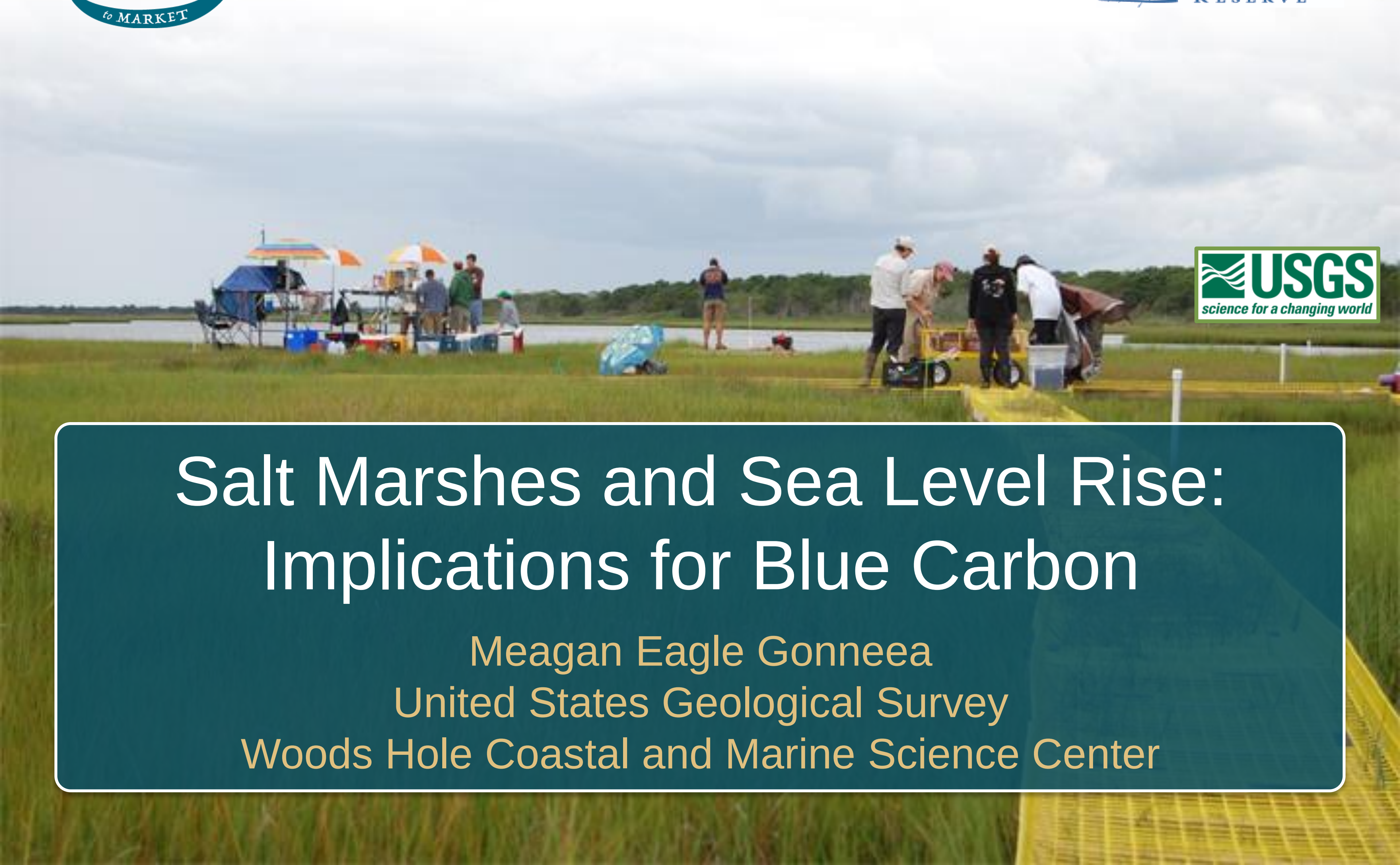
Capitalizing on **Coastal Blue Carbon**

The Conference Center at Massasoit Community College | *May 12-13, 2015*



Salt Marshes and Sea Level Rise: Implications for Blue Carbon

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Salt marshes are resilient ecosystems.

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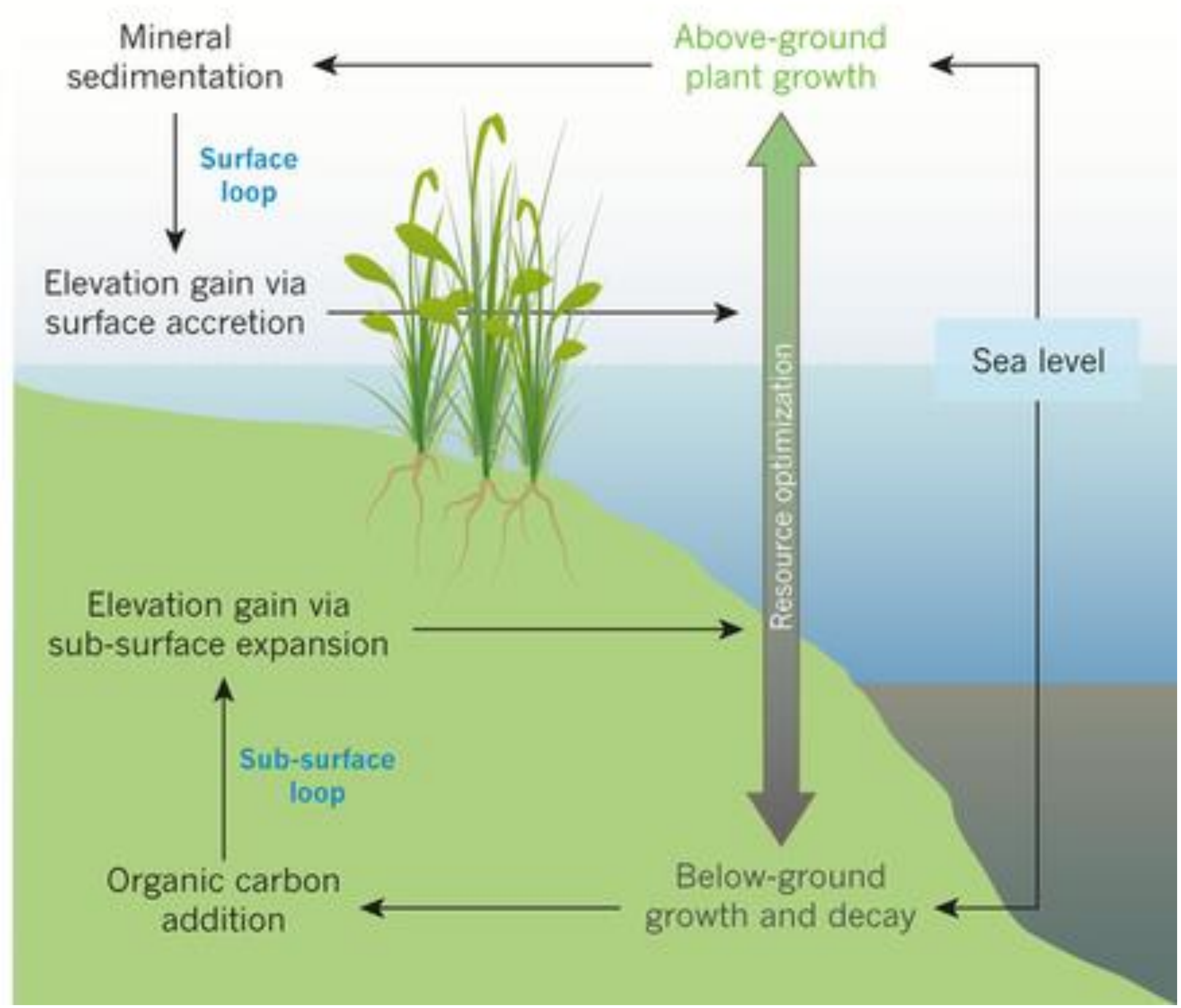
- Sea level rise
- Storms
- Temperature increase
- Nutrient loading
- Land use conversion
- Tidal restriction

Salt marsh growth involves complex biological and physical interactions.



