Modeling Salt Marsh Gains and Loss

Approaches and Challenges

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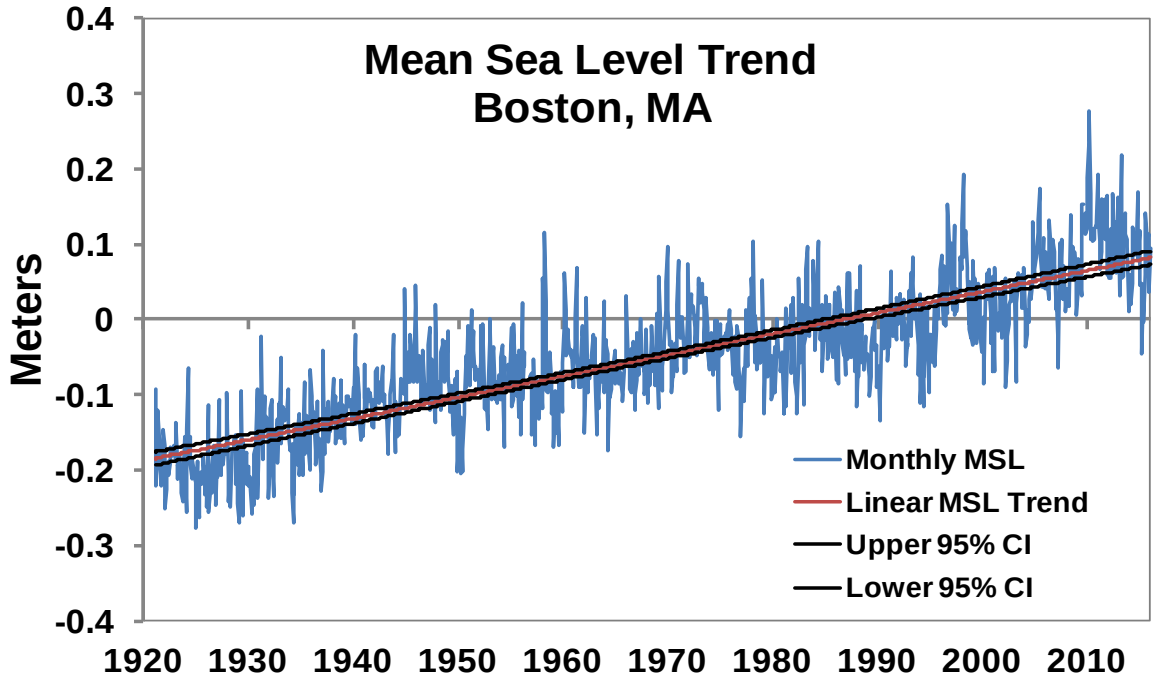
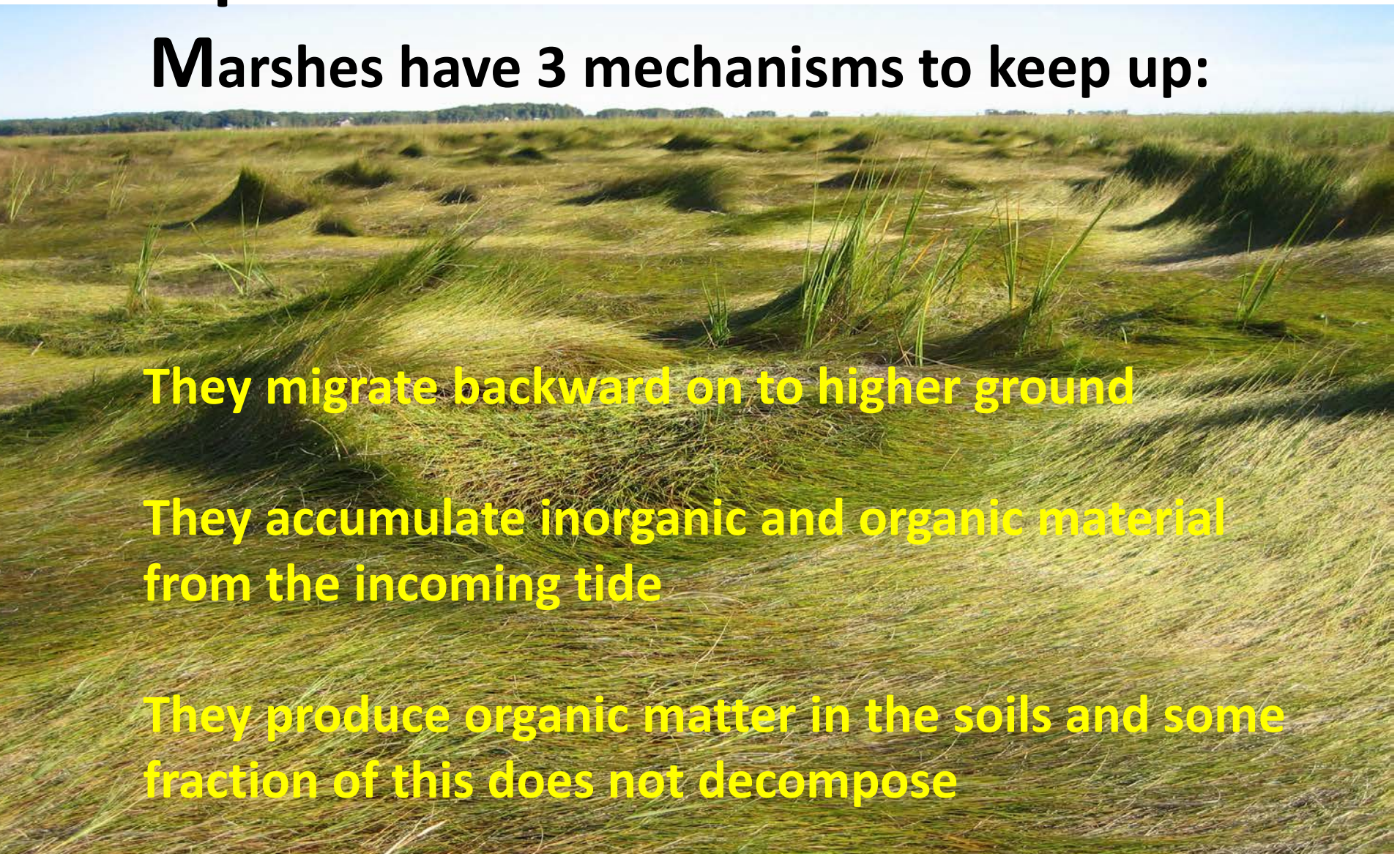
Marshes have two Challenges

