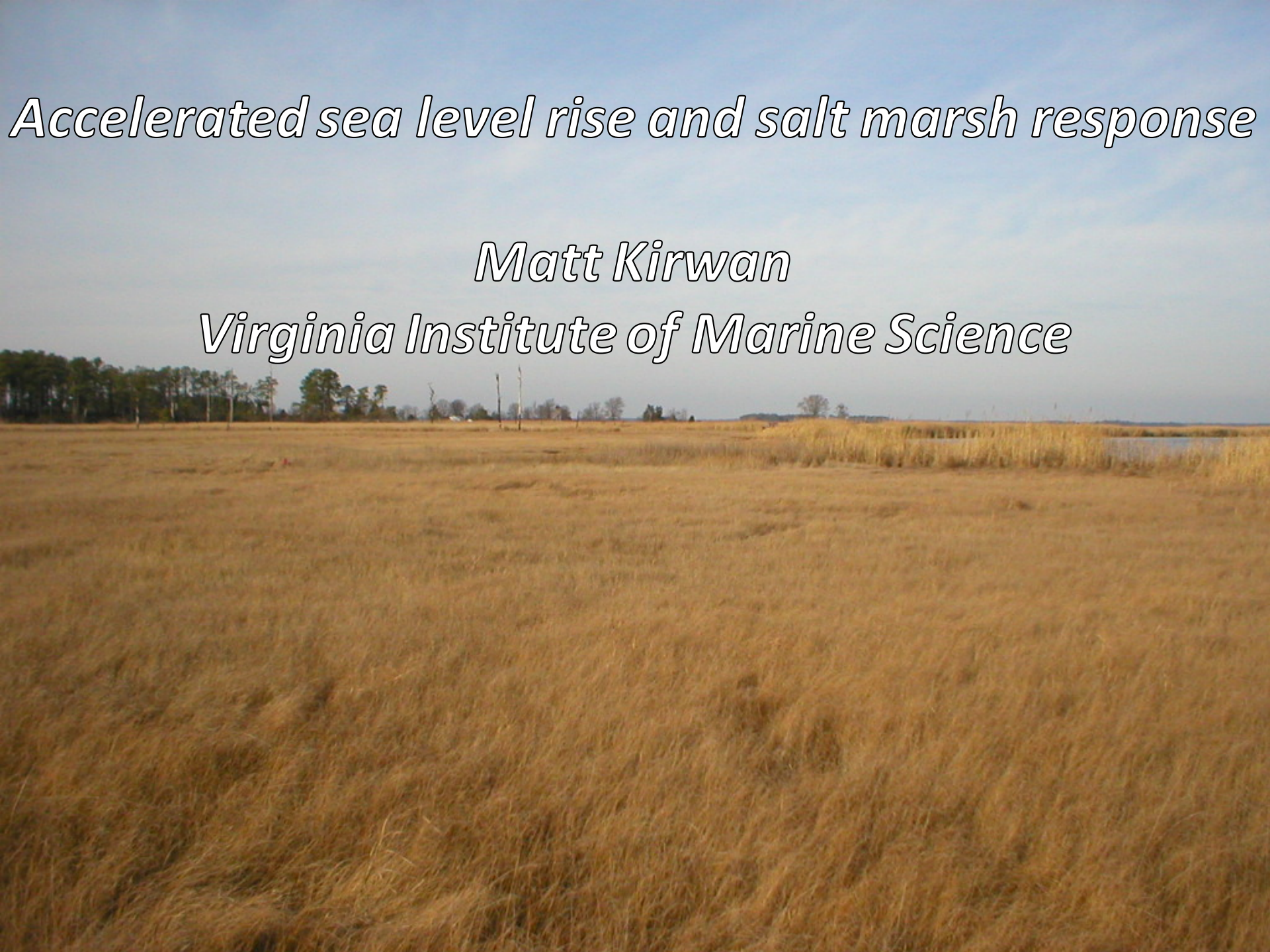