Kirwan & Megonigal, 2013

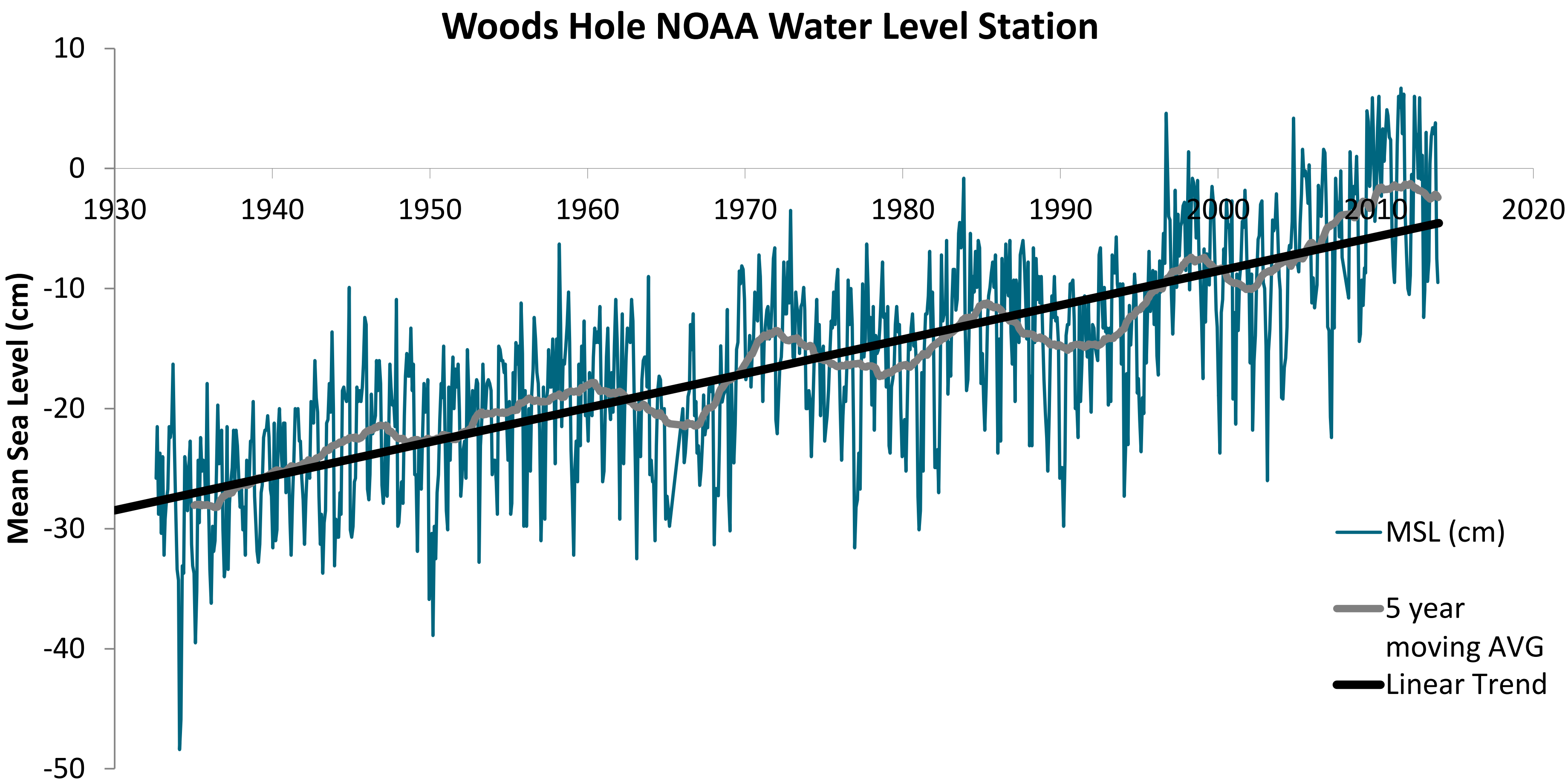
Marsh growth

- Production above (leaves) and below ground (roots)
- Mineral sediment deposition

Marsh decay and loss

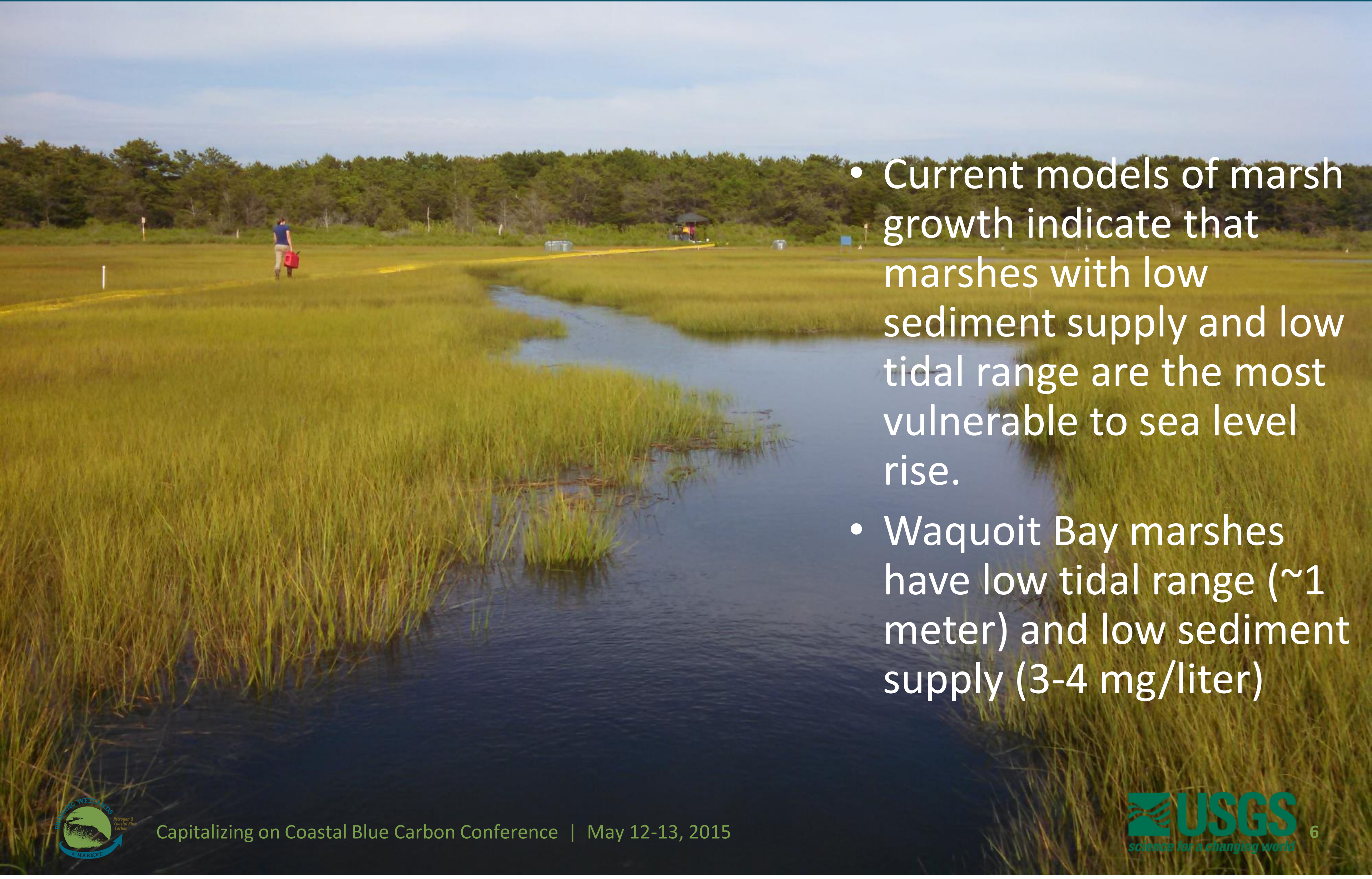
- Decomposition
- Erosion

New England sea level rise is rapid—2.8 mm per year since 1932.



Data available at: tidesandcurrents.noaa.gov, station ID 8447930

How are these salt marshes responding to sea level rise?



- Current models of marsh growth indicate that marshes with low sediment supply and low tidal range are the most vulnerable to sea level rise.
- Waquoit Bay marshes have low tidal range (~1 meter) and low sediment supply (3-4 mg/liter)

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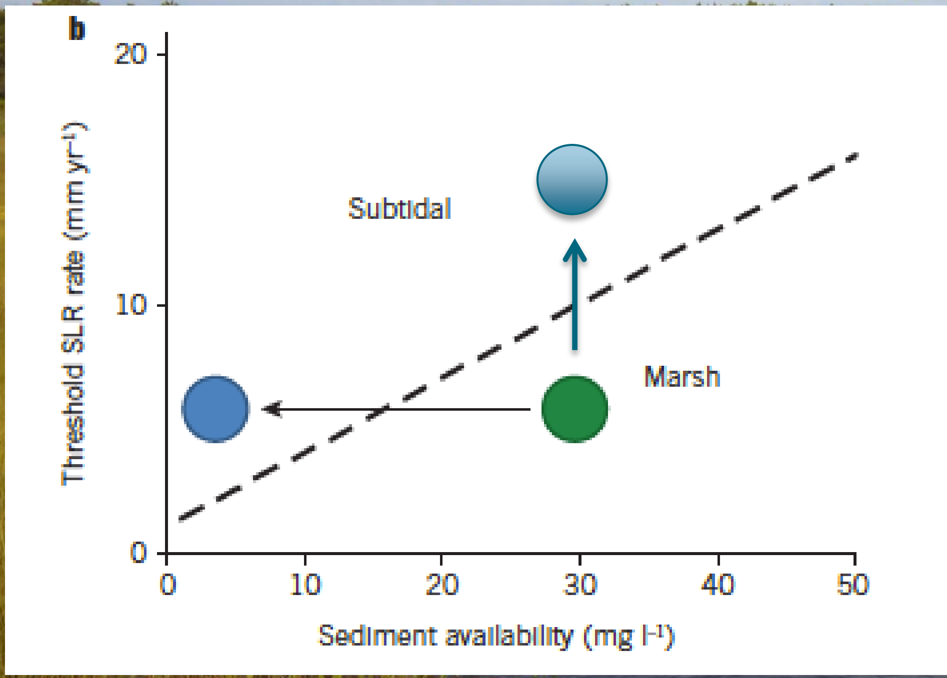

