BUILDING ADAPTIVE FOUNDATIONAL RESILIENCE FOR COASTAL WETLANDS: AN EVERGLADES EXPERIMENT

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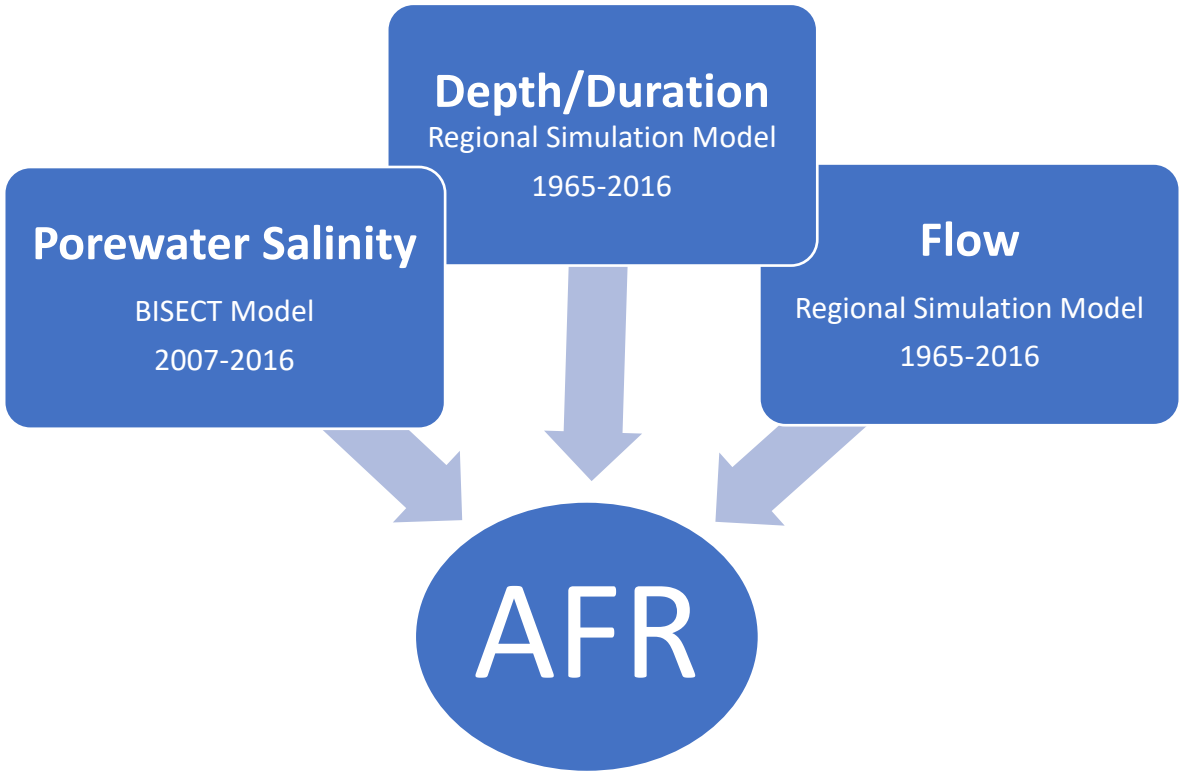
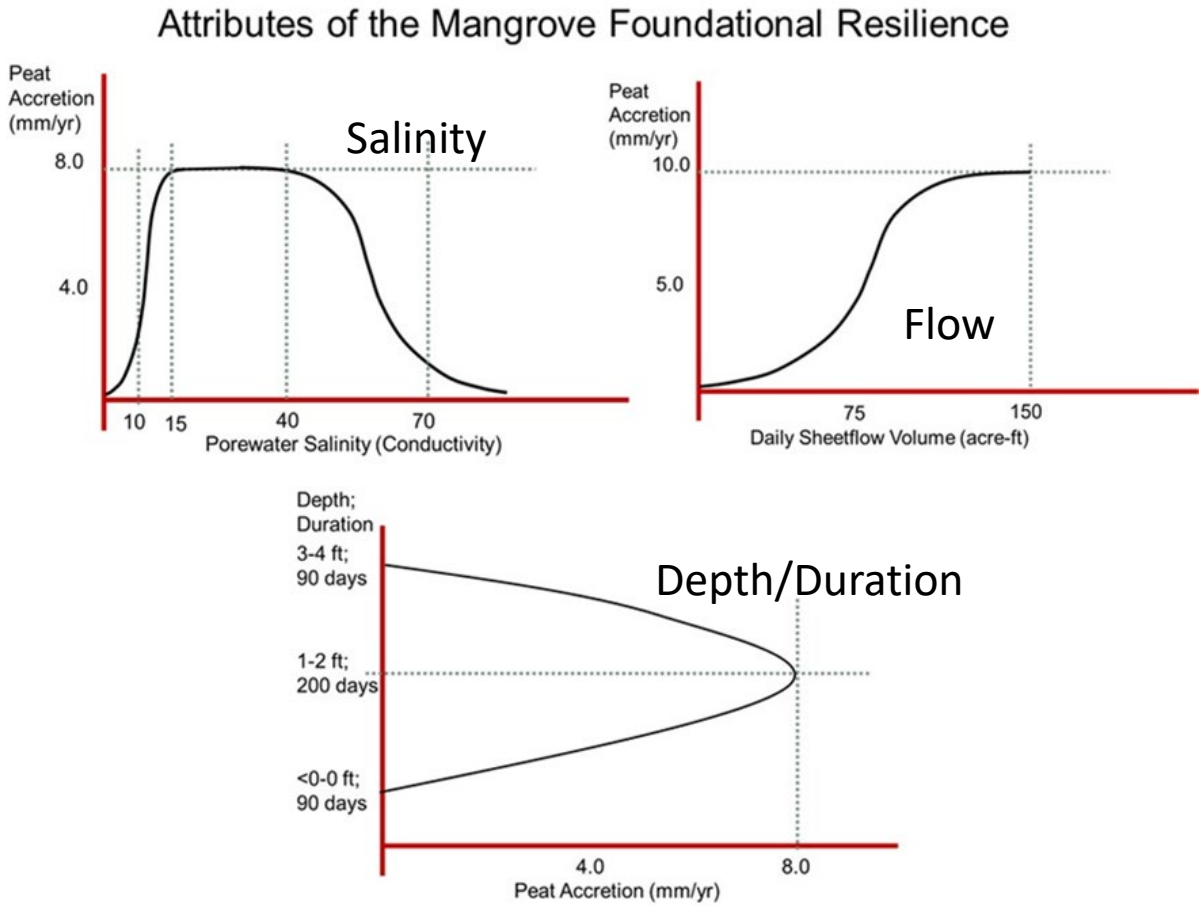
BUILDING ADAPTIVE FOUNDATION RESILIENCE (AFR) FOR COASTAL WETLANDS