The first is Sea Level Rise:

Long term average 2.8 mm/y but over the last 20 years more like 4 mm/y.



Sea-level rise is often reduced to a “1D” problem of vertical accretion



Marshes have 3 mechanisms to keep up:

They migrate backward on to higher ground

They accumulate inorganic and organic material from the incoming tide

They produce organic matter in the soils and some fraction of this does not decompose

The second is erosion

- Marsh edge erosion
- Undercutting of creek banks
- Slumping of marsh soil onto tidal flats
- Erosion of peat and dirt from marsh surfaces

This makes understanding marsh gains and losses a “3D problem”

Because erosion and deposition are related to sea-level and SLR long-term predictions requires many different types of information

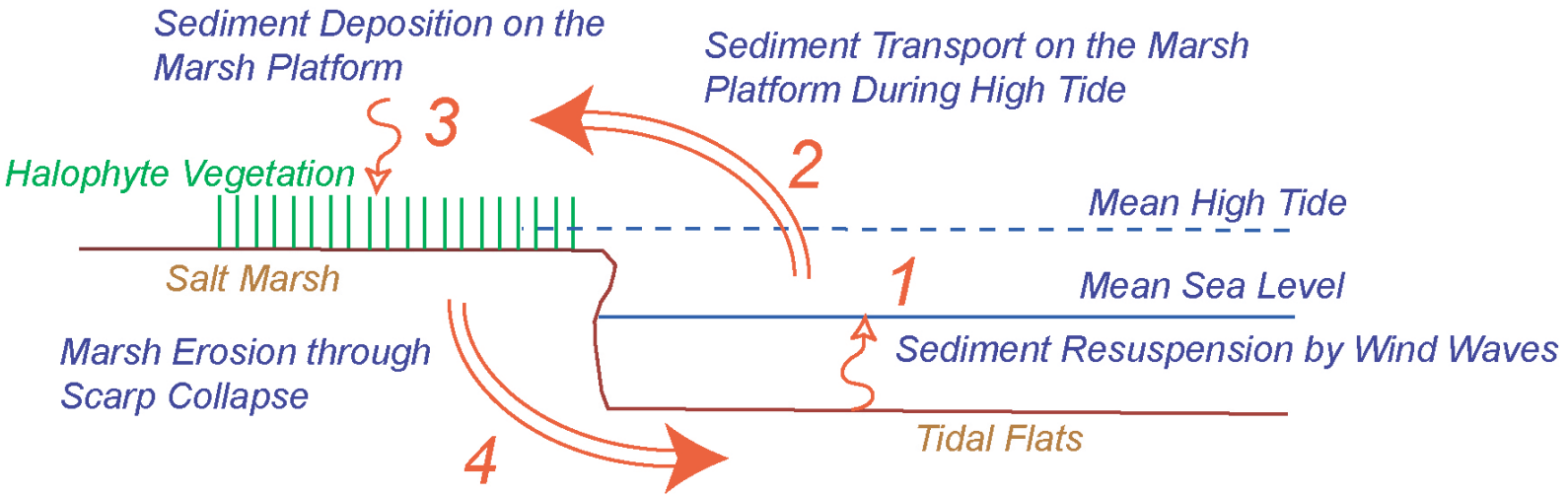


Figure from Sergio Fagherazzi

Marsh Transgression

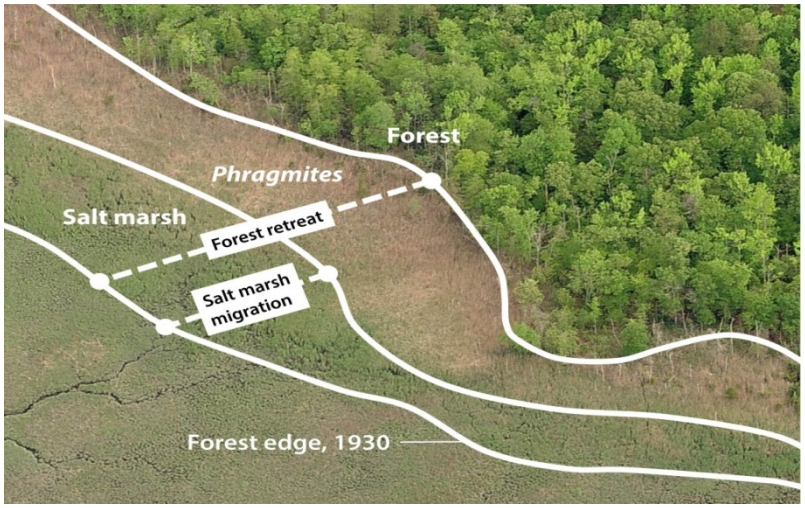
As sea level rises, new marsh can form in areas that were uplands. Models look a uplands slopes, some consider human built structures.