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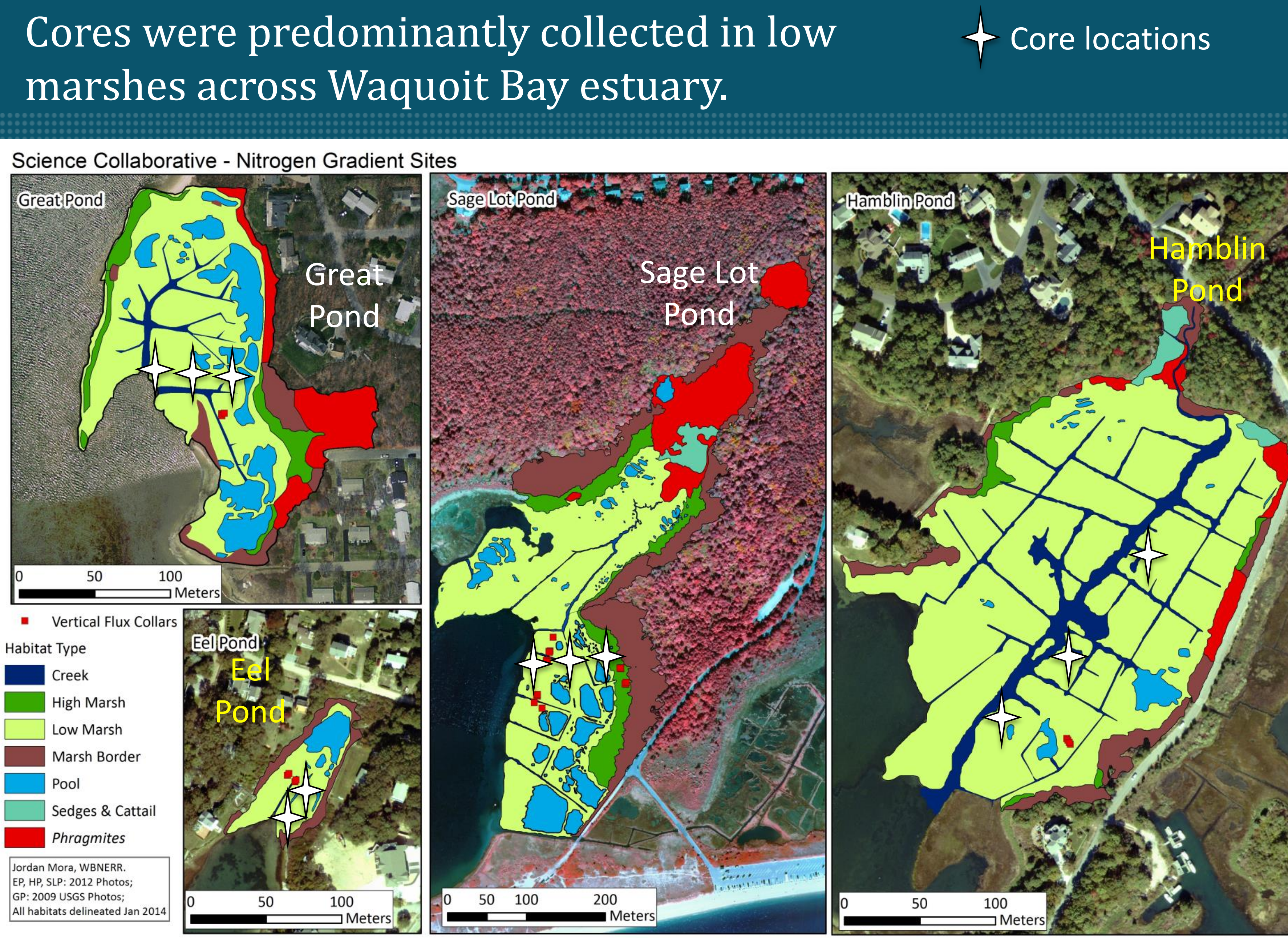
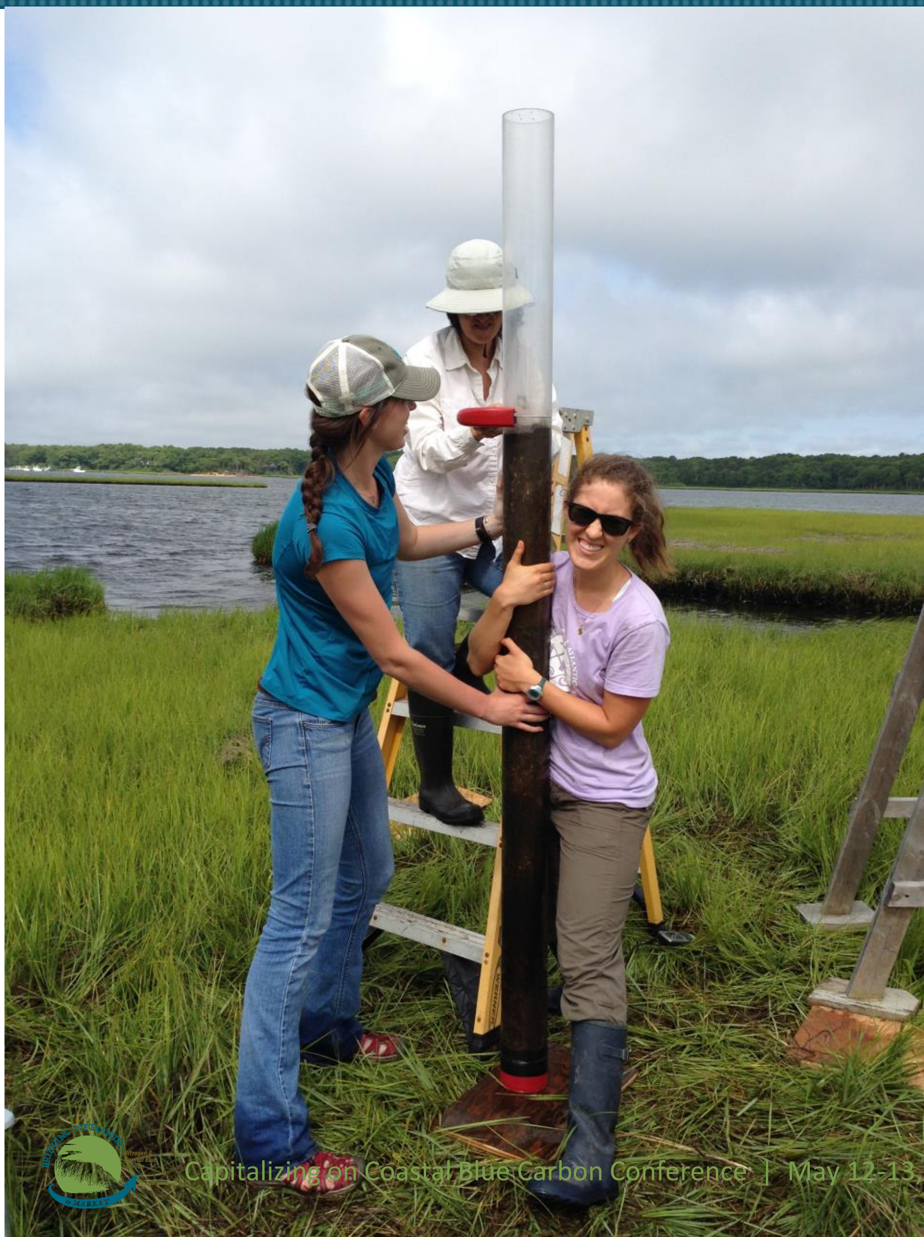
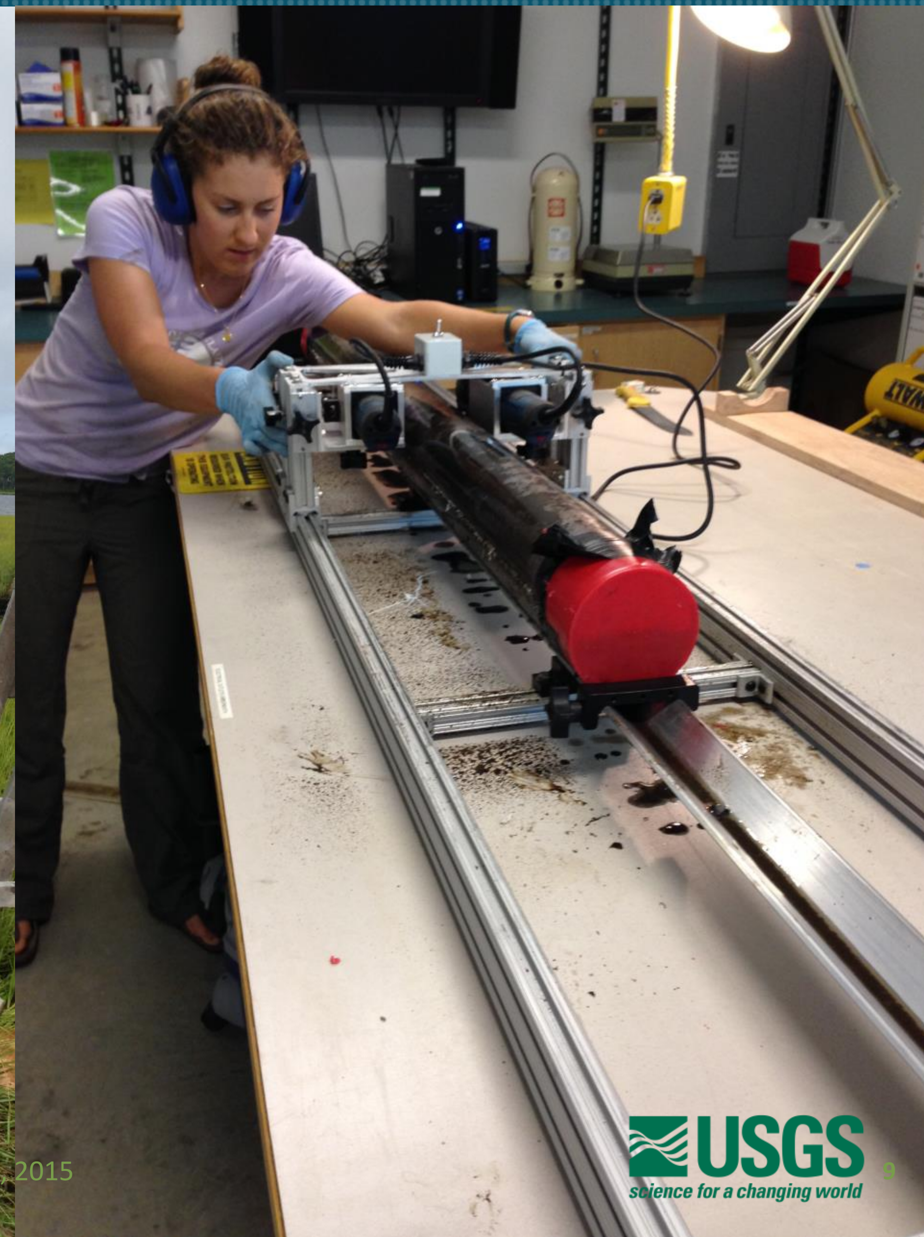
- Current models of marsh growth indicate that marshes with low sediment supply and low tidal range are the most vulnerable to sea level rise.
- Waquoit Bay marshes have low tidal range (~1 meter) and low sediment supply (3-4 mg/liter)

Cores were predominantly collected in low marshes across Waquoit Bay estuary.

