Blue Carbon Projects in Texas, Coastal Ecosystem Processes, and Critical Roles in the Global Cycling of Carbon

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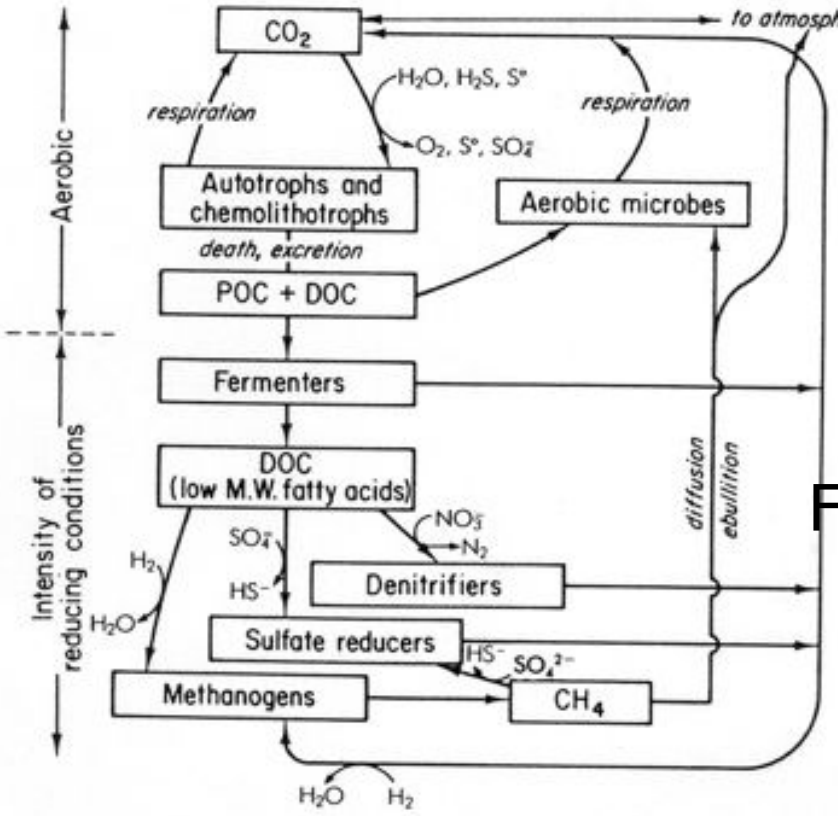

FIGURE 13-12. Carbon transformations in the transition from aerobic to anaerobic situations. The top part of the diagram is a simplified version of Fig. 13.1. The gradient from aerobic to anaerobic can be thought of as representing a sediment profile, with increased reduction and different microbial processes deeper in the sediment. Boxes represent pools or operators that carry out processes; arrows are processes that can be biochemical transformations or physical transport. Elements other than carbon are shown, where relevant, to indicate the couplings to other nutrient cycles. Some arrows indicate oxidizing and some reducing pathways.

O_2	-686
NO_3	-597
Fe/Mn	-300
SO_4	-220
CH_4	-57

ΔG Kcal/mole

Estimating Blue Carbon Storage Potential in Seagrasses Along the Texas Coast

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(with special thanks to Kim Jackson!)

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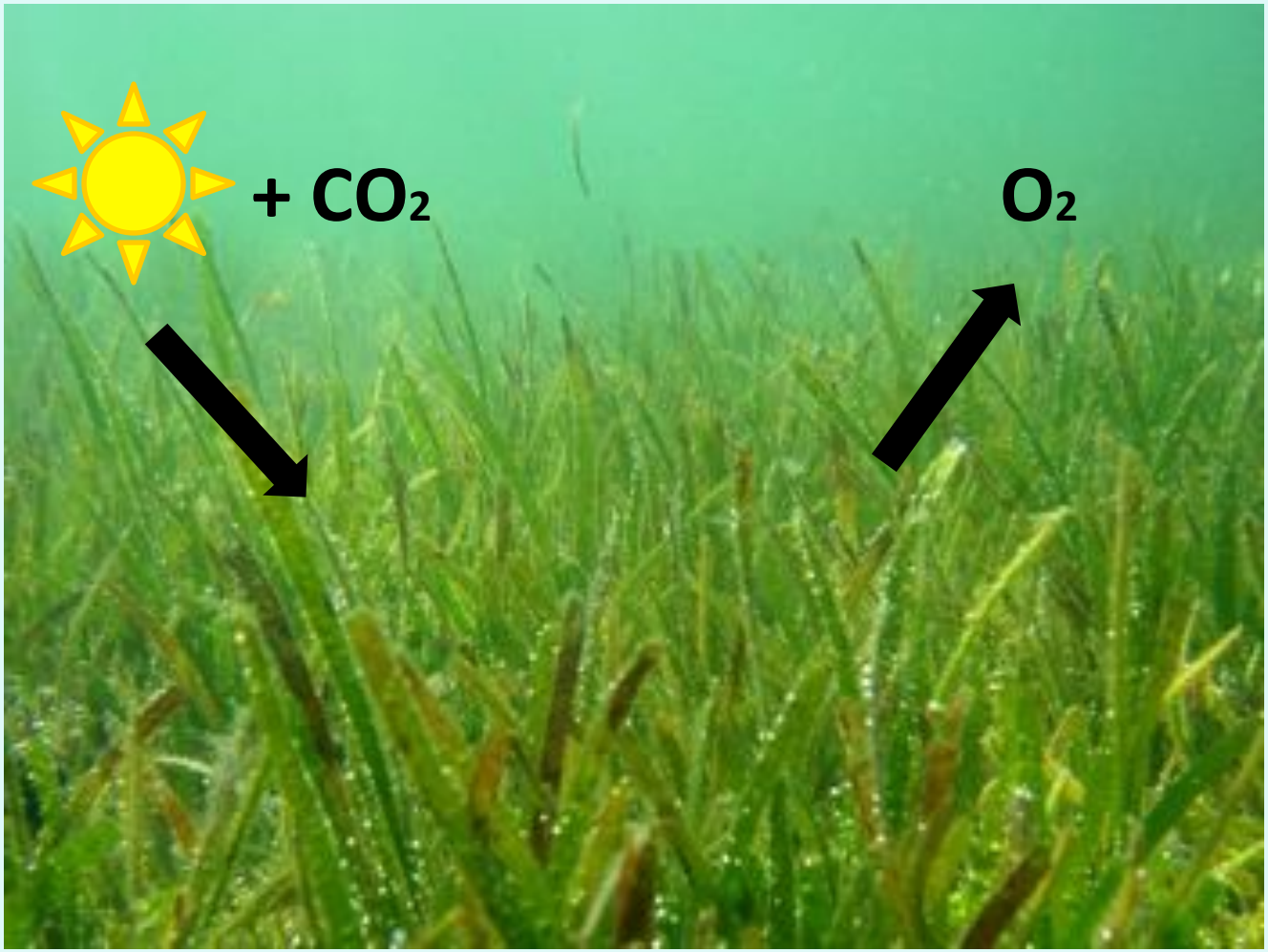
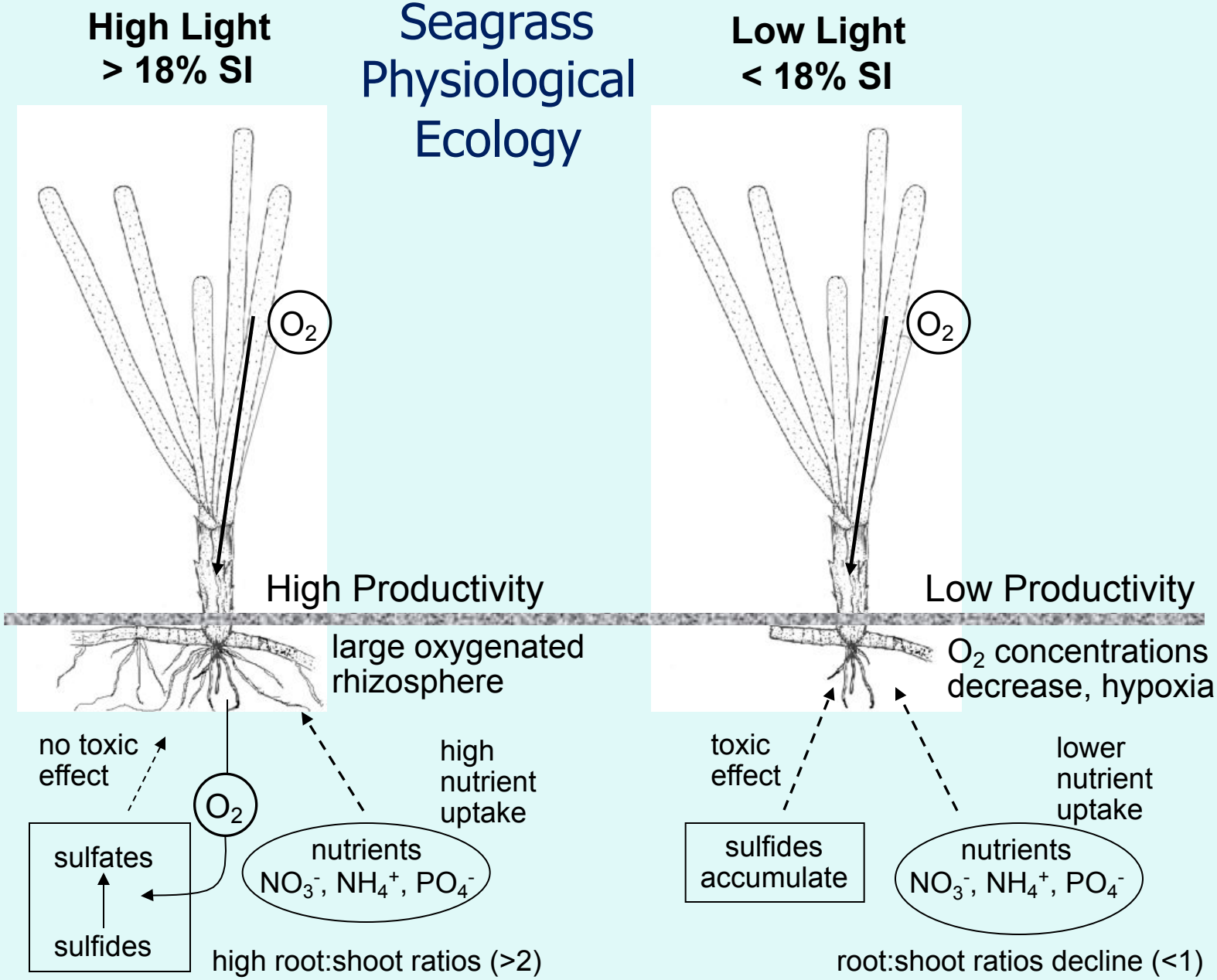
Why are seagrasses important?

