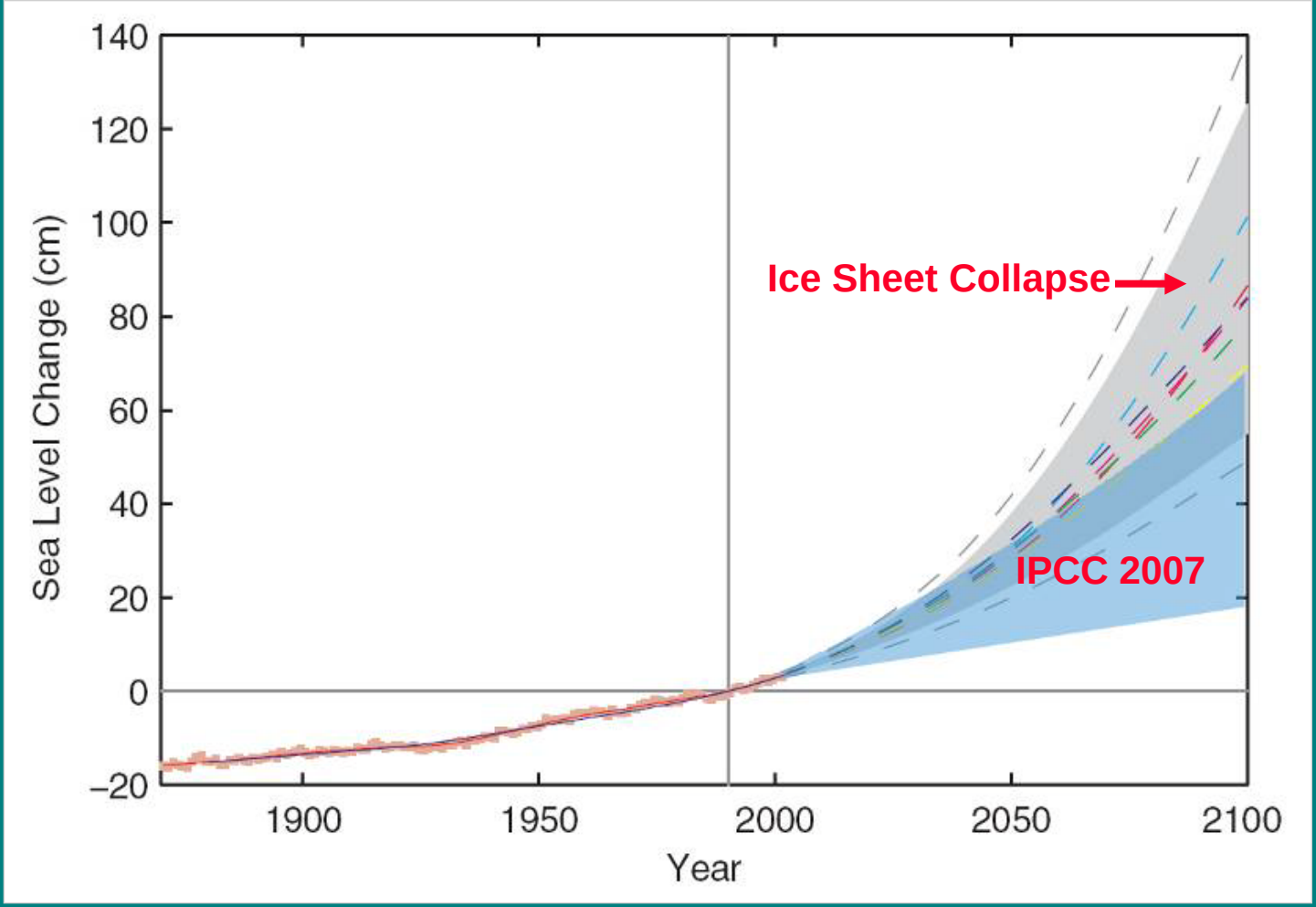
Sea-Level Rise and Salt Marsh Restoration Workshop, NOAA Restoration Center, Gloucester, MA, September 14, 2010

Why restore coastal wetlands if sea level is going to rise and inundate the coasts?