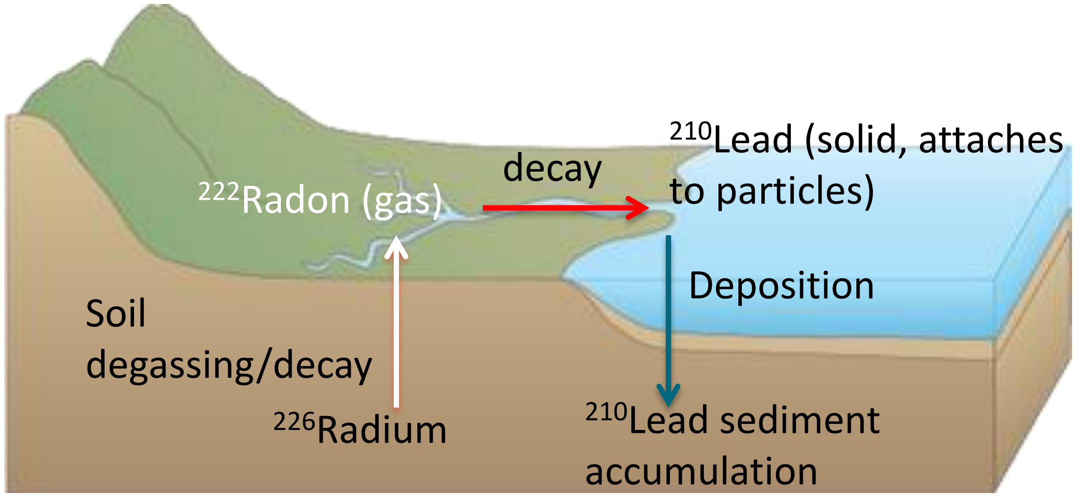


Coring the salt marsh



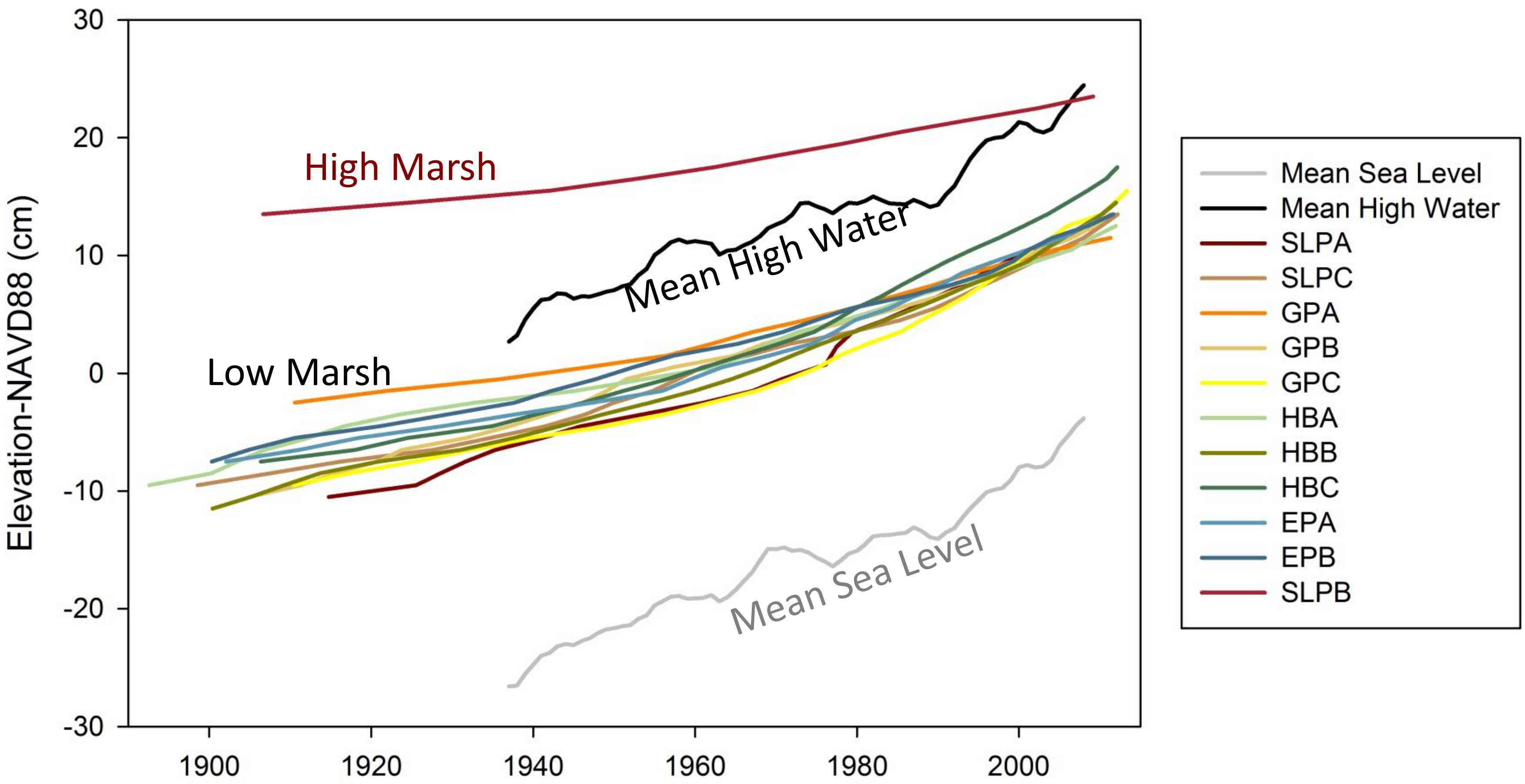


High resolution sediment ages were determined from ^{210}Pb profiles.



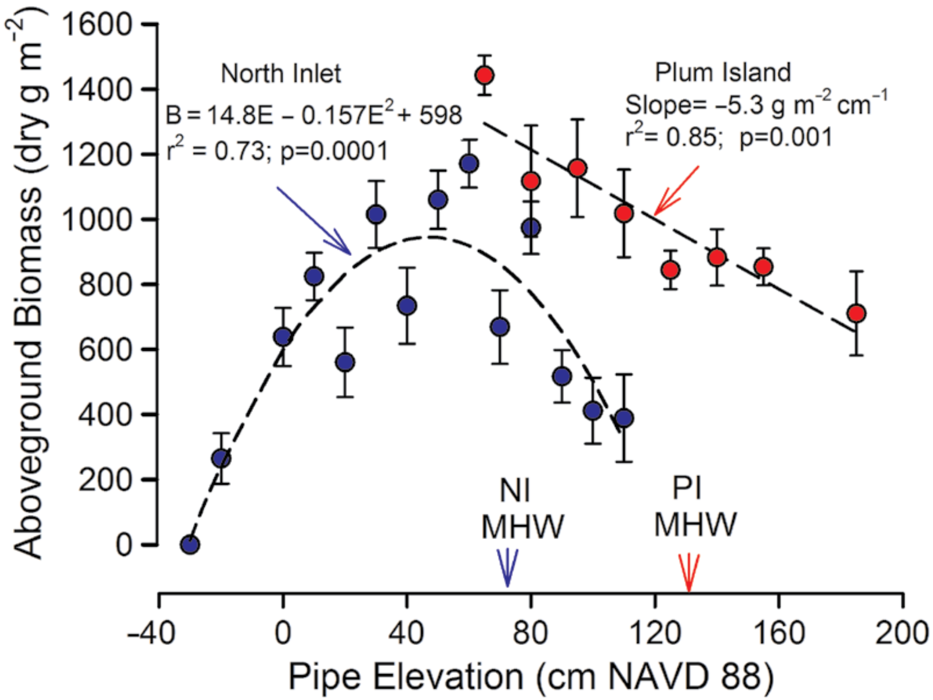
- We assume ^{210}Lead supply to the marsh is constant.
- Changes in sediment ^{210}Lead activity are due to:
  - 1) radioactive decay (22 year half life) and
  - 2) variable sedimentation rate.
- We have 15-25 dated sediment layers since 1900 for 11 cores:
  - 10 low marsh
  - 1 high marsh

The low marsh is growing more rapidly than the high marsh.



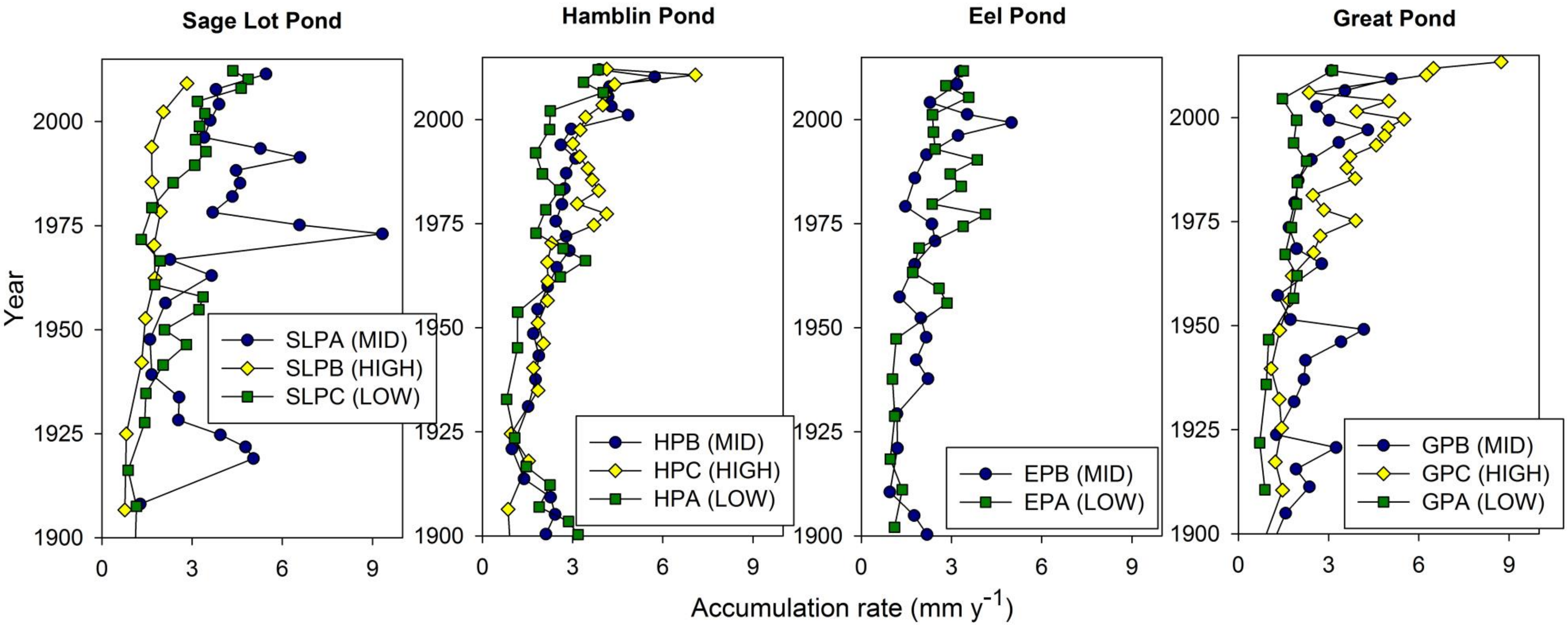
There is an optimal place within the tidal frame for marsh grass production.