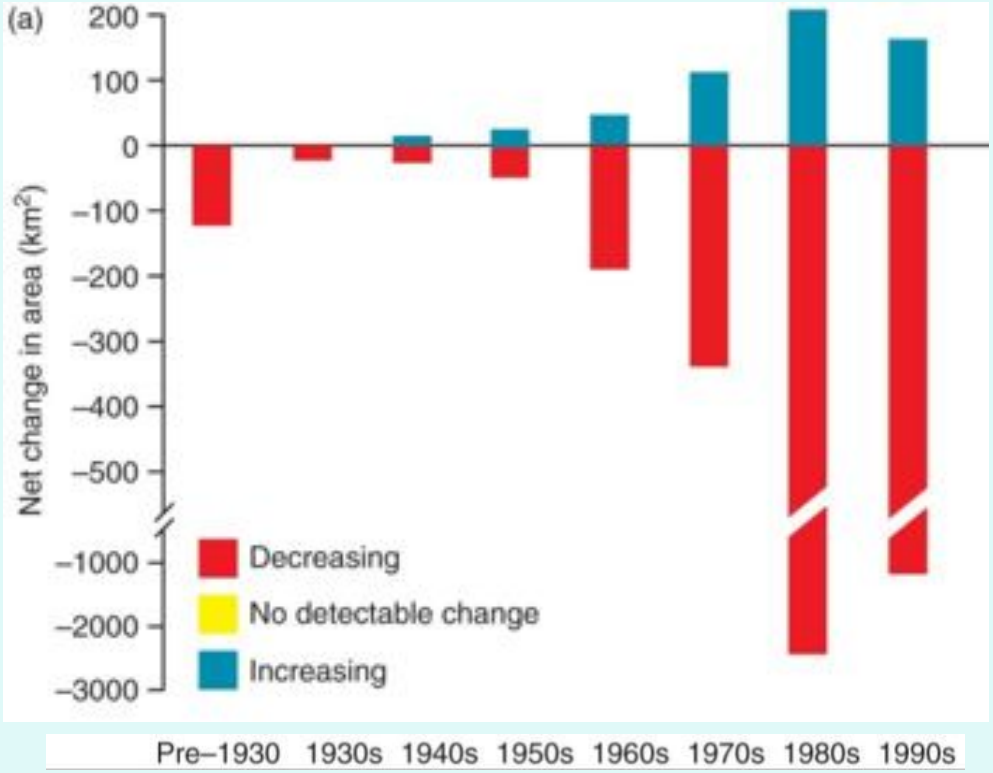
Provide habitat, produce oxygen through photosynthesis and produce enormous amounts of organic carbon



Seagrass Physiological Ecology



Seagrass Cover is Declining Worldwide

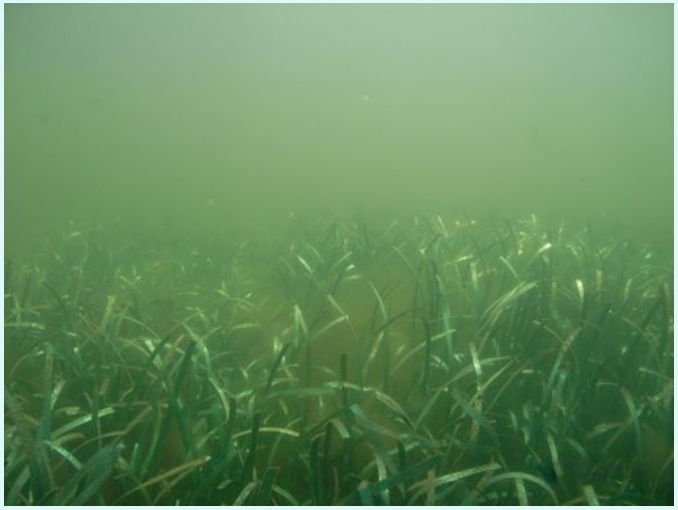


- 18% worldwide decline over past 20 y (33,000km^2)
- Causes
  - Natural (storms, floods, droughts)
  - **Anthropogenic**