Ability is constrained by:

Natural Slope

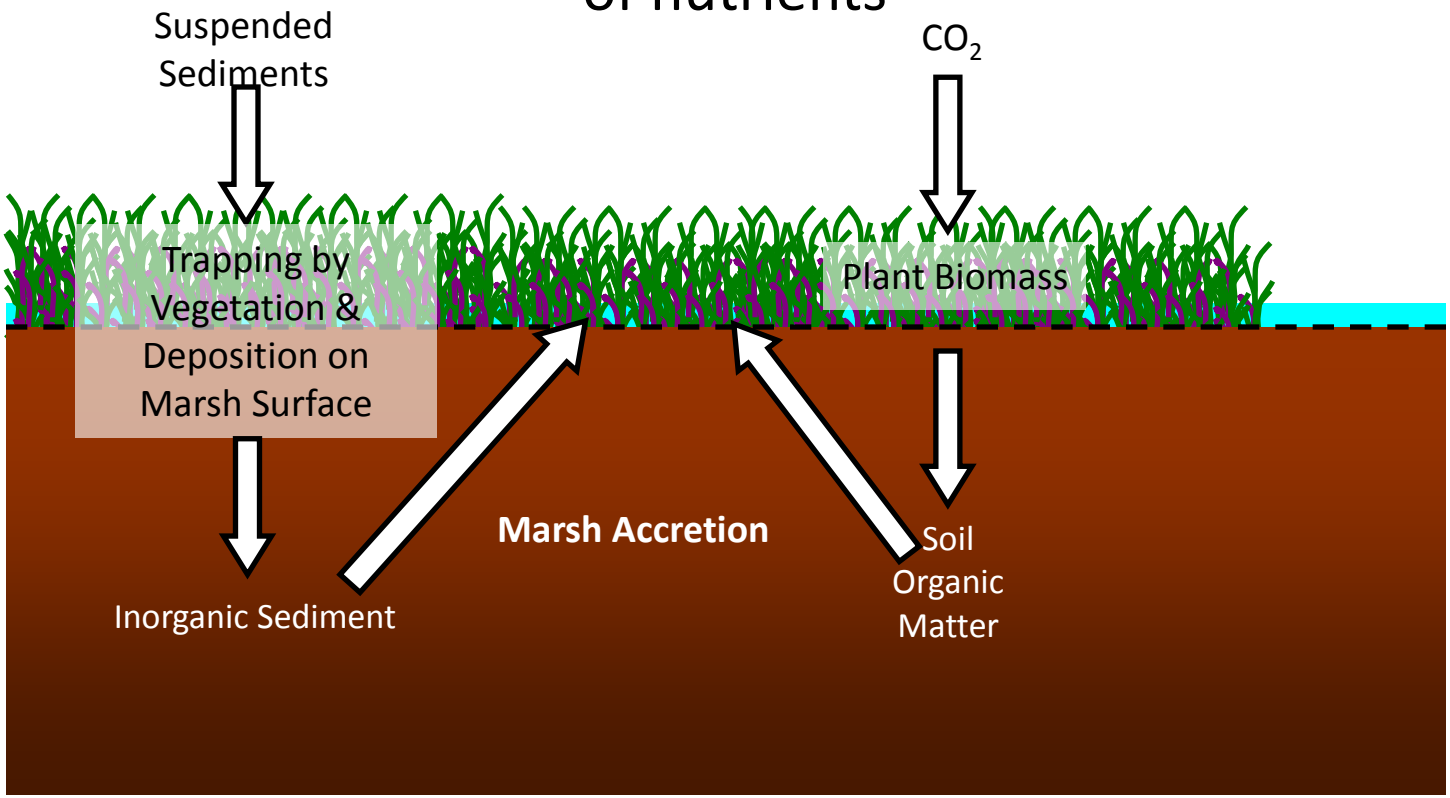
Armoring

Biological Barriers



Vertical accretion models

Many aspects well known for S. alterniflora, less well known or other species. Other unknown, long-term temperature responses (more decomposition?) role of nutrients



Erosion and Deposition

First have to move water

- Hydrodynamic models.
- Often forced by real climatology
- Grid size can have a large impact on resolution
- Need good bathymetry, digital elevation model
- Many do well with currents and tides (need site specific verification)
- Some do not include waves, and waves are still a challenge