Figure 7. Profile view of a "marsh organ" planted with *S. alterniflora* at the edge of a Plum Island salt marsh. *Photo by J.T. Morris, 2008*



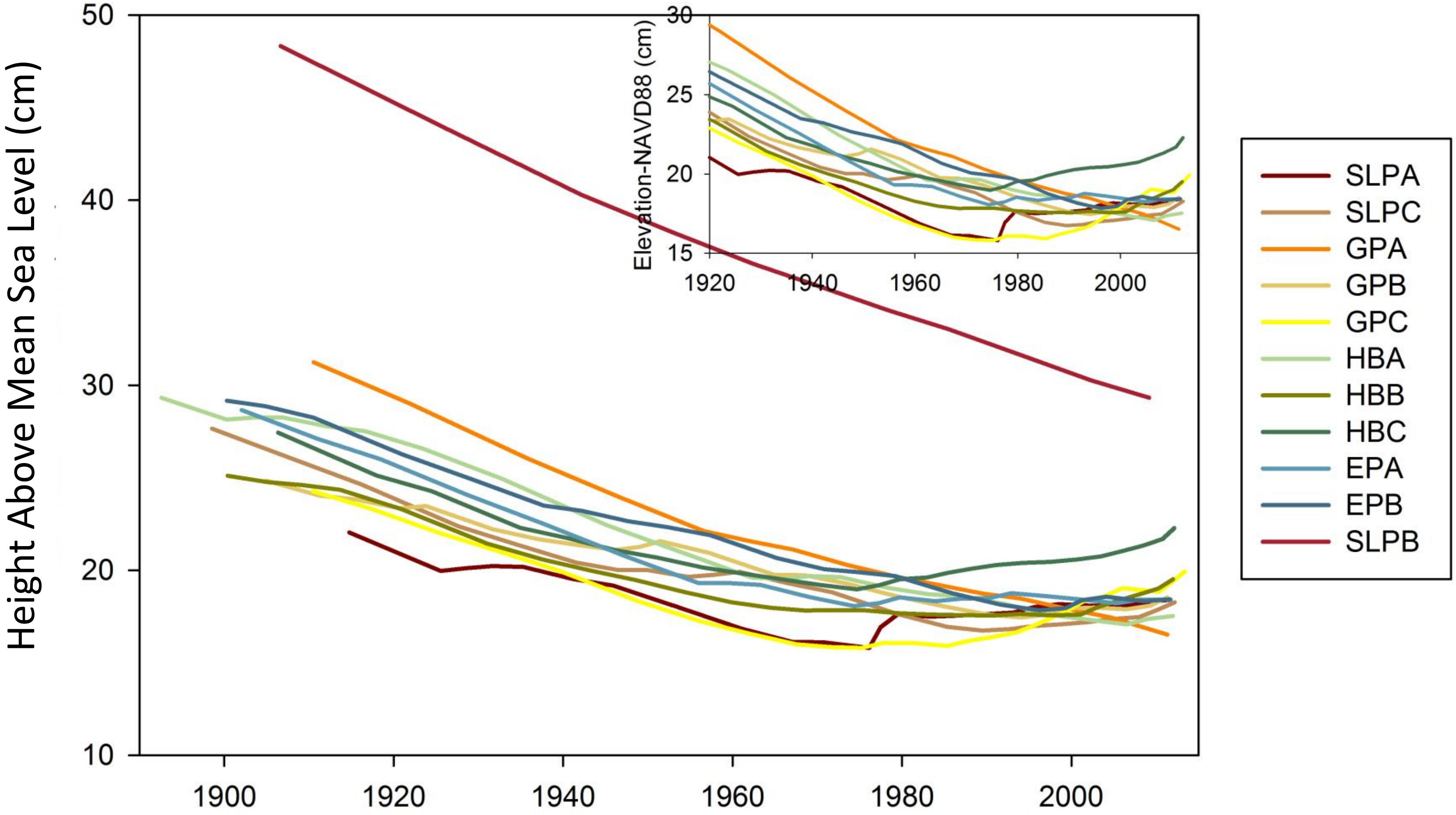
Morris, *Oceanography* (2013)

Accumulation rates are increasing in all marshes.



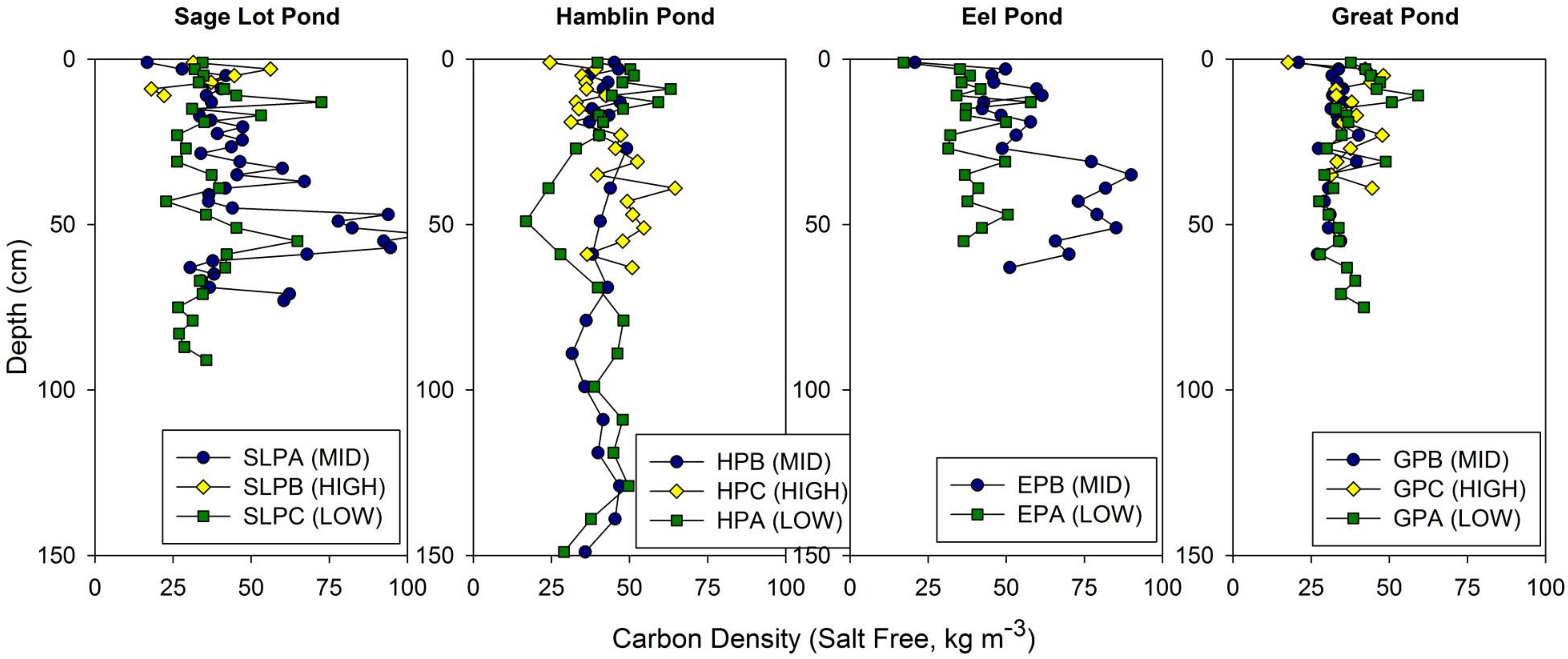
Rates in 1900 were 1-2 mm/year.
Modern rates are 3-5 mm/year.

Most cores indicate a turning point in elevation loss around 1970.