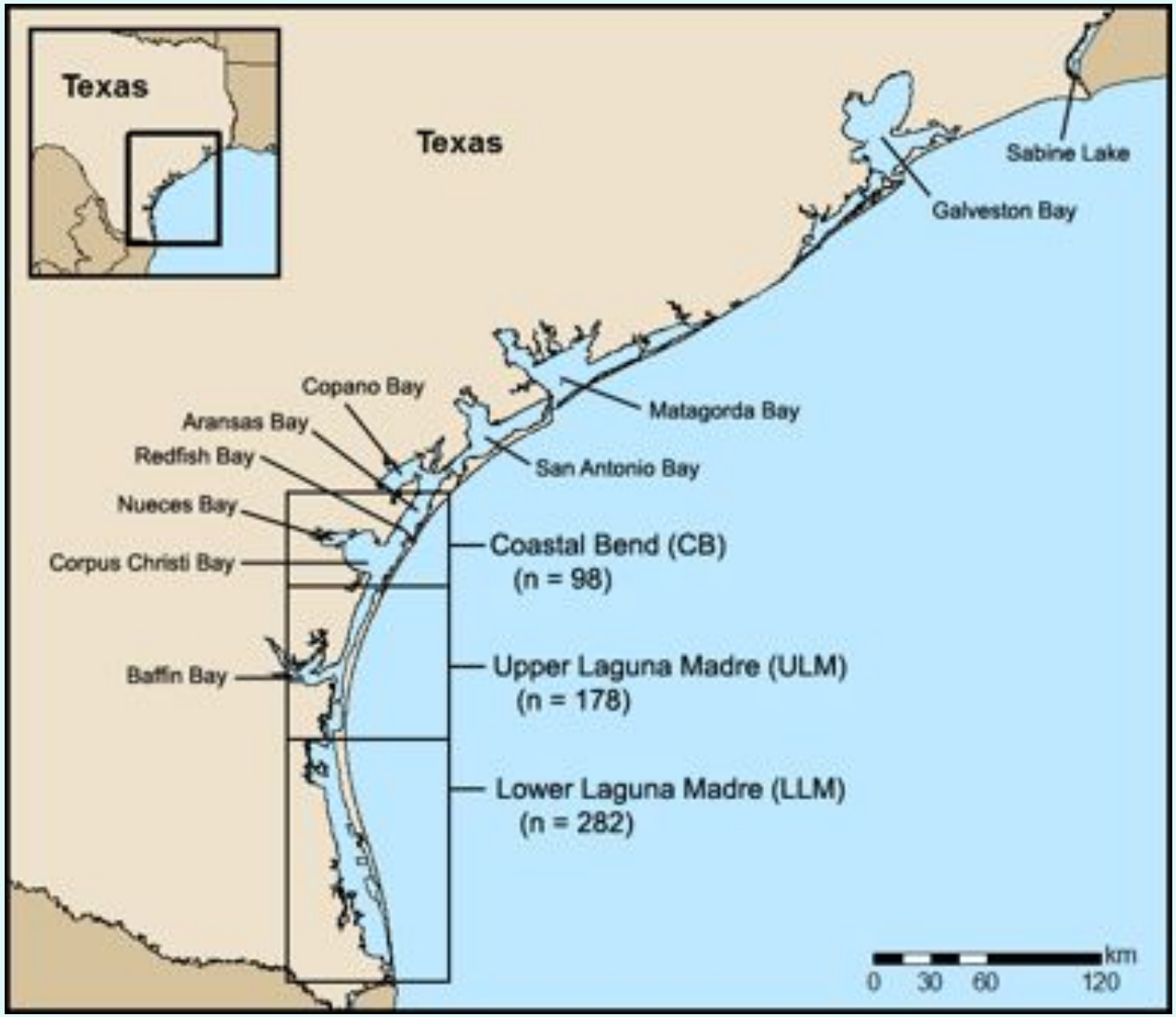
From Waycott et al. (2009)

Concerns

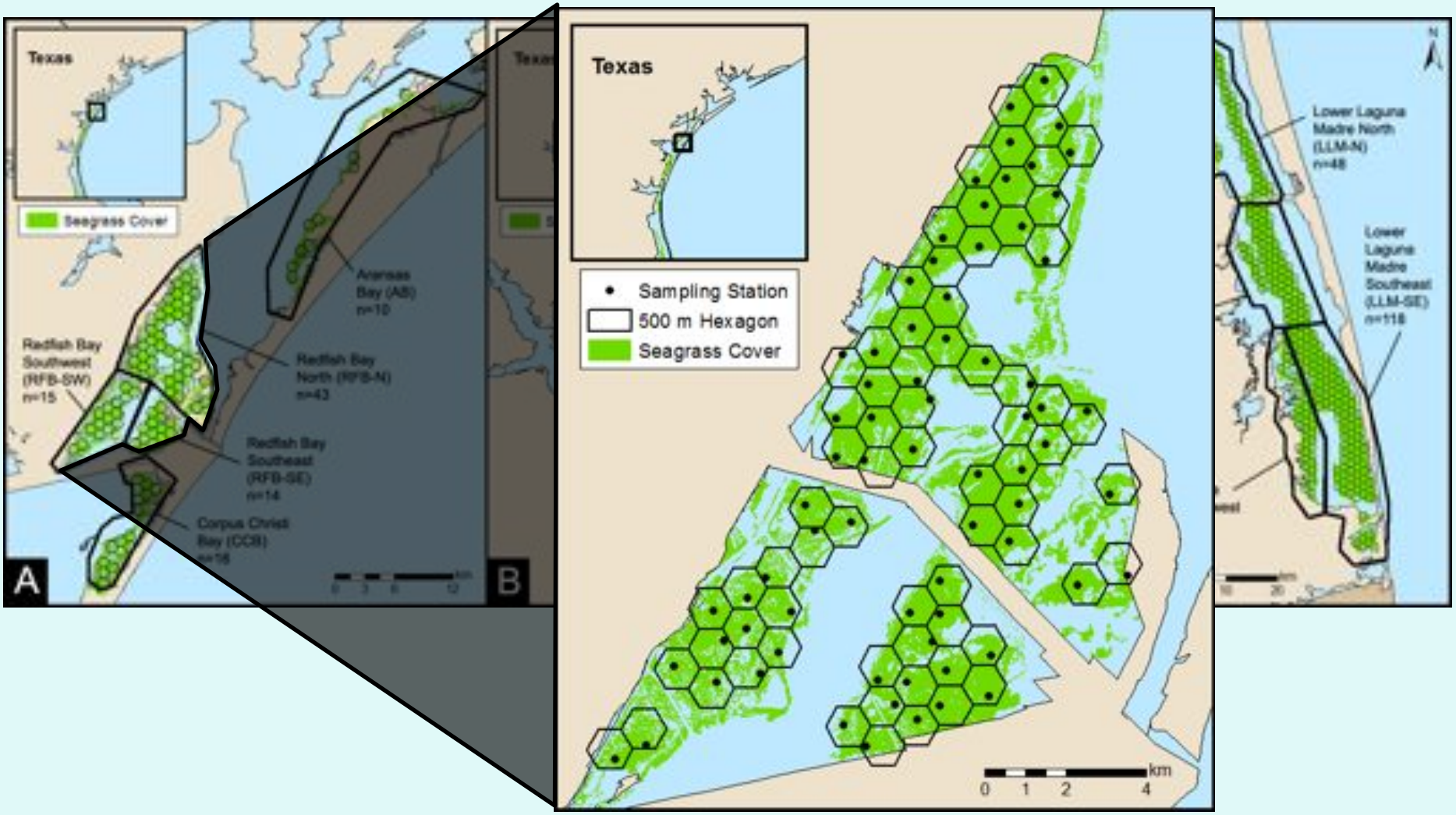
- Habitat degradation resulting in seagrass loss
  - Physical removal of seagrass
  - Increased light attenuation
- Release of CO_2 to atmosphere
- Current rate of seagrass loss and remineralization could result in a release of ~ 299 $TgCyr^{-1}$