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Implicit Assumptions in this Question

- Both restored and natural wetlands will not keep pace with future sea-level rise
- Wetlands will require repeated, frequent restoration
- Sea-level rise is the only climate-related driver we need be concerned with

Assessing wetland vulnerability to sea-level rise: 4-step process

- Elevation Capital (your starting point)
- Elevation Trends (compare to RSLR)
- Processes Controlling Elevation Trends
- Forecast Future Vulnerability (models)

Cahoon & Guntenspergen 2010

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Assessing wetland vulnerability to sea-level rise:

STEP #1: GEOSPATIAL FRAMEWORK:

Determine the elevation of your marsh relative to local sea level.

Tie marsh elevation and sea level to common datum

Starting Point or Elevation Capital:
Is your marsh located high or low within its growth range?

1. Growth Range ~ Tidal Range
2. Elevation Capital

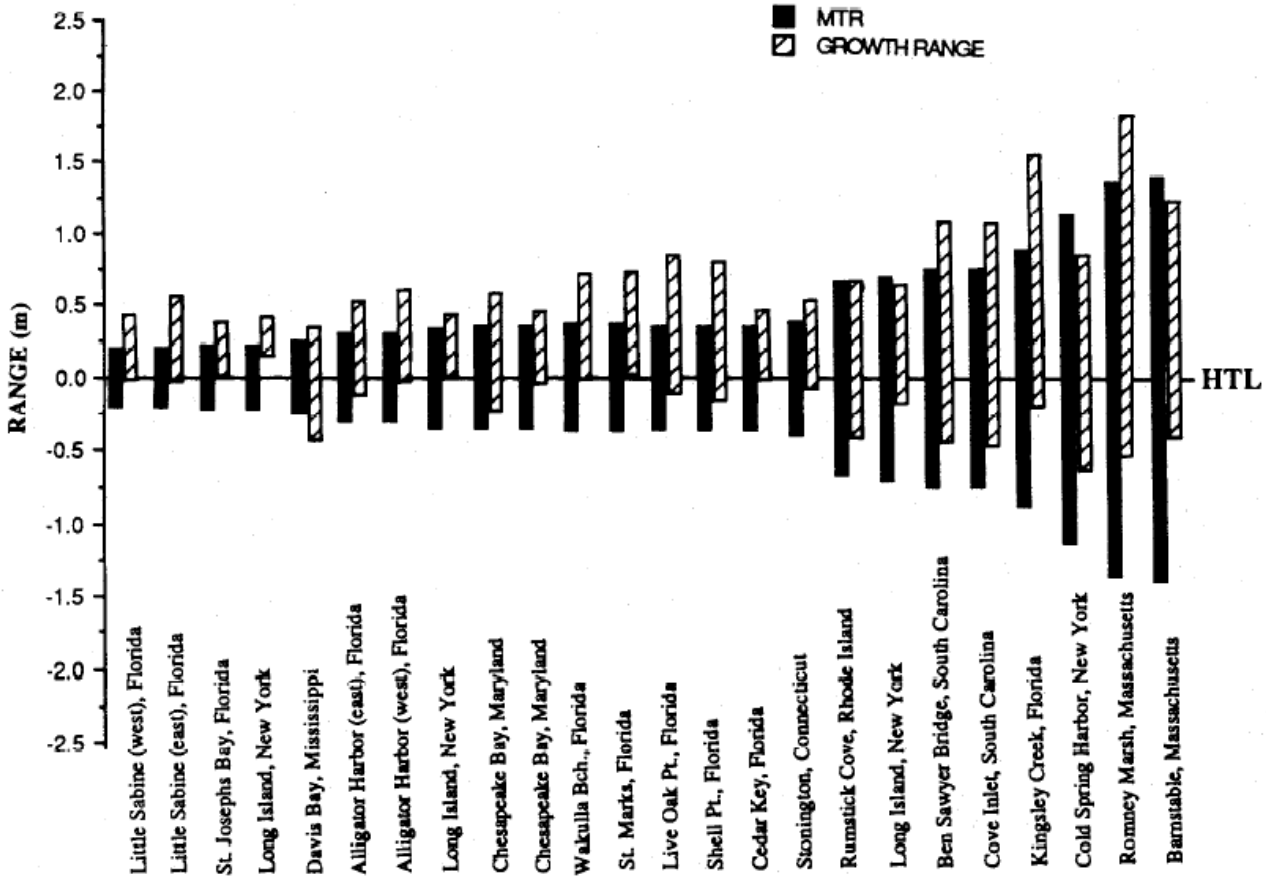