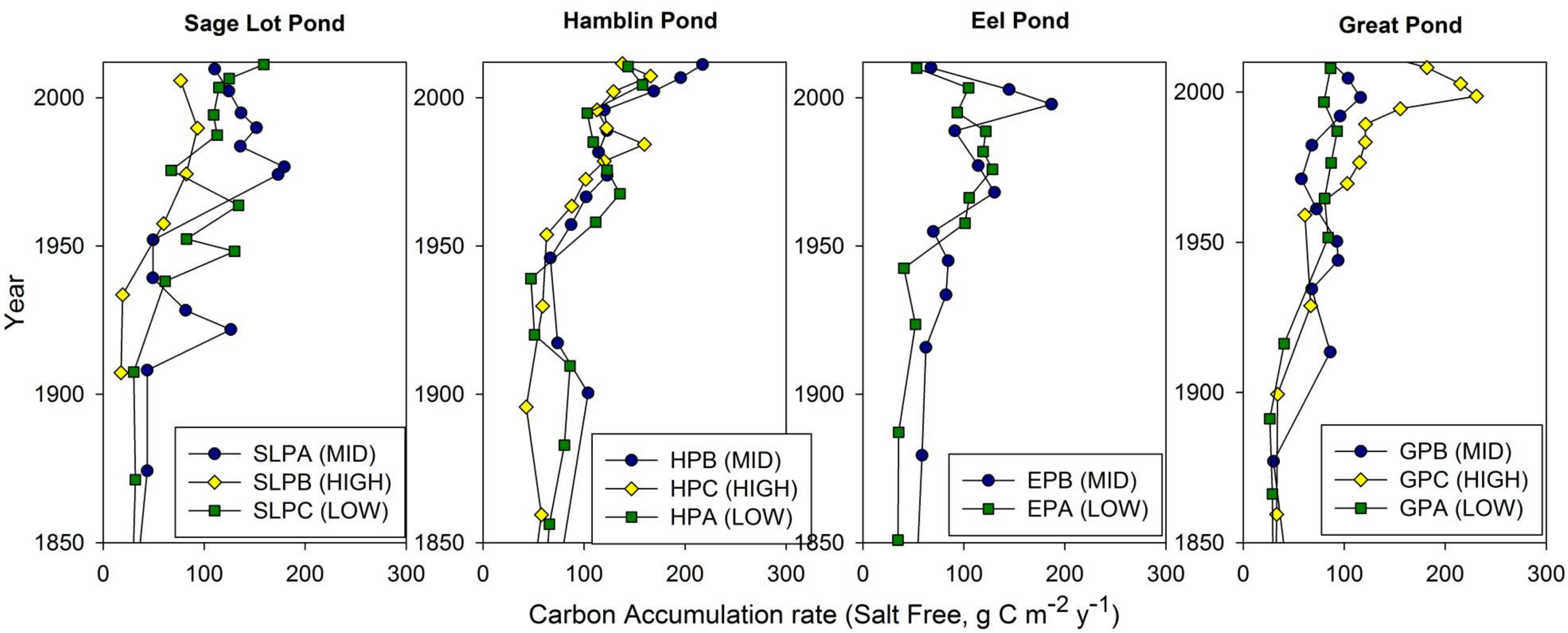


WHAT ABOUT BLUE CARBON?

Carbon density is high and is constant with depth, including down to sediments that are greater than 1000 years old.



Carbon burial has increased since 1900 due to higher accumulation rates, not increased soil carbon content.



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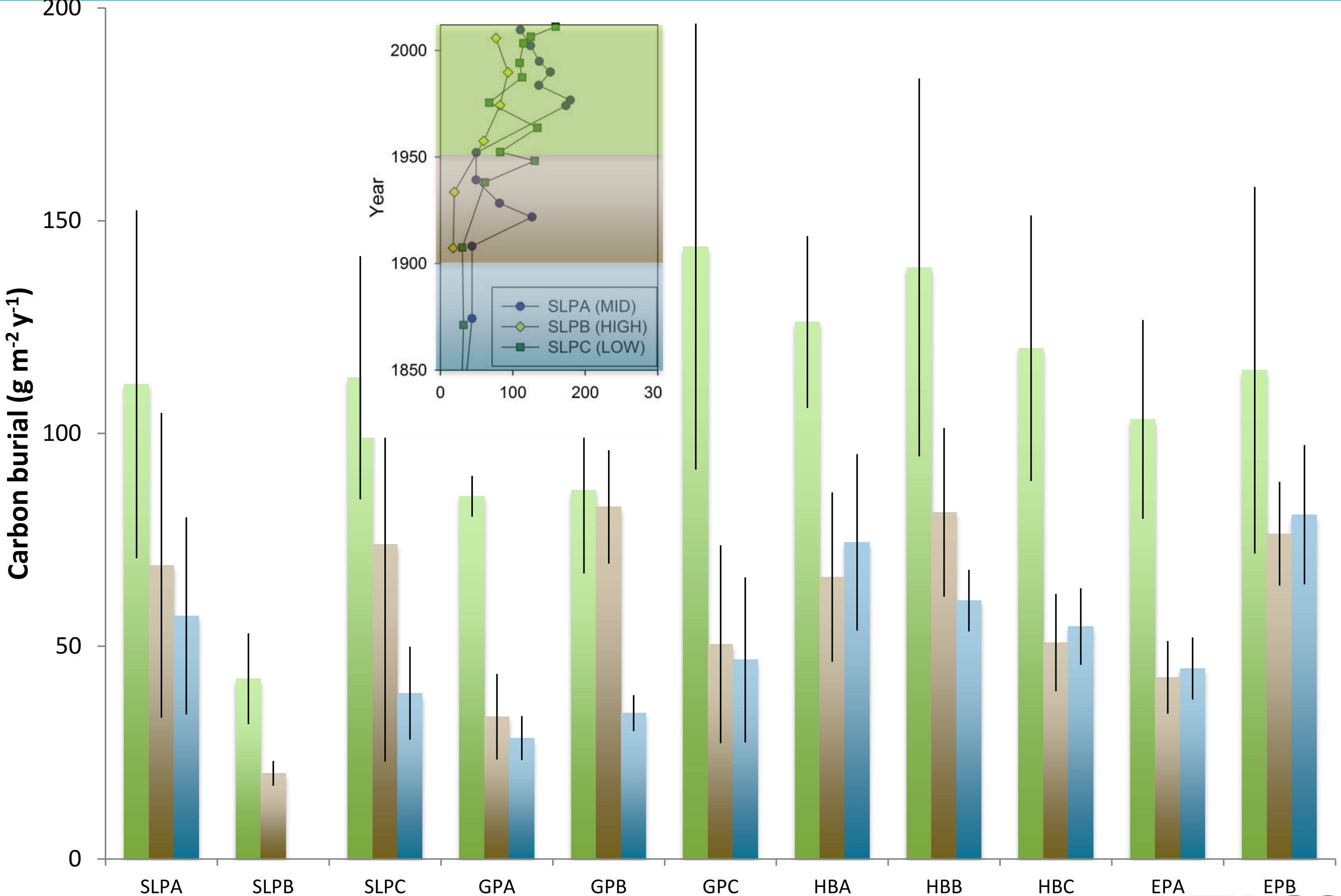
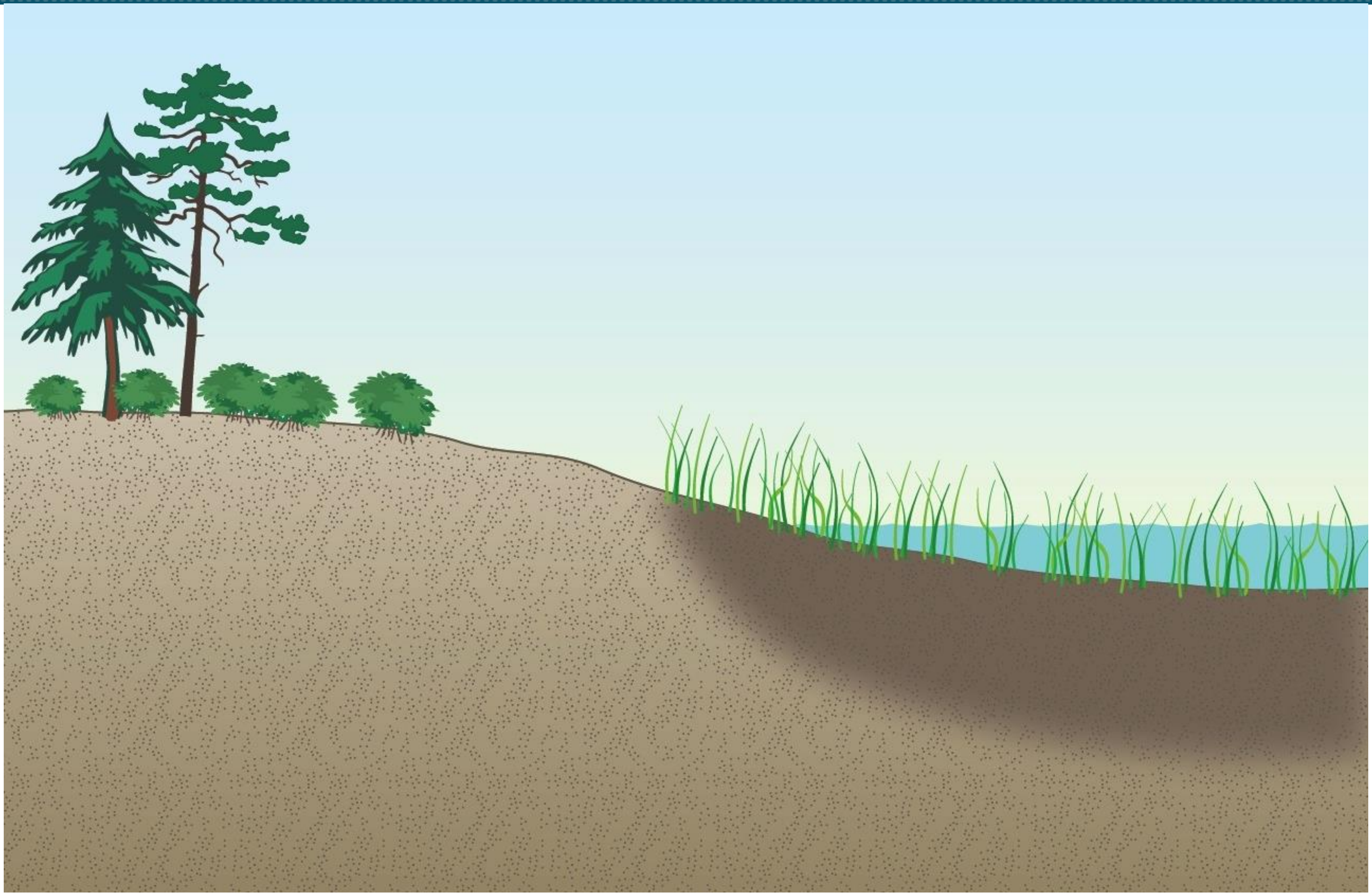
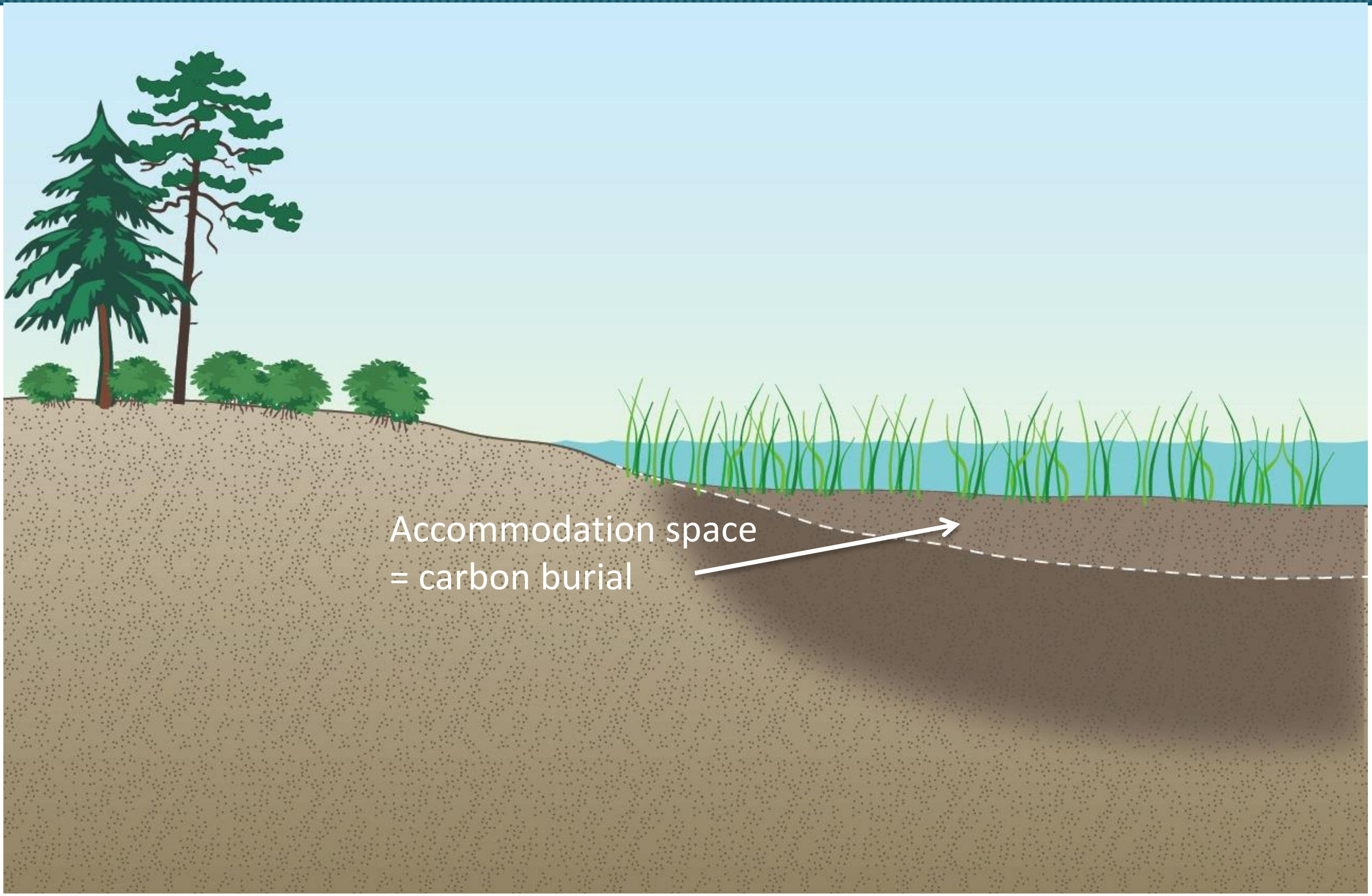
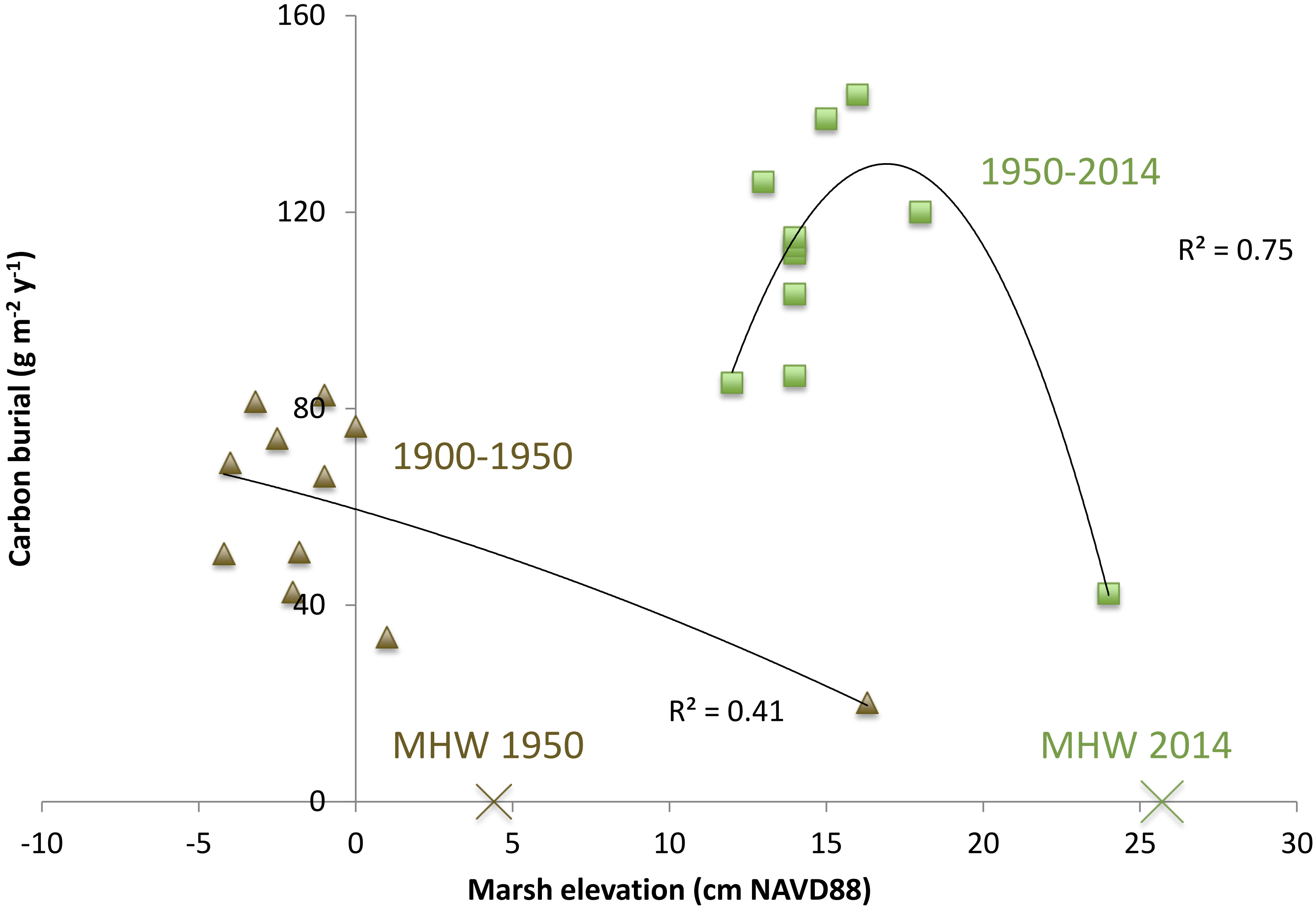