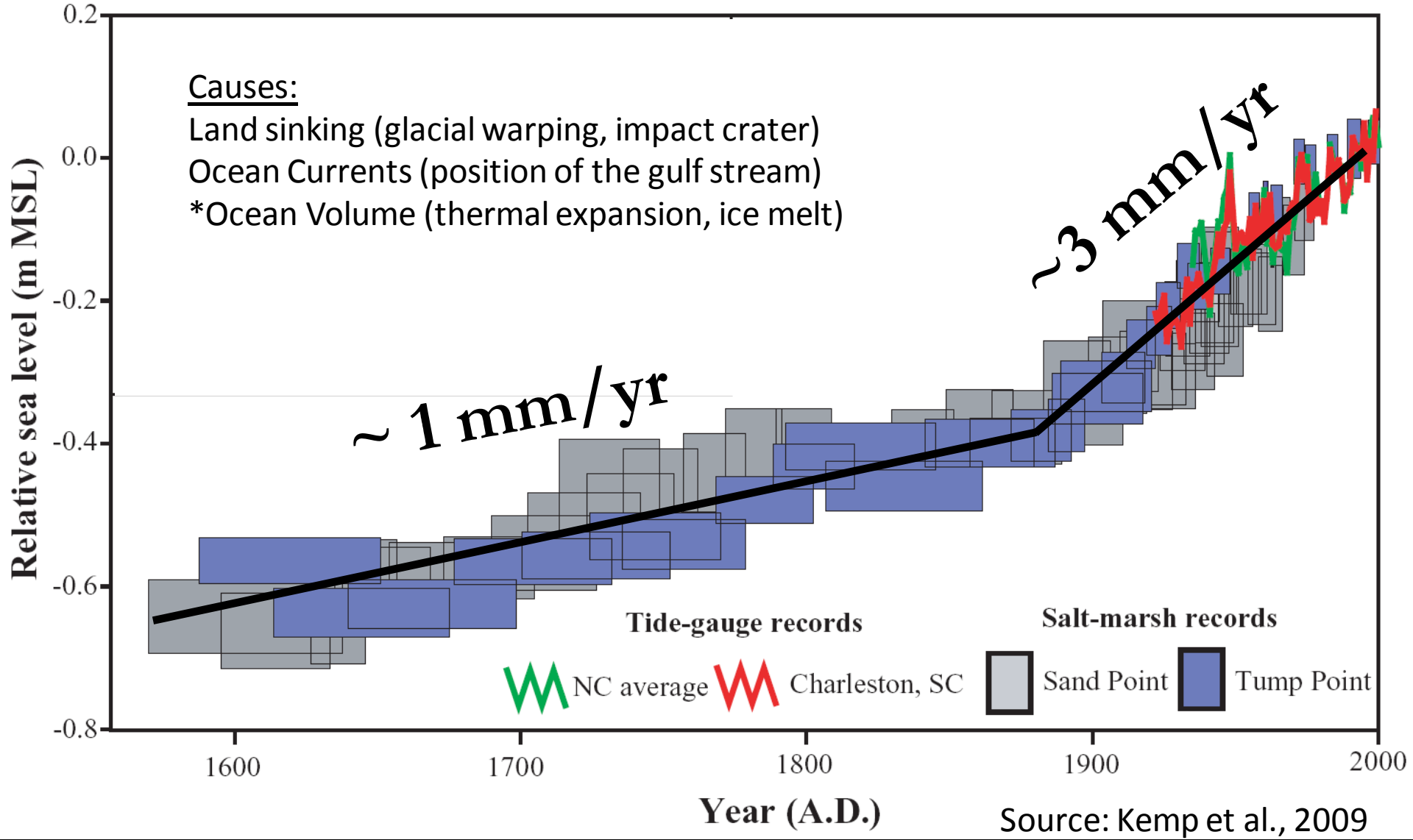