Fig. 2. The elevational range of growth of *Spartina alterniflora* relative to mean tide range (MTR) at selected locations along the Atlantic and Gulf coasts (arranged in order of increasing tidal amplitude). The half tide level (HTL) is the plane midway between mean high water (MHW) and mean low water (MLW).

McKee, K. L. & W. H. Patrick, Jr. 1988. The relationship of smooth cordgrass (Spartina alterniflora) to tidal datums: a review. Estuaries 11:143-151

Elevation Capital

How much does your marsh have?

If the marsh needs restoring, the expectation is that the elevation capital is depleted.

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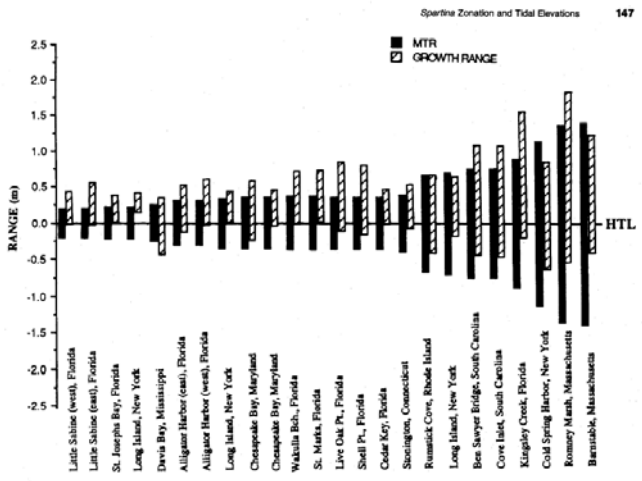
Restoration of Wetland Elevation

Sediment Addition: Raise the elevation within the growth range thereby increasing the elevation capital

Sediment Removal: establish the elevation near the upper end of the growth range thereby maximizing elevation capital

Restoration of Wetland Elevation

Maximizing elevation capital can restore/enhance ecosystem services for many decades



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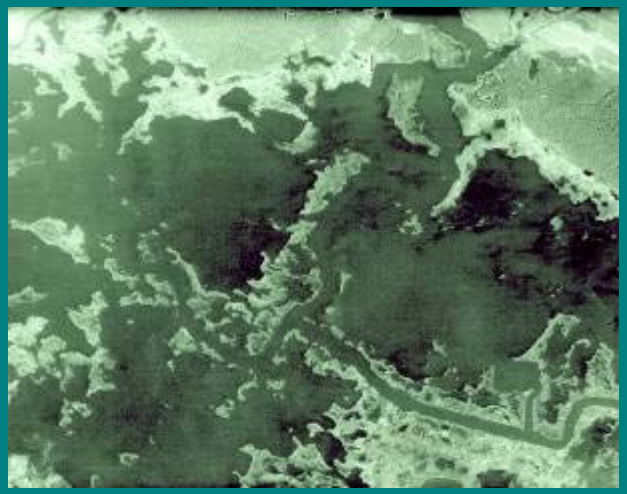
How long does it take for a microtidal marsh to become submerged and convert to open water?