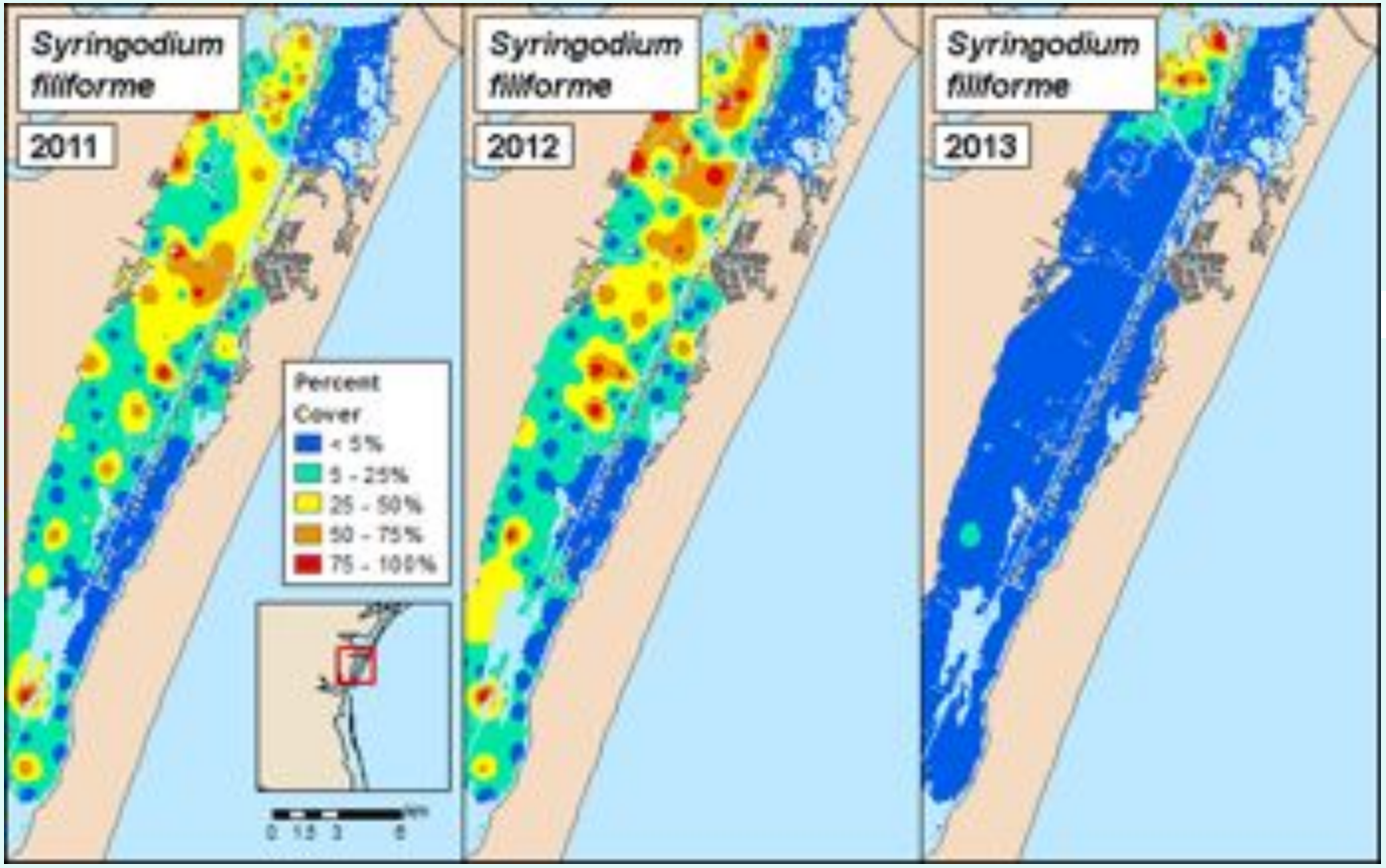
Texas Seagrass Monitoring Program Study Area



Design and Methodology

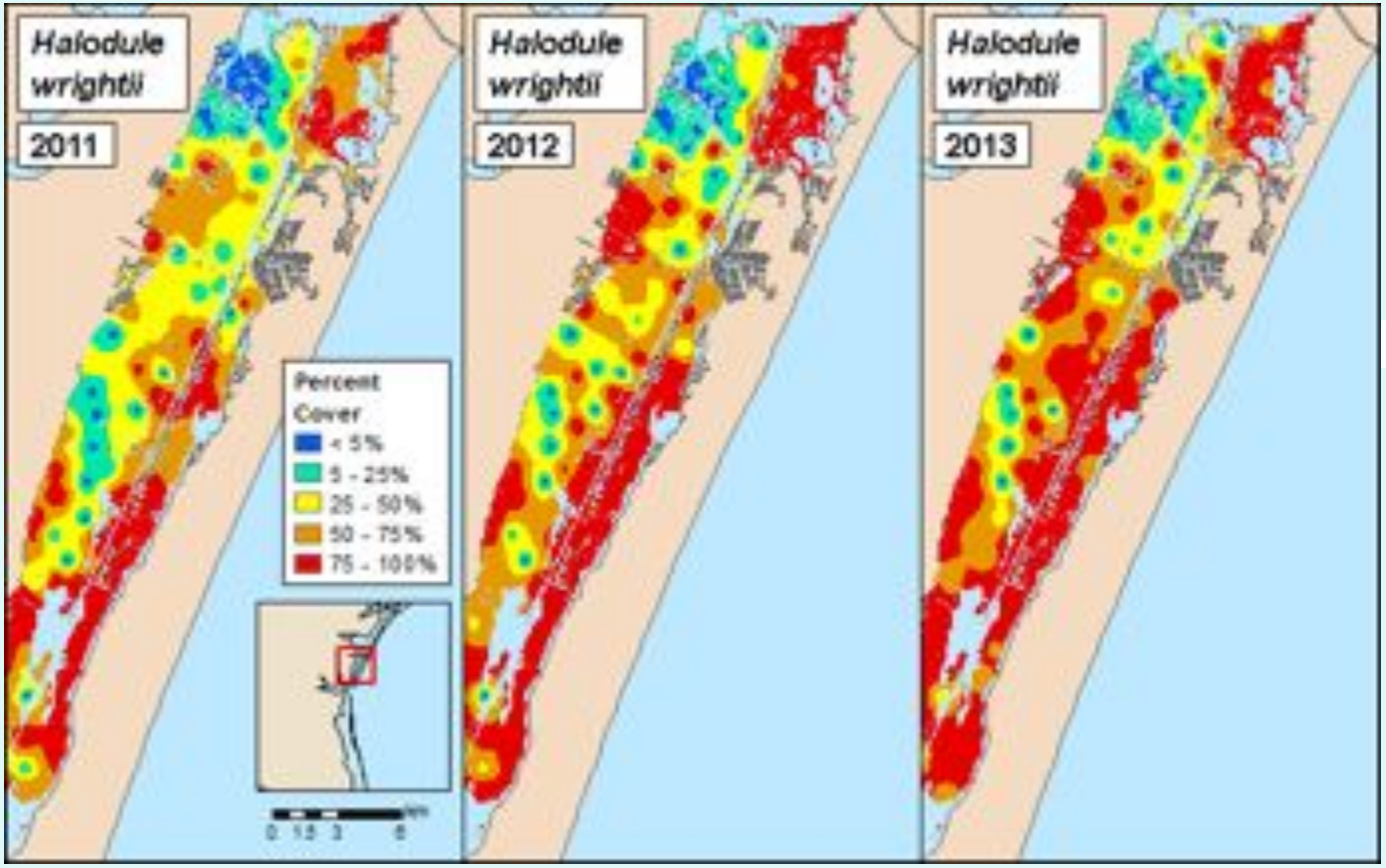


Upper Laguna Madre: *Syringodium filiforme*



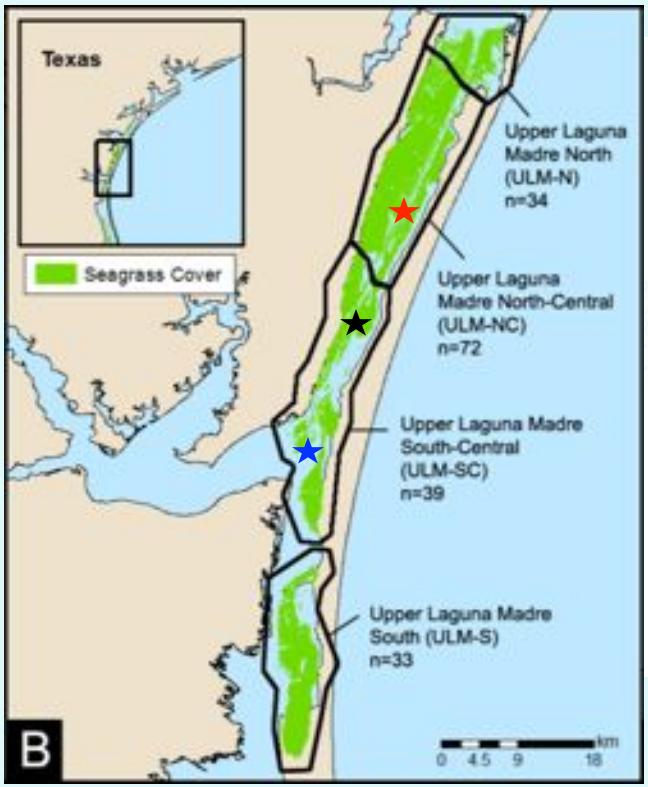
- *Syringodium filiforme* cover decreased across central ULM