Accelerated sea level rise and salt marsh response

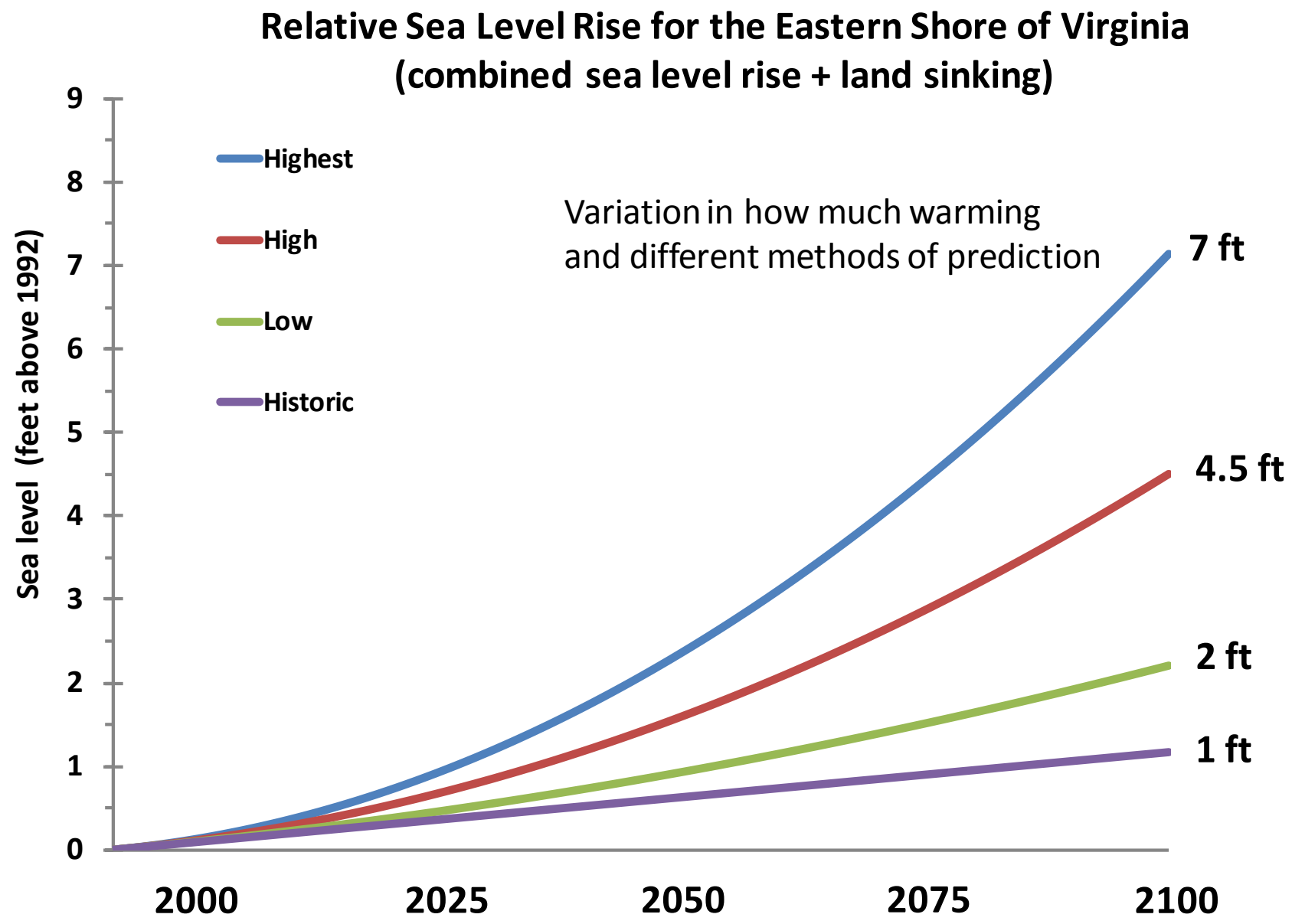
Matt Kirwan
Virginia Institute of Marine Science

Historical Sea level Rise



Source: Kemp et al., 2009

Mid-atlantic region even faster!



Source: Mitchell et al., 2013. Recurrent flooding study for tidewater Virginia. Modified by D. Richardson, UVA