1938



1974

1989

MARSH LOSS AT BLACKWATER NATIONAL WILDLIFE REFUGE

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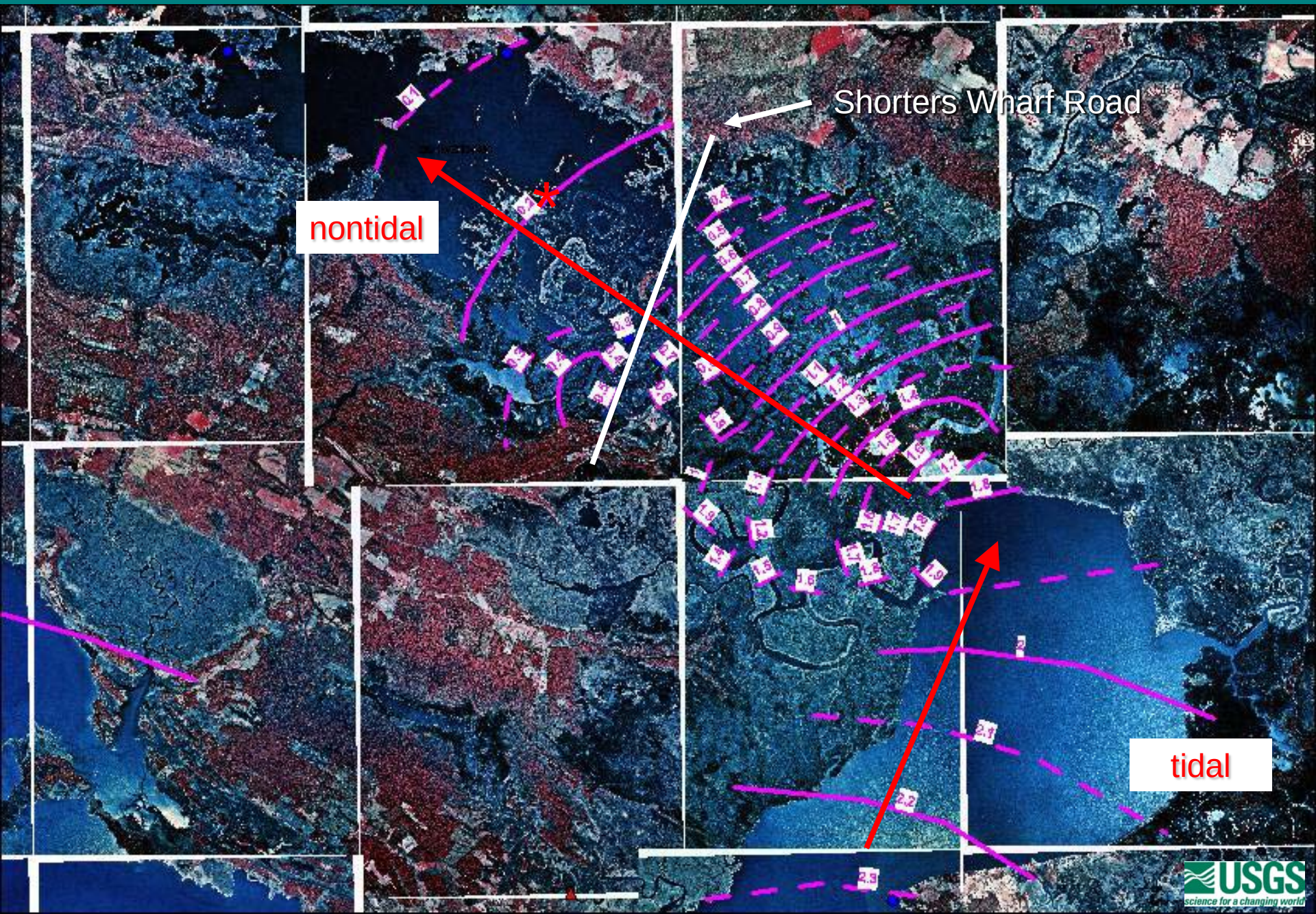
Knowing your marsh elevation is essential for successful marsh restoration

Variations in Range of Tide (Mean Range of Tide in feet, NOAA)