Second – have to figure out how the sediments will move with the water

- Marsh grasses, biological films, all mean sediments do not erode as though they were unconsolidated particles
- Decomposition in sediments can changes susceptibility to erosion
- Sediment sources change over time

Ecomorphic Feedbacks

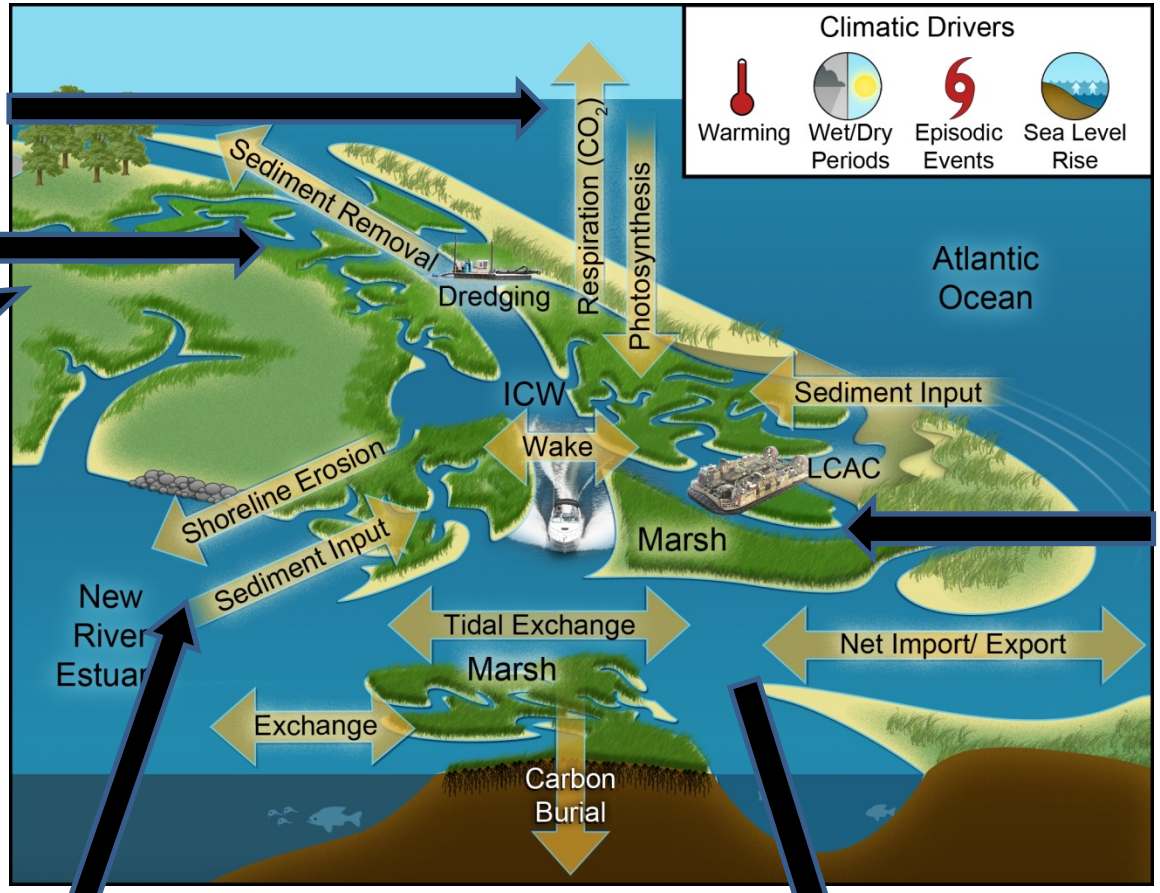
Salinity
Nutrients
Temperature
MSL, MHW
Biomass
Species

Watershed

Sediments
Nutrients
Water

Transgression

Natural slope
Armoring
Biological Barriers



Bioturbation

Burrows
Excavation

Hydrodynamics

Velocity
Tides
Waves

Sediment Transport

Grain size
Density
Role of biota
Changing sources

3D Landscape Evolution