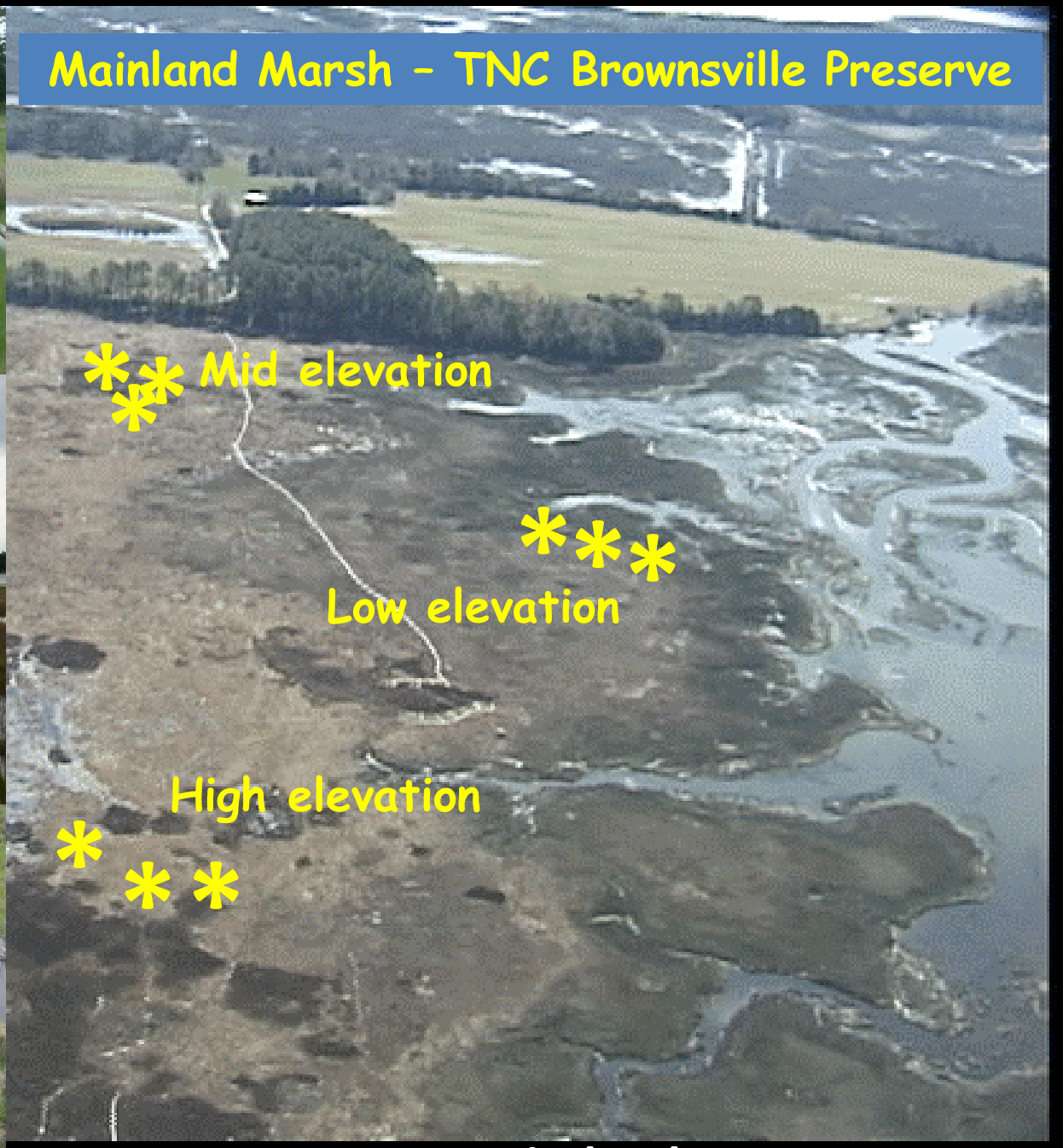

How will Virginia's marshes respond to sea level rise?

Factors that control wetland size

Transgression
(elevation/connectivity)