August 2003

Big Egg: Jet-Spray Restoration Site

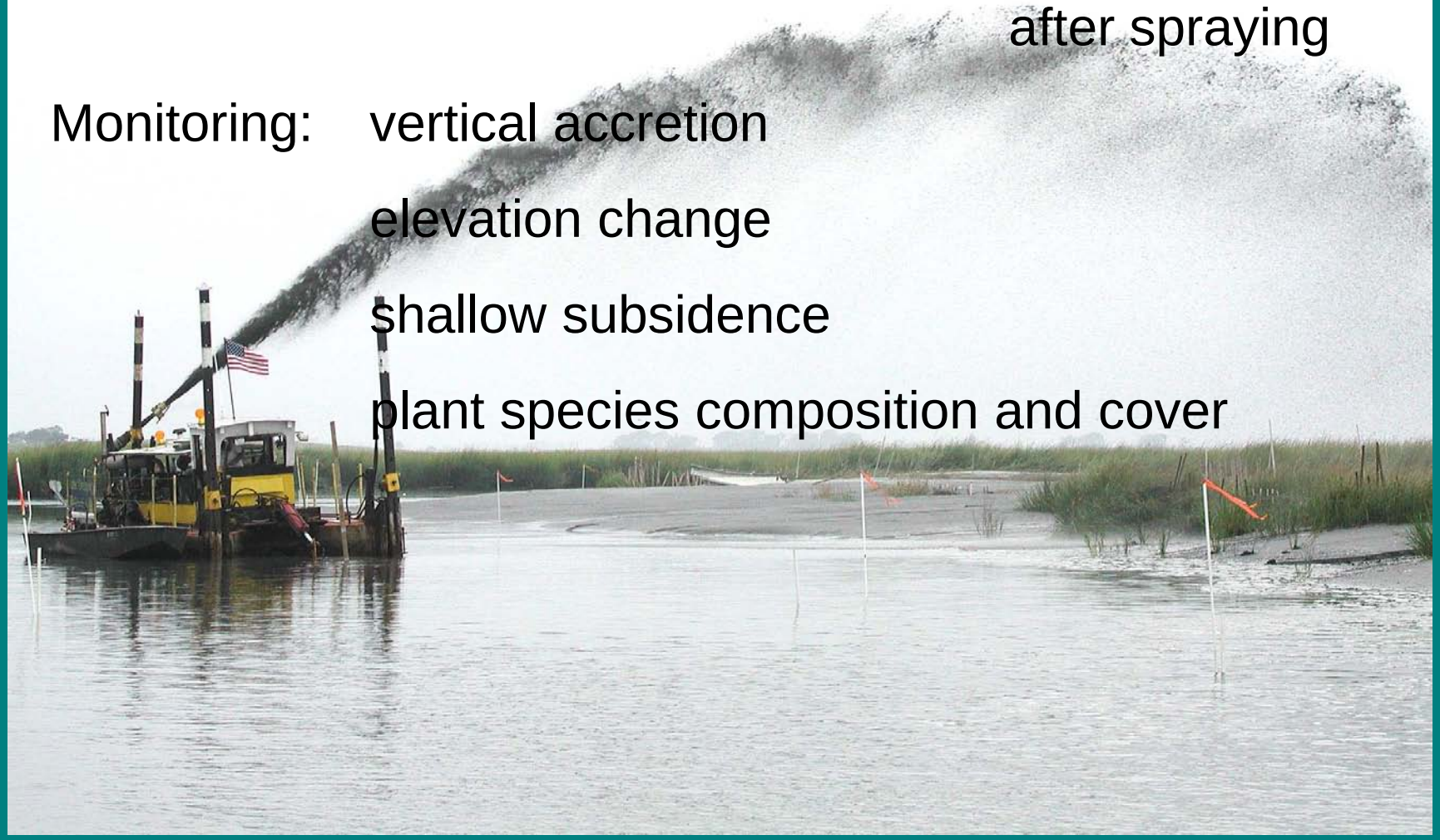
Sampling in spray and control marsh mudflats, before and after spraying

Monitoring: vertical accretion

elevation change

shallow subsidence

plant species composition and cover



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Relative Sea-Level Rise

Tide Gauge	Rate	Record Length
The Battery, NYC	2.73 mm y^{-1}	140 years
Sandy Hook, NJ	3.85 mm y^{-1}	64 years

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Patterns of Vegetation Loss on Marsh Islands