Outline

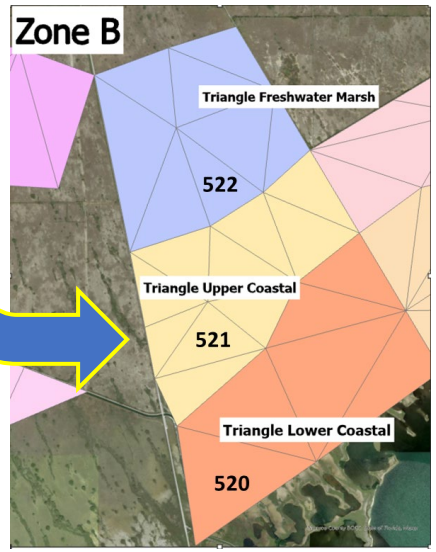
1. Definition and utility of AFR
2. The Sea level Rise challenge
3. Can Thin Layer Placement (TLP) enhance the AFR?

Adaptive Foundational Resilience (AFR) is a measure of the ability of the foundational vegetation (e.g., mangrove) to adapt to sea level rise by *building elevation* as a function of water depth, water quality and flow.

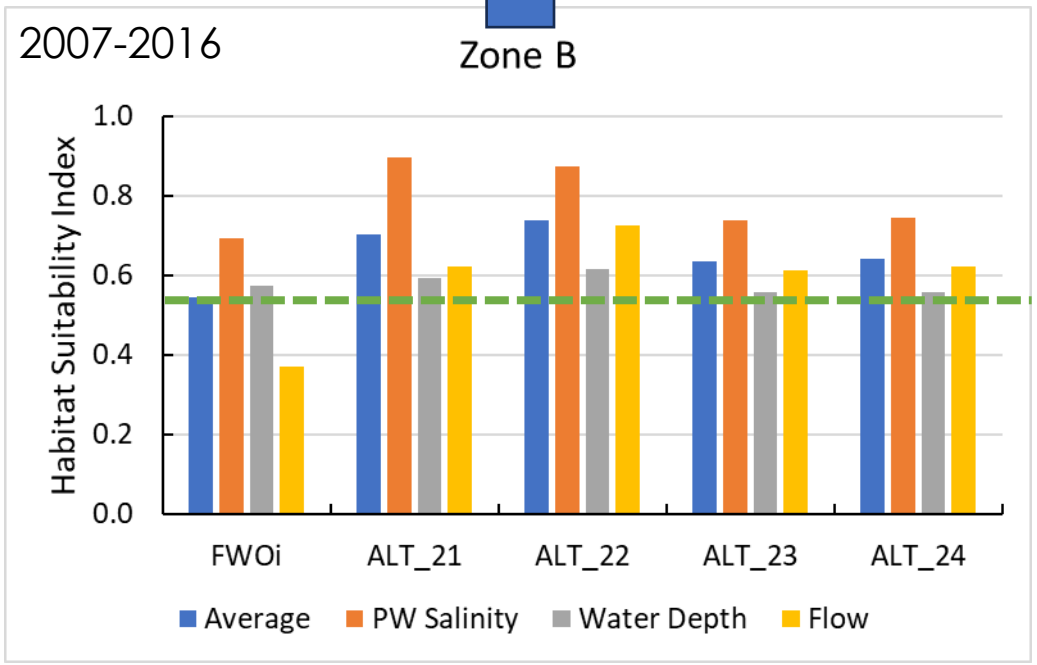




ADAPTIVE FOUNDATIONAL RESILIENCE IN THE SOUTHERN GLADES OF MIAMI



Alternative_22 is the Most Enhanced Mangrove Habitat



Triangle (Zone B)