Vertical Maintenance
or Submergence

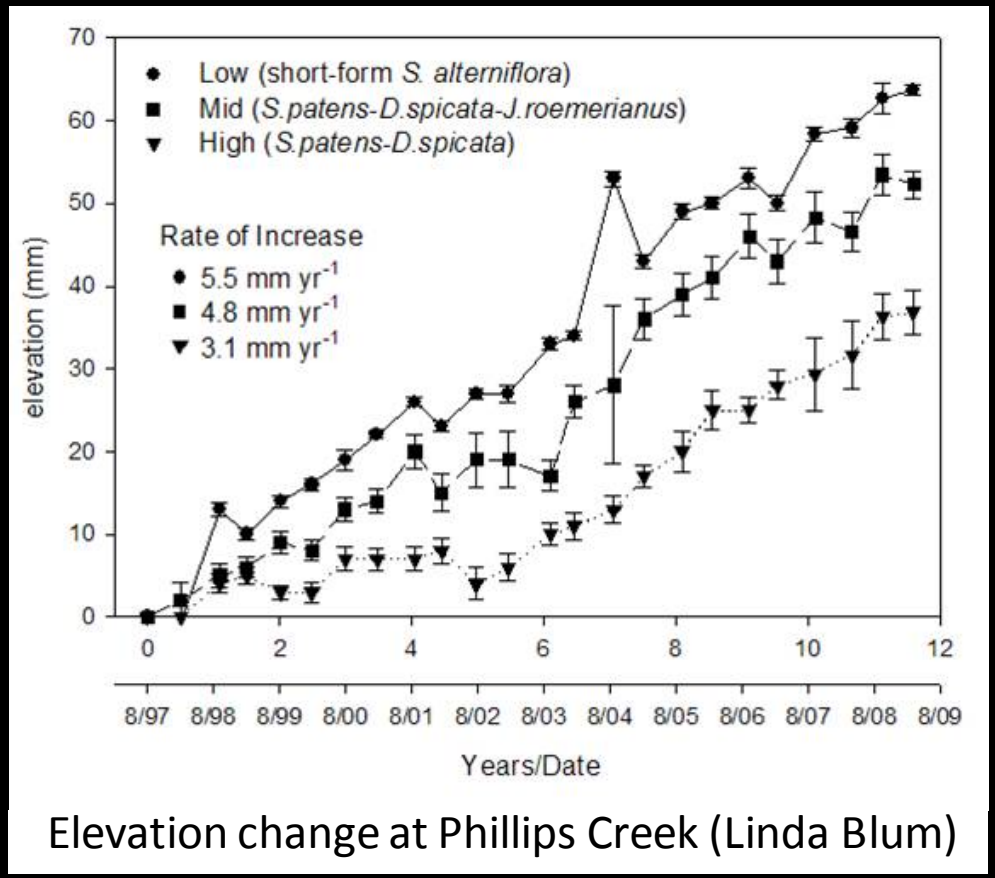
Edge Erosion



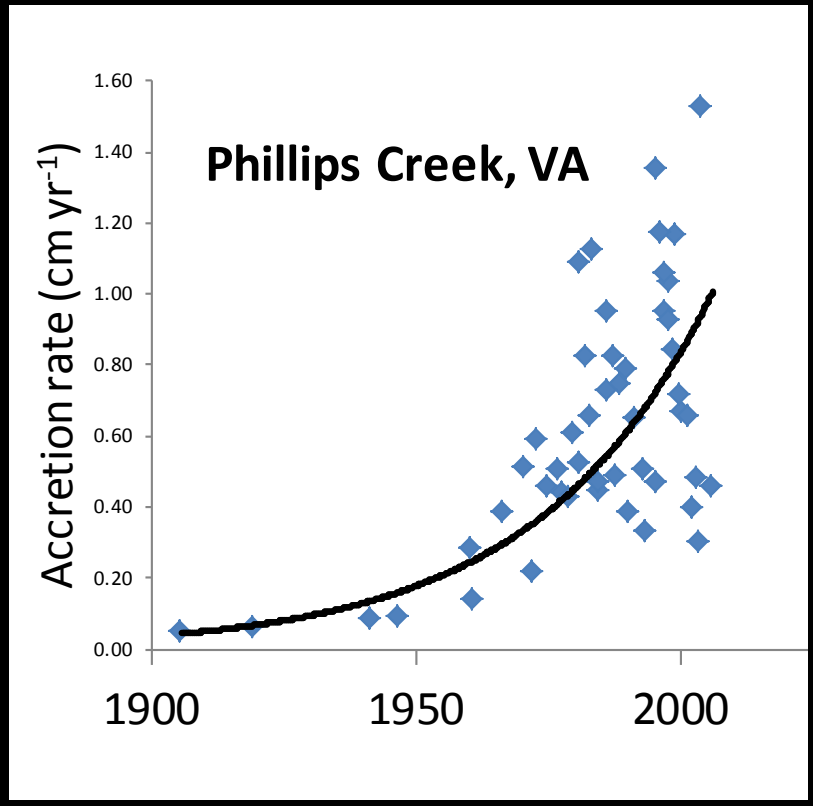
Source: Linda Blum, UVA + LTER

Vertical Dimension: Marshes tend to be resilient

Feedbacks between sediment transport, plant growth, and hydrodynamics allow coastal wetlands to adapt to changes in sea level



Elevation change at Phillips Creek (Linda Blum)



Mainland marshes keeping up
Accretion rate increases with sea level rise!