- Interior Marsh Breakup
- Erosion of Margins of Islands

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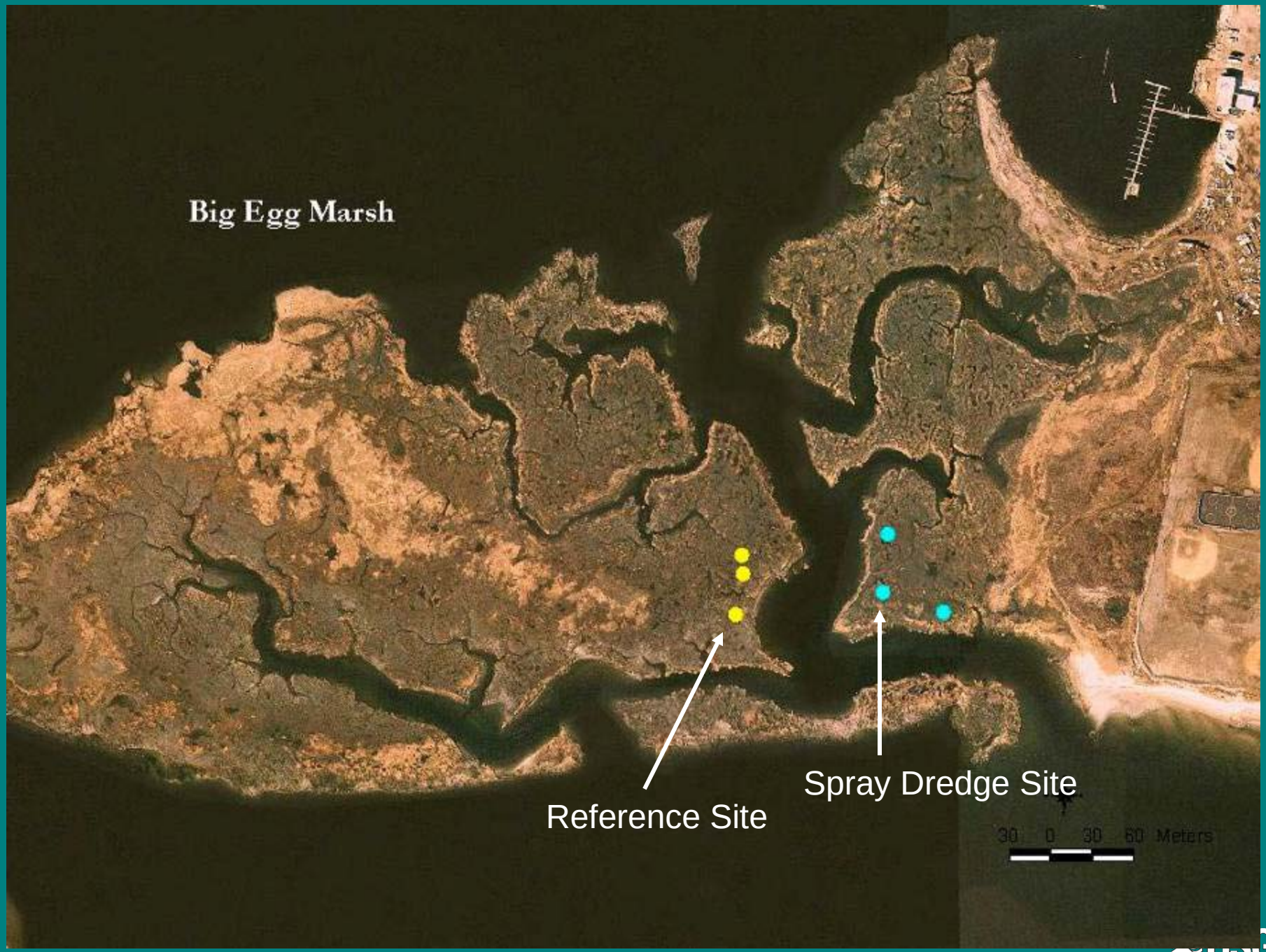

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Big Egg Marsh: Restoration Project

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Elevation and Accretion Measurements

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Elevation and Accretion Measurements