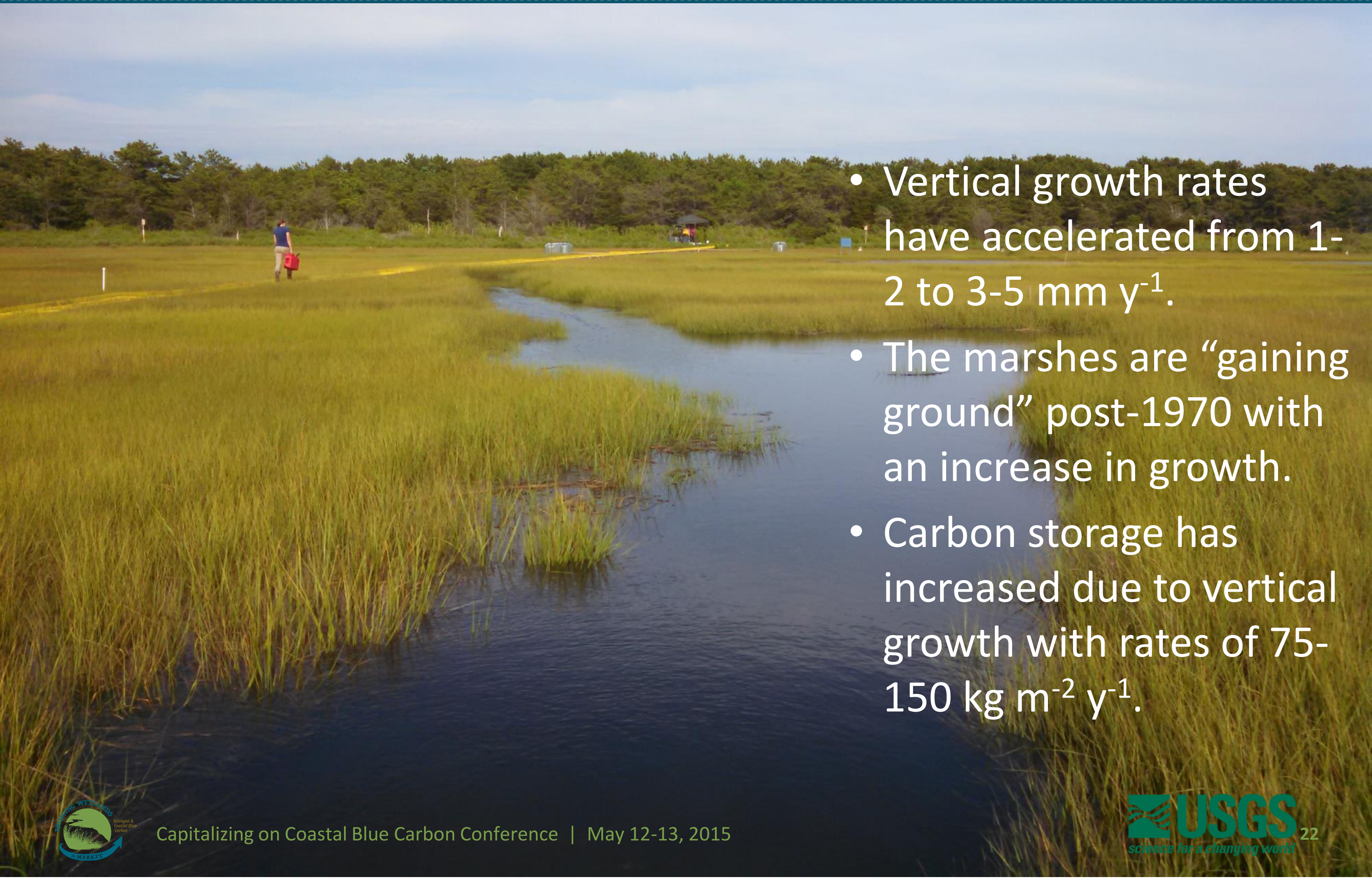
A vertical accommodation space allows for enhanced carbon storage upon sea level rise.