Factors that control wetland size

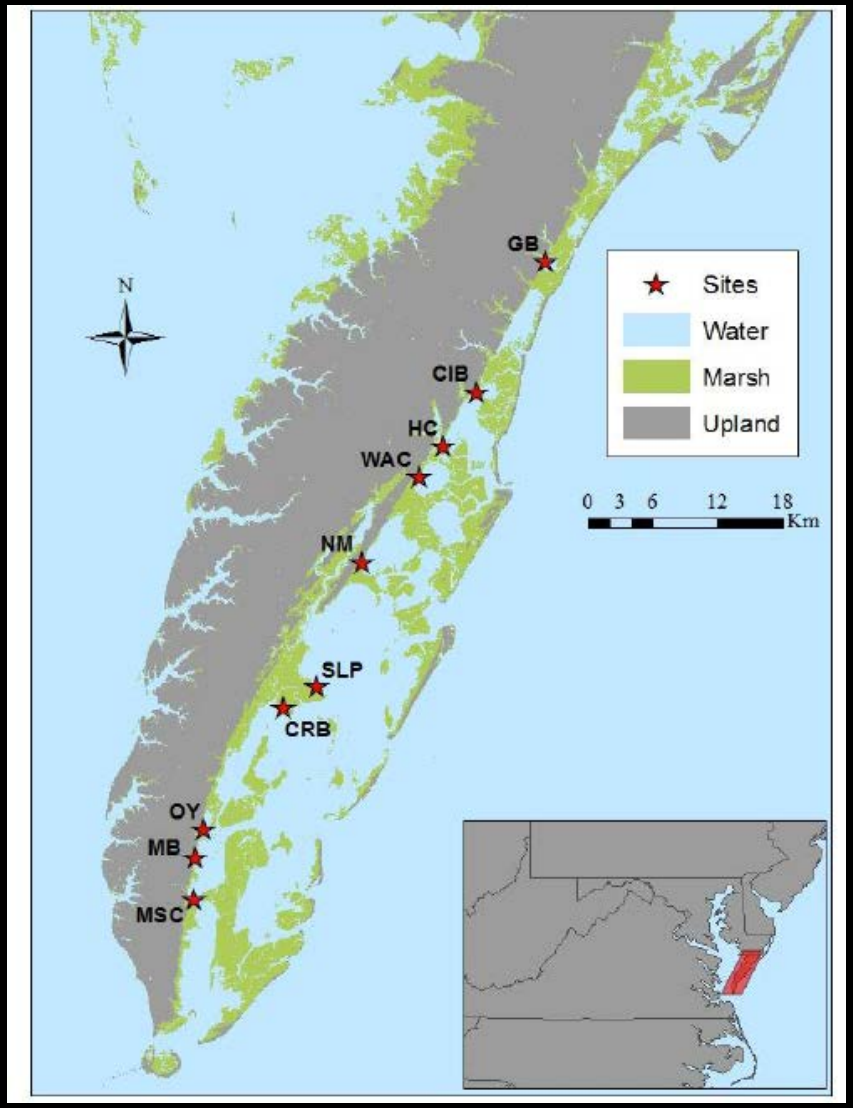
Transgression
(elevation/connectivity)

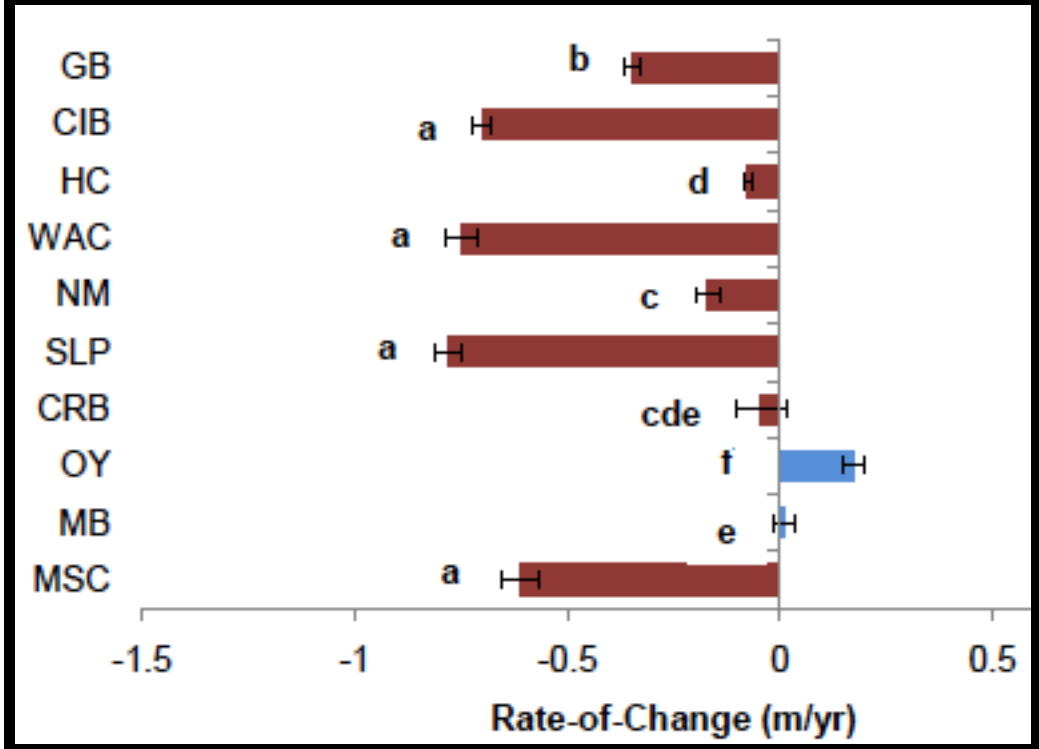
Vertical Maintenance
or Submergence

Edge Erosion

Edge Erosion:

Average erosion rates at 10 sites along the mainland marsh-bay boundary from 1957 - 2009





Average erosion rate along entire mainland marsh-bay boundary from 2002-2009 is 0.2m/y.