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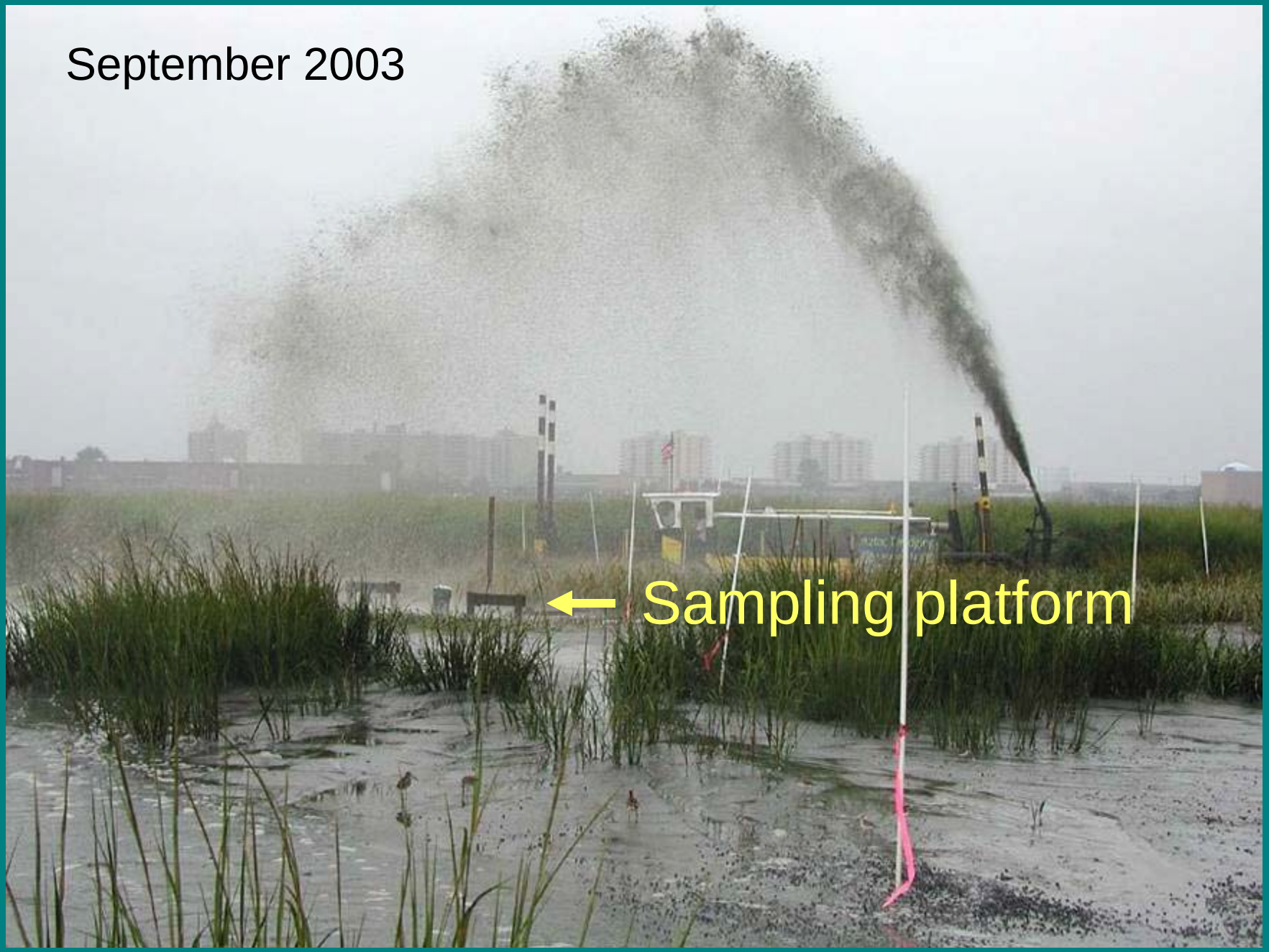