FWOi Average Score: 0.56

Highest Average Score: 0.75

Best Alternative: ALT22

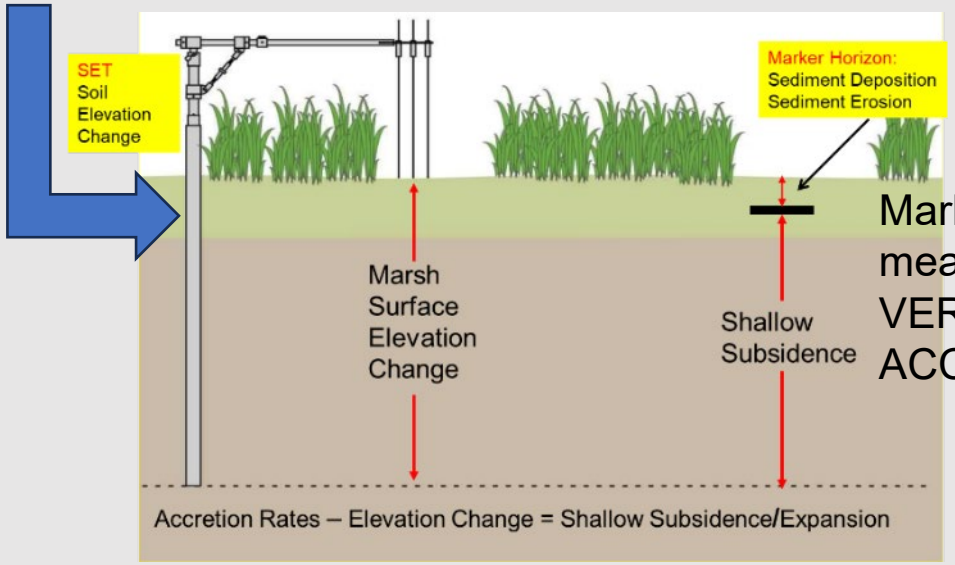
2nd Best Alternative: ALT21

Most Important Attribute: PW Salinity

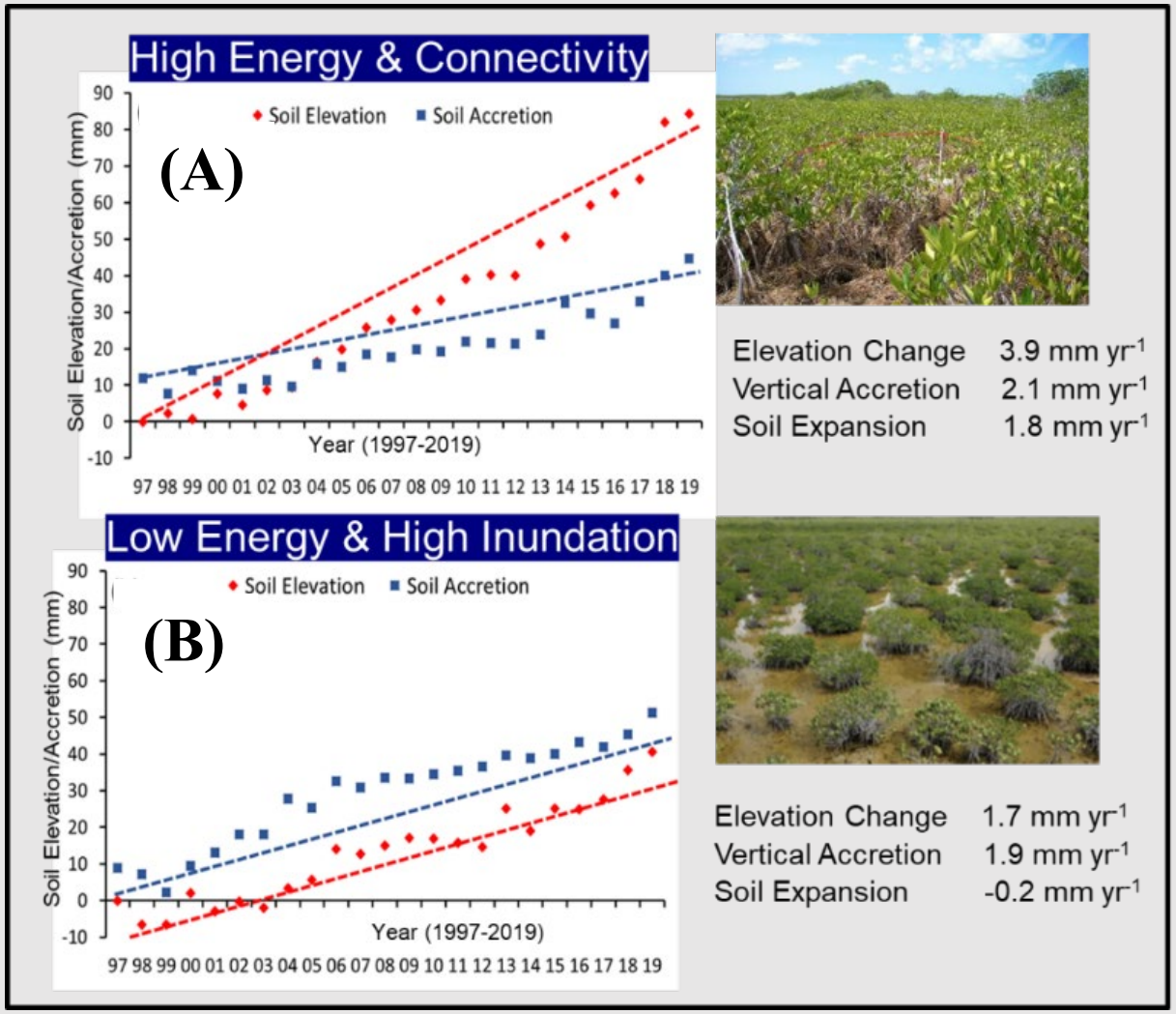
2nd Most Important Attribute: Flow & Depth

2. The Sea Level Rise Challenge (in the SFWMD)

The Surface Elevation Table (SET) measures ELEVATION CHANGE that incorporates both Surface and Subsurface Processes.



Marker Horizons measure VERTICAL ACCRETION



Increased freshwater inflows in Taylor Slough (A) has created accretion rates that range between 3.7 mm/yr and 4.2 mm/yr, which is significantly higher than in areas that are outside the influence of Taylor Slough, such as Highway Creek (B) (From Sklar et al. 2021).