Upper Laguna Madre: *Halodule wrightii*

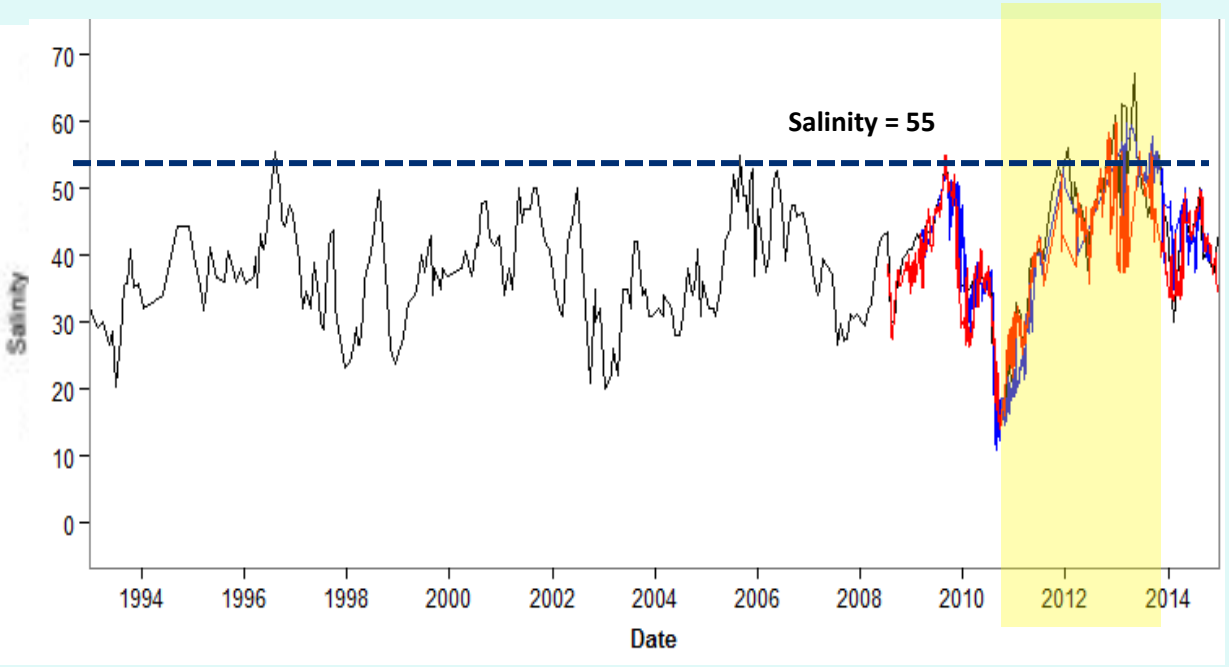


- *Halodule wrightii* cover increased across all subregions

Upper Laguna Madre: Salinity



★ NPS Bird Island station (collected every 15 min)
★ Dunton lab LM-151 station (collected bi-weekly)
★ NPS Baffin Bay station (collected every 15 min)



- Salinities very unstable through time
- Extended period of high (>55) salinity in late 2012 and early 2013

Blue Carbon

- Sediment and living biomass are important carbon stores in coastal environments
- Seagrass meadows occupy only 0.2% of all oceans but bury ~ 27.4 $TgCyr^{-1}$ (Fourqurean et al. 2012)
- Carbon burial in sediments plays an important role in global C budgets

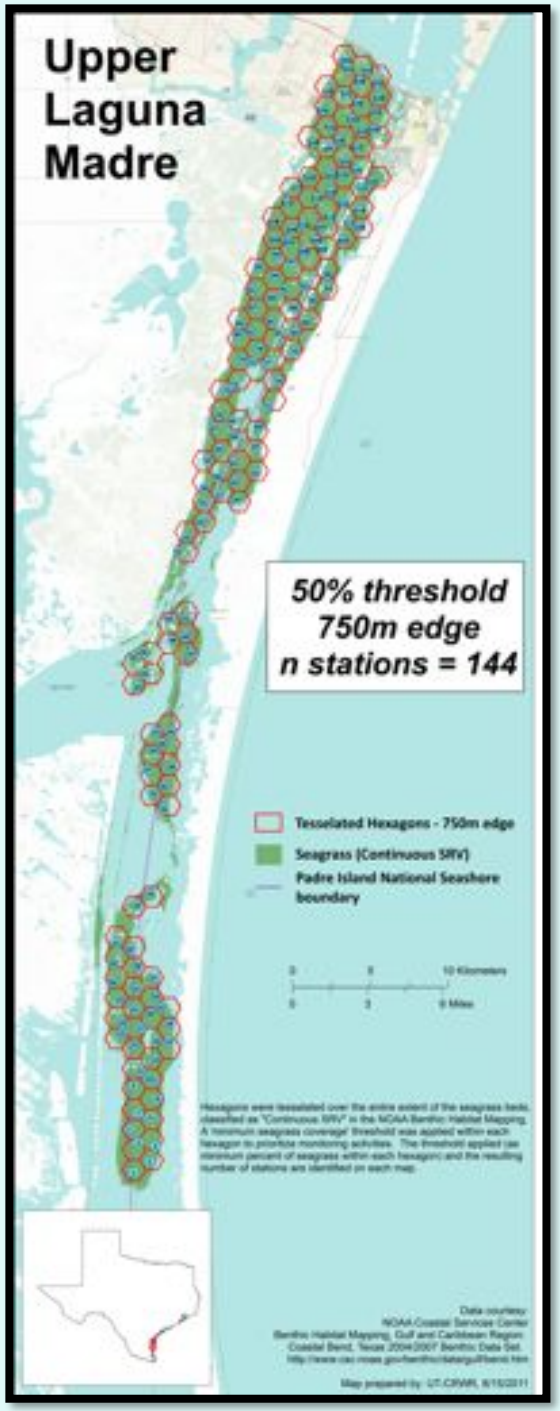
Texas Seagrasses

- Species:
  - *Halodule wrightii*
  - *Thalassia testudinum*
  - *Syringodium filiforme*
  - *Ruppia maritima*
  - *Halophila engelmannii*

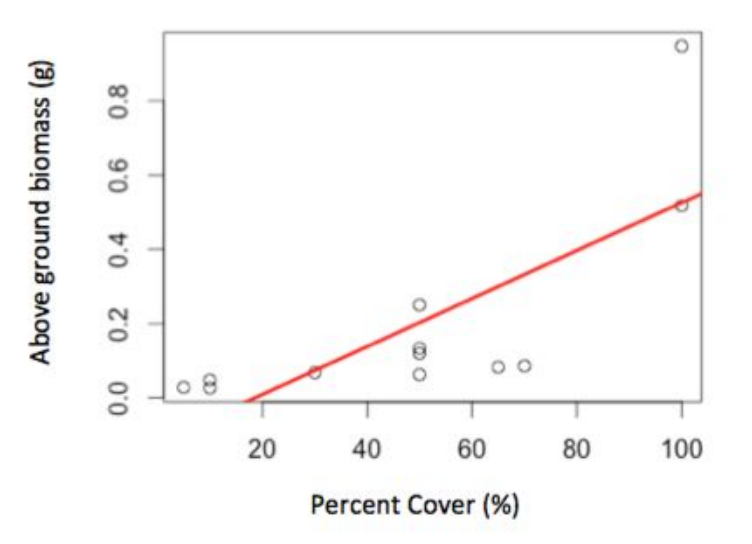
- *Focused on major three:*
  - *H. wrightii, T. testudinum,* and *S. filiforme*