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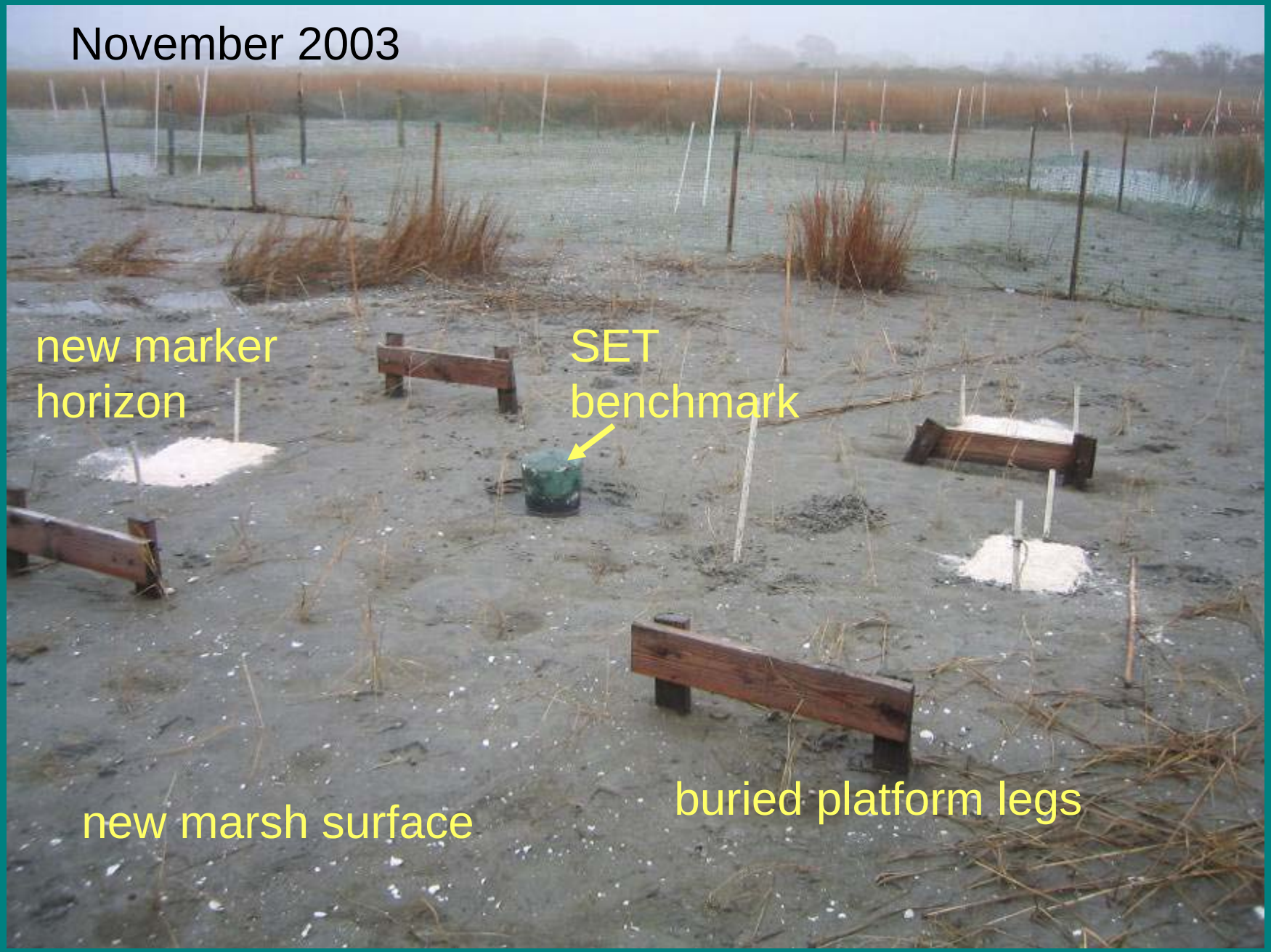

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Big Egg Spray Marsh – 30 Aug 2005

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Big Egg Spray Marsh – Aug 22, 2007

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Big Egg Restoration, 2007

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Implicit Assumption #1:

Both restored and natural wetlands will not keep pace with future sea-level rise

For worst case s-l-r scenario: probably true

Otherwise: depends (rate, setting, elevation capital, climate change)

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Implicit Assumption #2:
Wetlands will require repeated, frequent restoration

For worst case s-l-r scenario: definitely true

Otherwise: depends (rate, setting, elevation capital, climate change)

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Implicit Assumption #3:
Sea-level rise is the only climate-related driver we need be concerned with

Definitely false.

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To improve our understanding of wetland survival as sea level rise accelerates, we need improved knowledge on:

- Mineral vs. organic matter accumulation in maintaining wetland elevation
- How wetland elevation dynamics vary among geomorphic settings and regions
- Interaction between climate drivers and accretionary processes
- How this interaction changes as climate changes

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Got Elevation?

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