Preservation of organic carbon is a function of both production and decay.



How are these salt marshes responding to sea level rise?



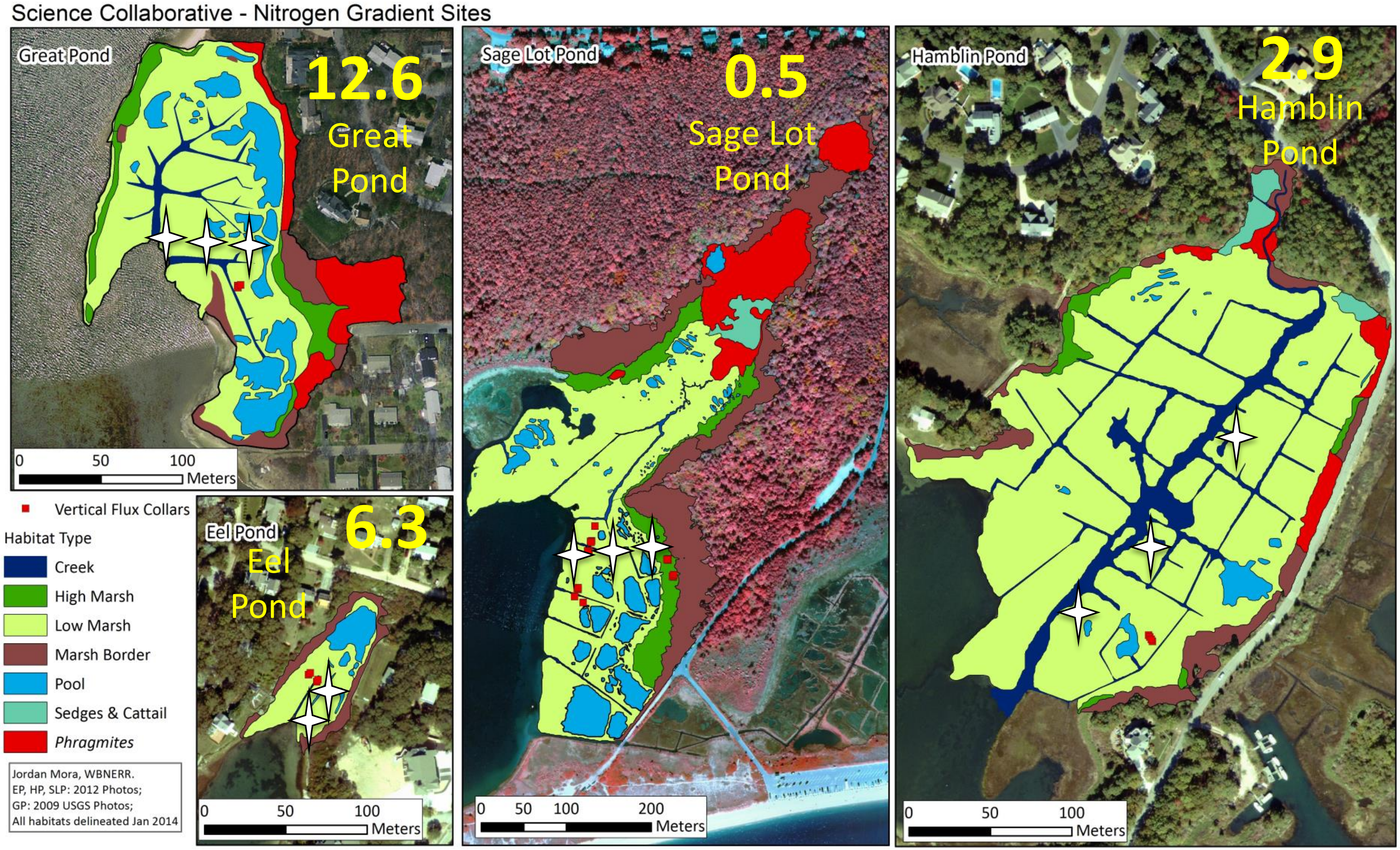
- Vertical growth rates have accelerated from 1-2 to 3-5 mm y^{-1}.
- The marshes are “gaining ground” post-1970 with an increase in growth.
- Carbon storage has increased due to vertical growth with rates of 75-150 kg m^{-2} y^{-1}.

IMPACT OF NITROGEN LOADING ON CARBON BURIAL

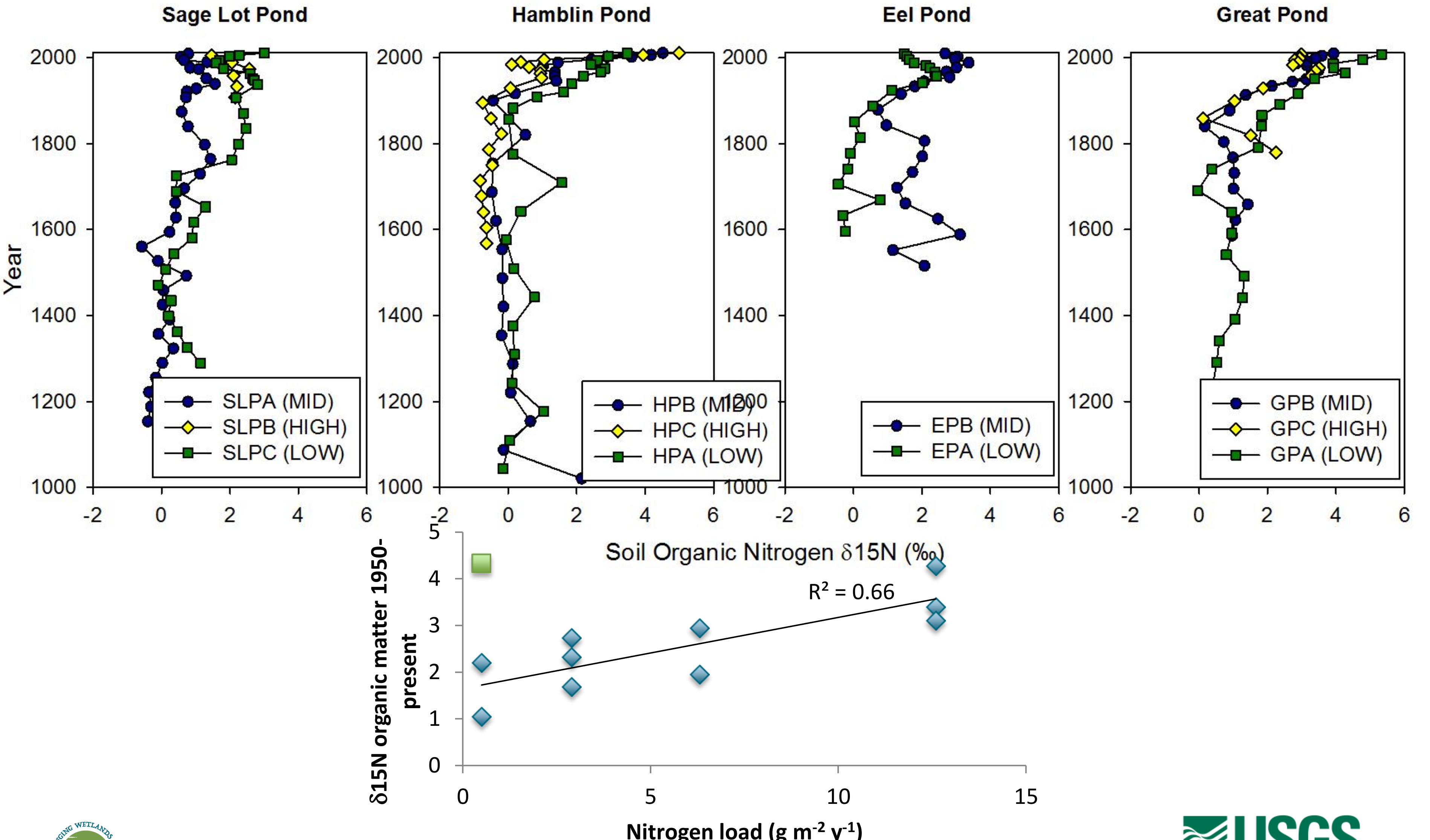
There is a moderate nitrogen loading gradient to Waquoit Bay marshes.

Core locations

0.5 N Loading $g/m^2/year$



Nitrogen isotopes indicate anthropogenic additions are increasing across the salt marshes.



There is no difference in carbon burial across the nitrogen gradient within Waquoit Bay.