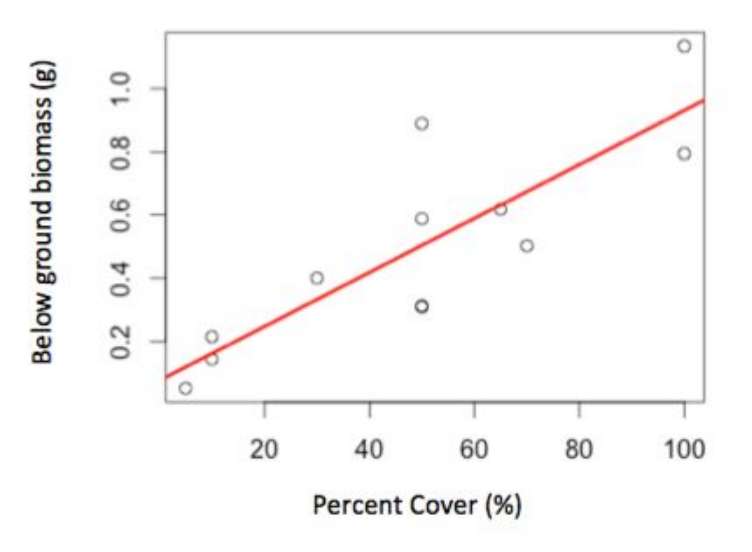
Tier 2 Methods

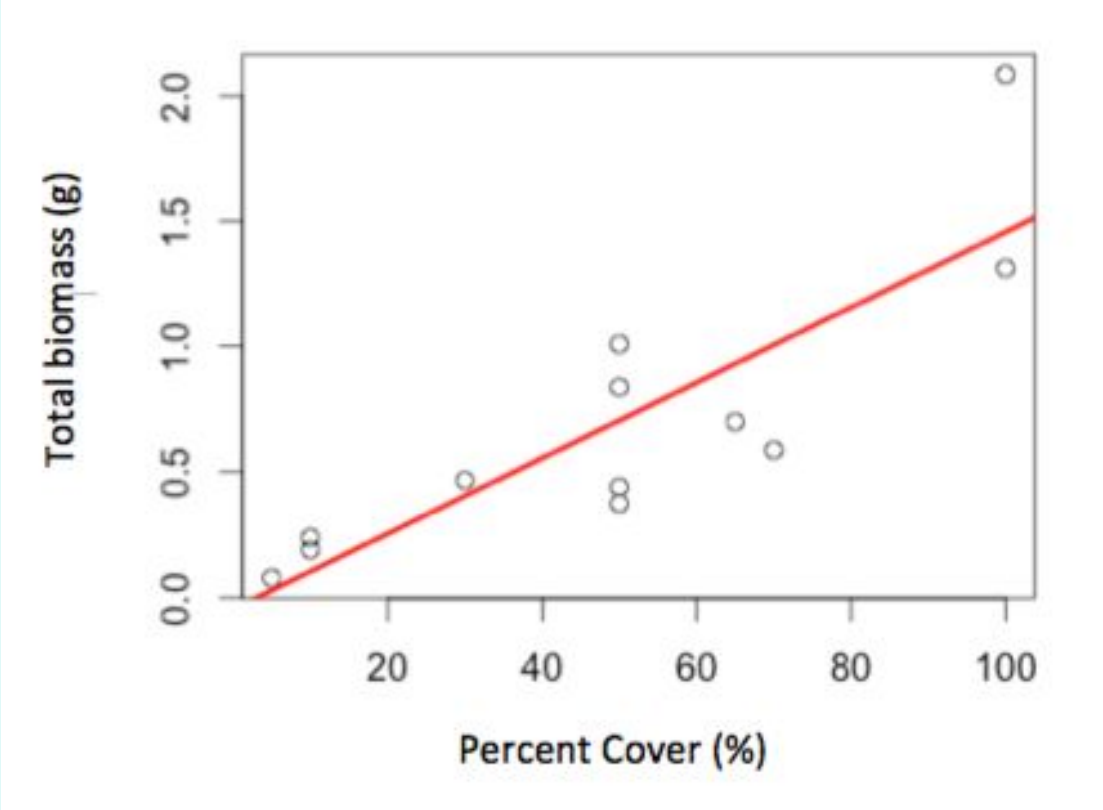
- 567 stations
- 3 Regions:
  - CB: NERR and Corpus Christi Bay
  - ULM: Upper Laguna Madre
  - LLM: Lower Laguna Madre
- Water Quality
- Seagrass height, percent cover
- GIS