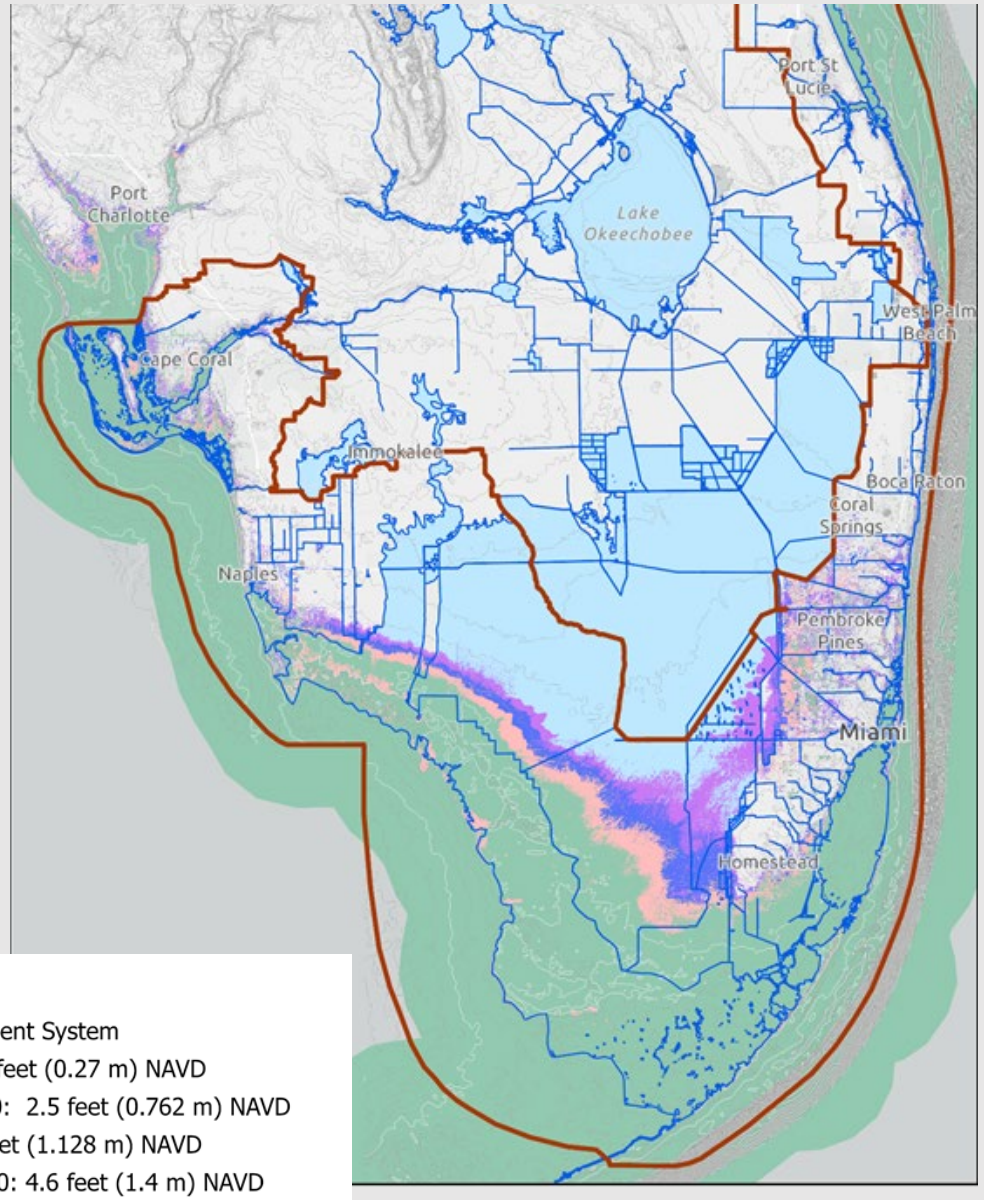
Sklar, FH, C. Carlson, C, Coronado-Molina and A.C. Maran. 2021. Coastal ecosystem vulnerability and sea level rise (SLR) in South Florida: A mangrove transition projection. Front. Ecol. Evol. 9:646083. doi: 10.3389/fevo.2021.646083