Source: McLoughlin, Wiberg et al. 2011

Factors that control wetland size

Transgression
(elevation/connectivity)

Vertical Maintenance
or Submergence

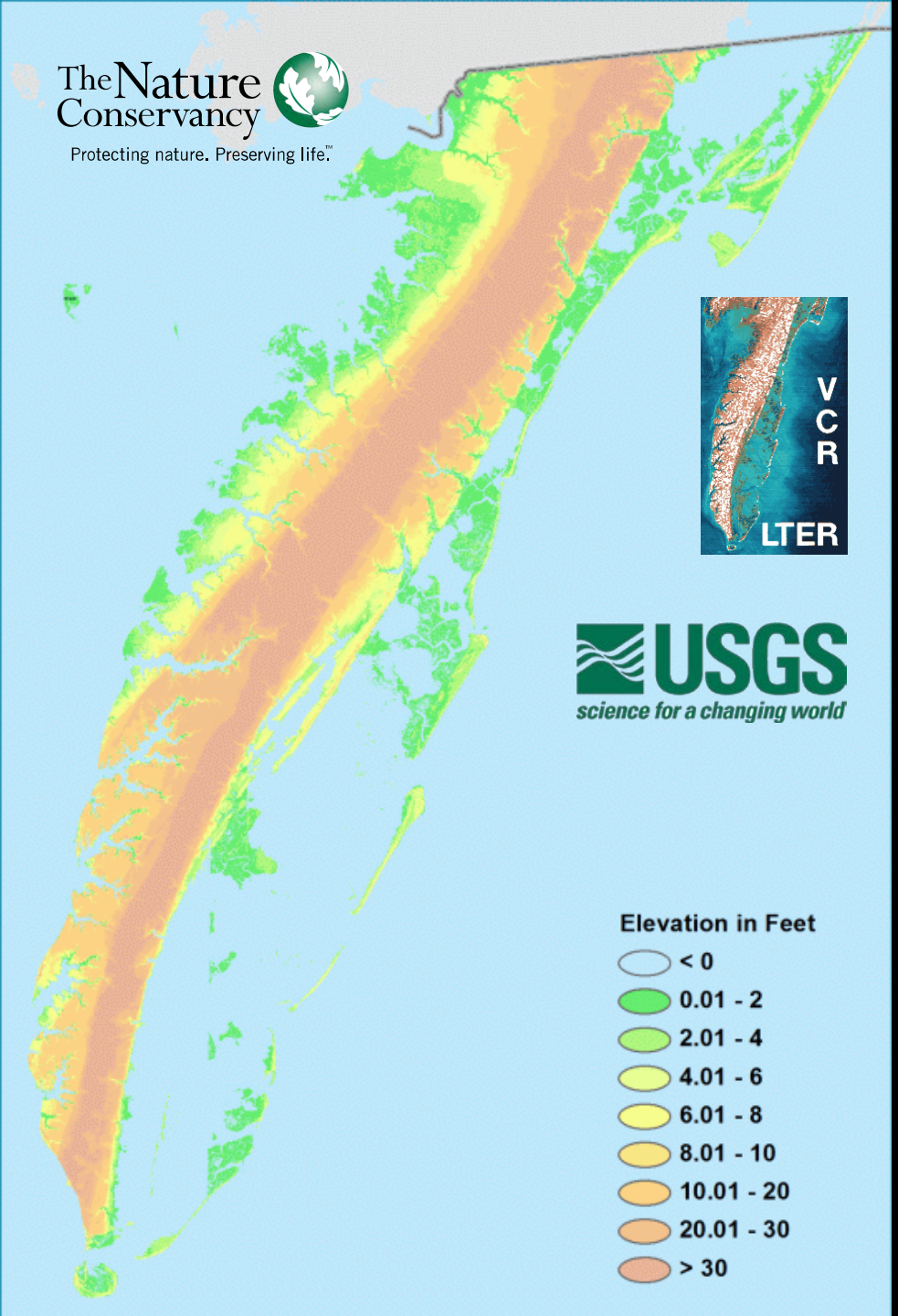
Edge Erosion

Pictures of active marsh migration

Dying Loblolly Pine forest

Marsh under trees

Will look like this in a decade or 2



How much land available for marsh migration?