Estimating Biomass Using Percent Cover

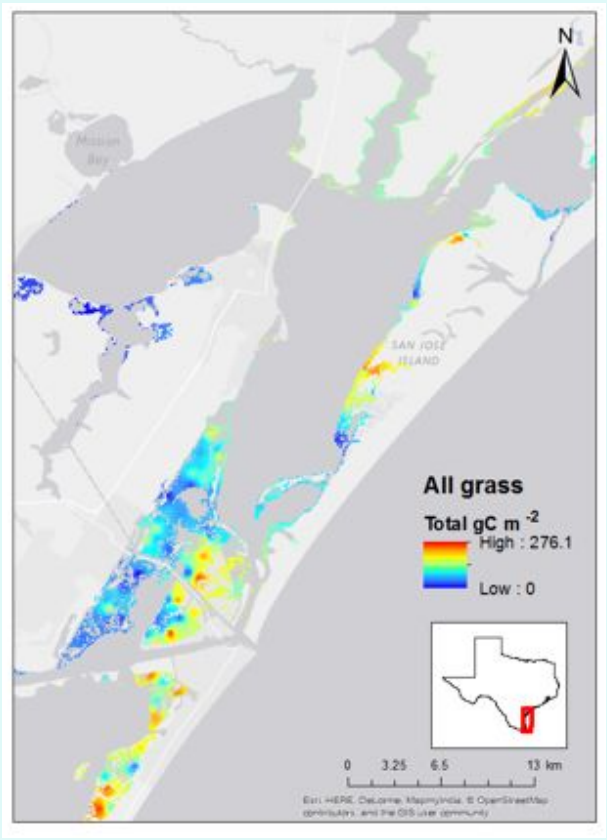




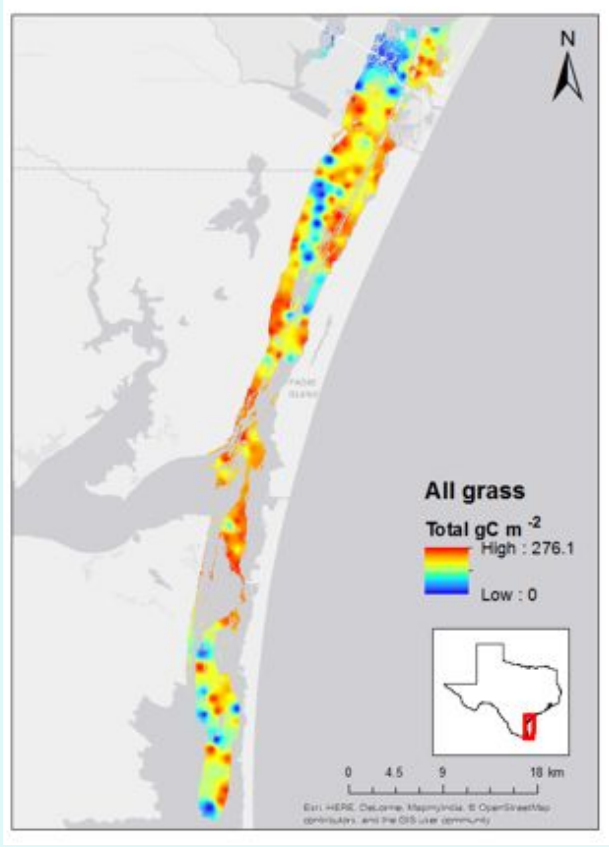


C_{org} in living biomass of *T. testudinum*, *H.wrightii*, and *S. filiforme*

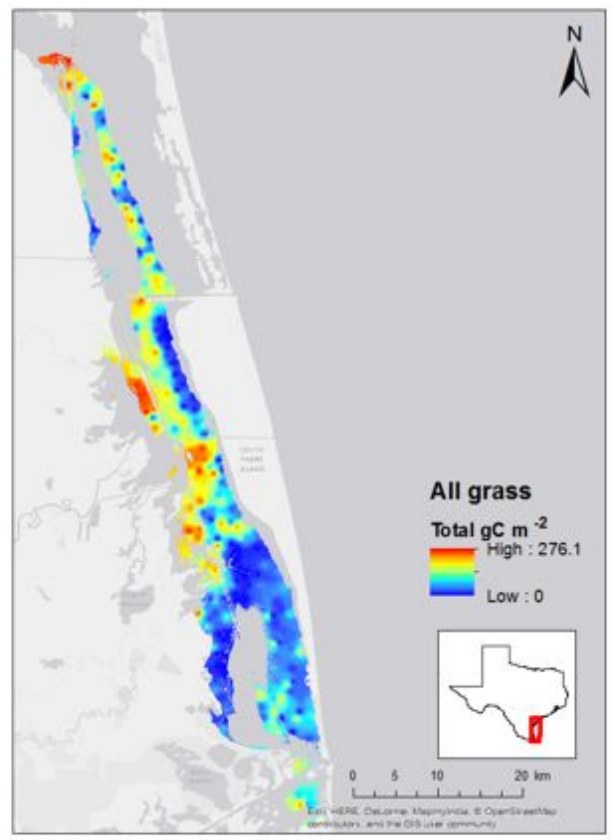
CB



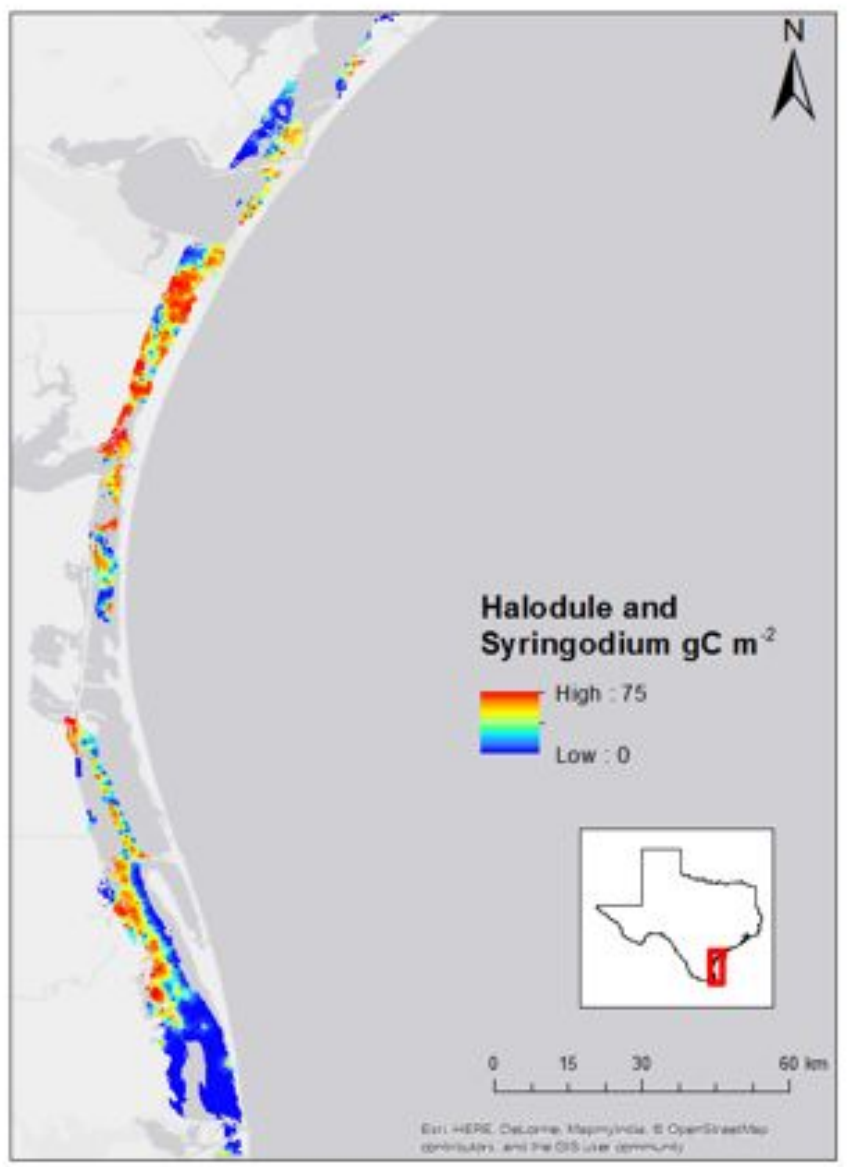
ULM

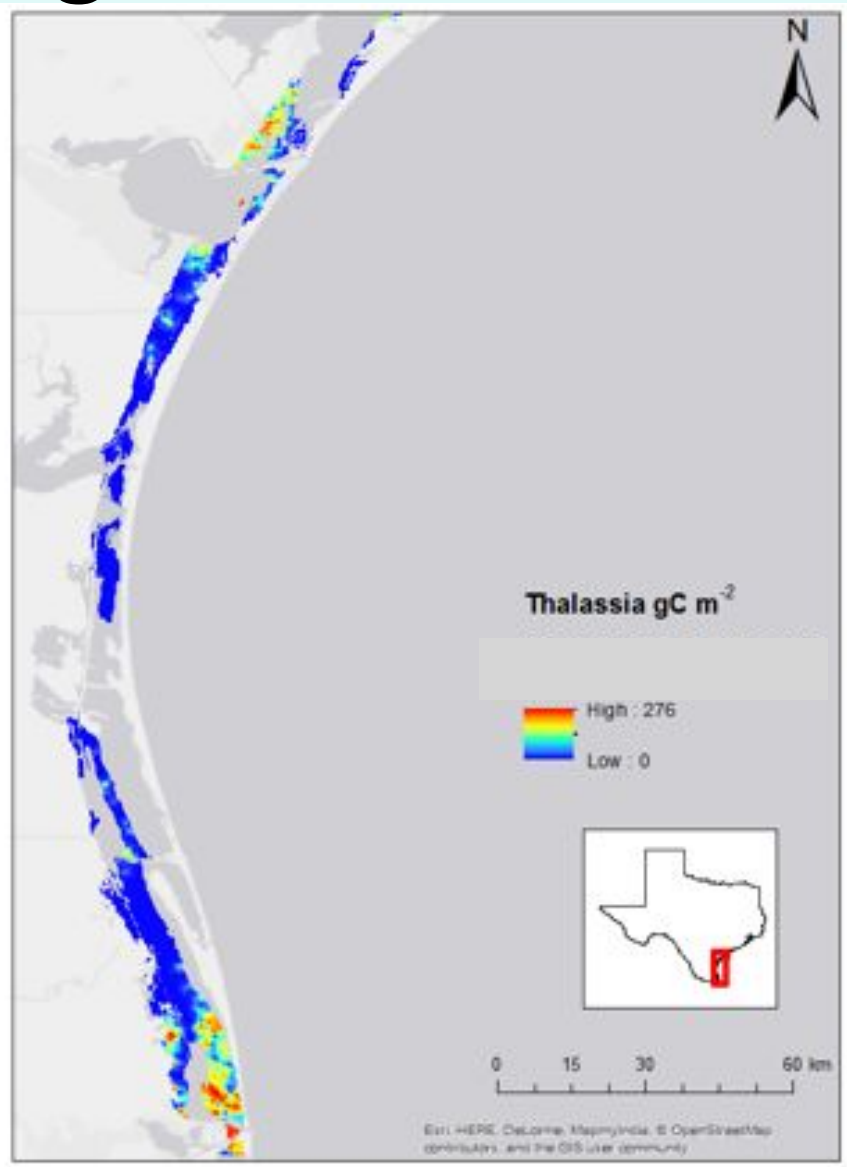


LLM



Above- and below-ground biomass





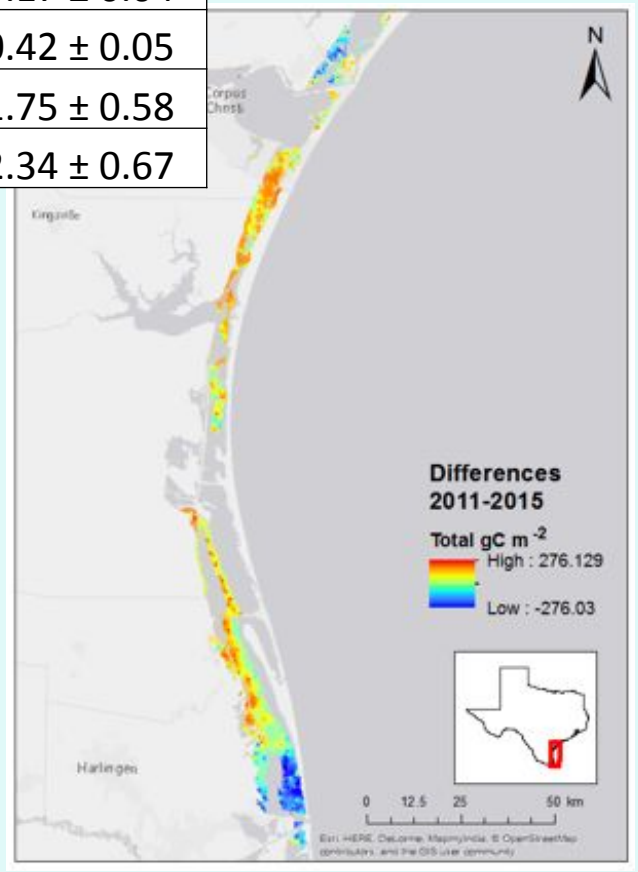
Above- vs. Below-ground Carbon Storage Based on % Cover

	Above-ground biomass (MgC ha^{-1})		Below-ground biomass (MgC ha^{-1})	
	T. testudinum	*H. wrightii* and *S. filiforme*	*T. testudinum*	*H. wrightii* and *S. filiforme*
CB	5.2	2.7	13.0	5.0
ULM	0.0	3.0	0.0	5.3
LLM	11.1	5.2	28.2	9.4

Interannual Variability: Comparison of 2011 and 2015

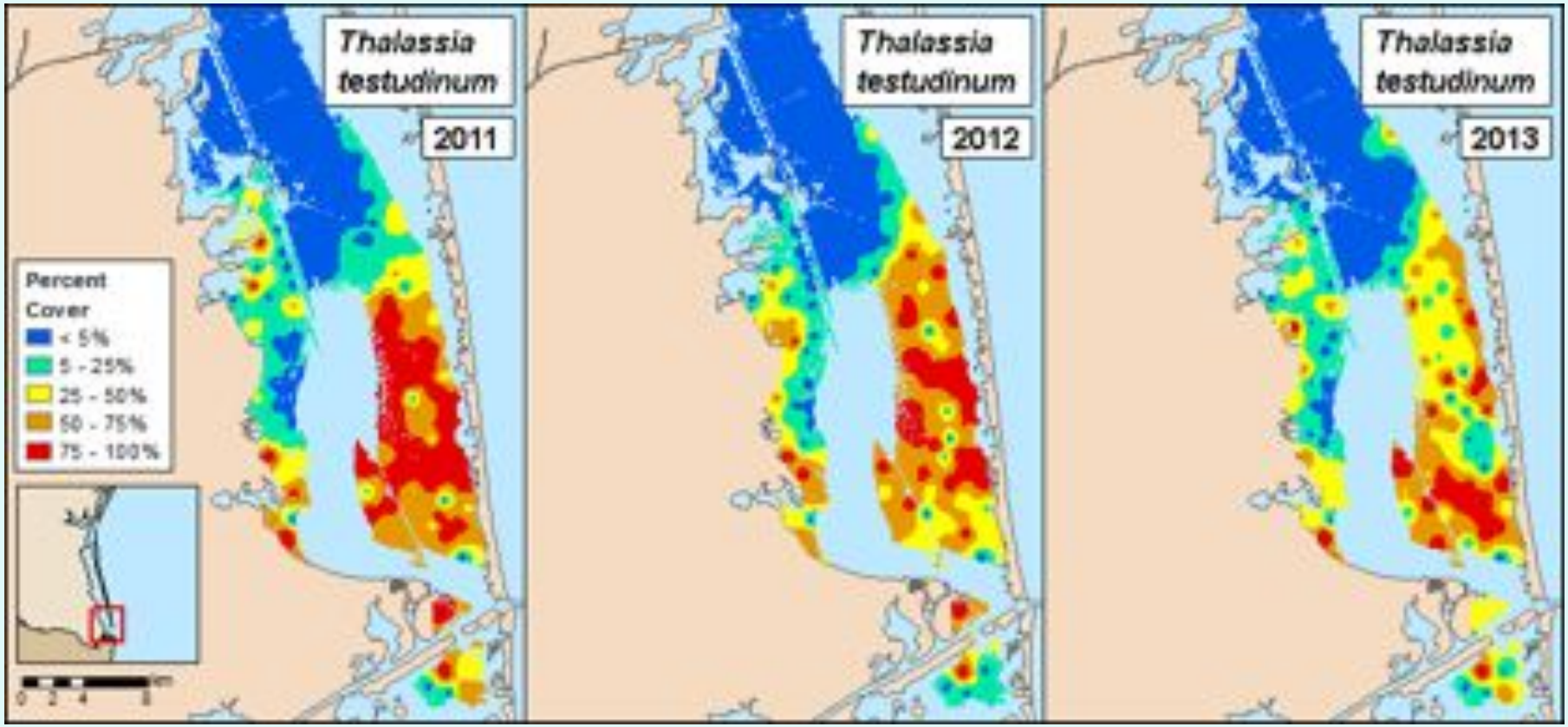
		Percent Cover		TgC ha^{-1}	
	Area (ha)	2011	2015	2011	2015
CB	11000	42.9	33.9	0.17 ± 0.04	0.17 ± 0.04
ULM	25000	72.0	74.5	0.40 ± 0.06	0.42 ± 0.05
LLM	47000	32.5	22.7	1.55 ± 0.49	1.75 ± 0.58
Total	83000	-	-	2.12 ± 0.59	2.34 ± 0.67

- Gains = Red hotspots:
  - ULM
  - Central and northern LLM
- Losses = Blue coldspots:
  - CB
  - Southern LLM



Total = Above- and below-ground

Lower Laguna Madre: *Thalassia testudinum*



- *Thalassia testudinum* cover decreased in LLM-SE

Summary

- Texas coast high C storage potential
- Spatial gains/losses but net increase in percent cover suggests an increase in C_{org} storage in living biomass
- Our next step is to collect benthic samples at our seagrass stations to ascertain C_{org} storage in sediments

Conclusions

- C_{org} storage potential in living seagrass biomass is substantial
- Below-ground storage is a critical C reserve and supply to sediments
  - C storage can extend several meters into the sediments
- Seagrass species composition affects C_{org} variability due to morphological differences
  - Above:below ground biomass ratio varies by species

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