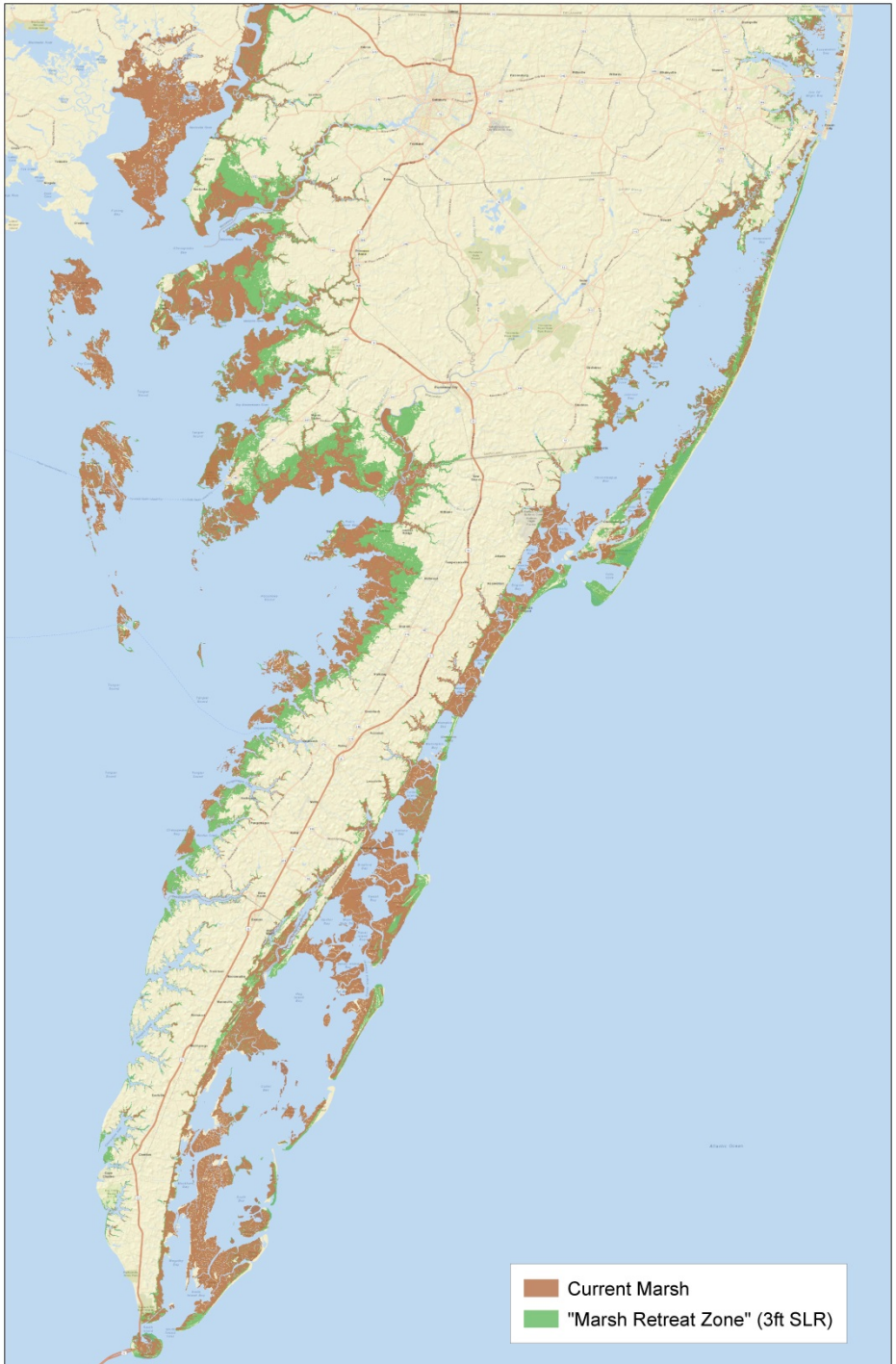
2010 LIDAR Elevation Data

Red= uplands > 30 ft

Green= marshland

Yellow= low lying forest and farms

Potentially inundated and converted to marsh with 21st Century



Potential Marsh Retreat Zones

(Green = potential land for new marsh under 3 feet of SLR)

Virginia portion only:
2’ SLR = 28,600 acres
5.2’ SLR = 54,100 acres
7.5’ SLR = 75,000 acres

108,000 acres of marsh today on VA’s Eastern Shore

Source= Chris Bruce, TNC

Challenges to predicting upland migration

Forests and marsh at identical elevations

Human intervention (berms, ditches, seawalls, etc.)

Migration only following disturbance to trees, so lags

LTER Resources:

Site characterization along elevation transects extending through the forest-marsh interface. (vegetation type, biomass, soil properties, groundwater properties)

Interest in process-based approaches to predicting marsh survival and transgression

Conclusions

- **Mainland marshes tend to be stable in vertical dimension (i.e. build elevation with sea level rise)**
- **Erode on seaward side (0.2 m per year)**
- **Migrate to higher elevations on landward side**
- **Enough adjacent land to accommodate severe loss of existing marsh**

So, whether marshes will expand or contract in response to future SLR depends on whether we allow them to transgress inland.