2. The Sea Level Rise Challenge (in the SFWMD)

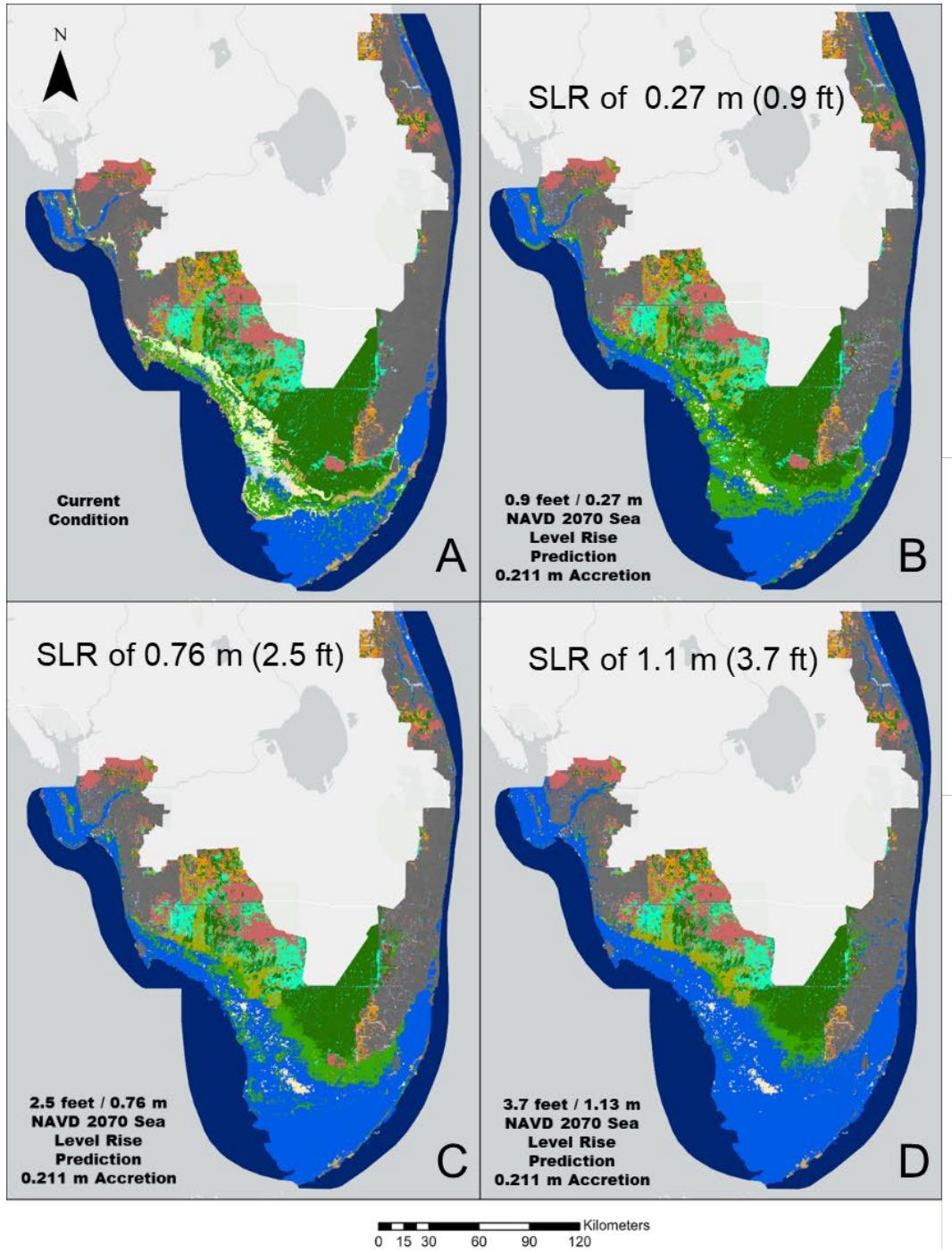
A Mangrove Transition Projection

Land Cover Classification	Transition #1 Water Depth Change (ft)	Transition #1 Wetland Type	Transition #2 Water Depth Change (ft)	Transition #2 Wetland Type
Agriculture	1.0	Estuarine Water		
Barren Land	1.0	Estuarine Water		
Mangrove Swamp	2.5	Estuarine Water		
Saltwater Marshes	2.5	Estuarine Water		
Estuarine Water		No Change		
Saltwater Ponds		No Change		
Tidal Flats		No Change		
Marine		No Change		
Open Water		No Change		
Palustrine Cypress	1.0	Mangrove Swamp	2.5	Estuarine Water
Palustrine Marsh	1.0	Mangrove Swamp	2.5	Estuarine Water
Palustrine Swamp	1.0	Mangrove Swamp	2.5	Estuarine Water
Terrestrial	1.0	Estuarine Water		
Urban		No Change		

"Bathtub" Model of Saltwater Intrusion



The Sea level Rise challenge

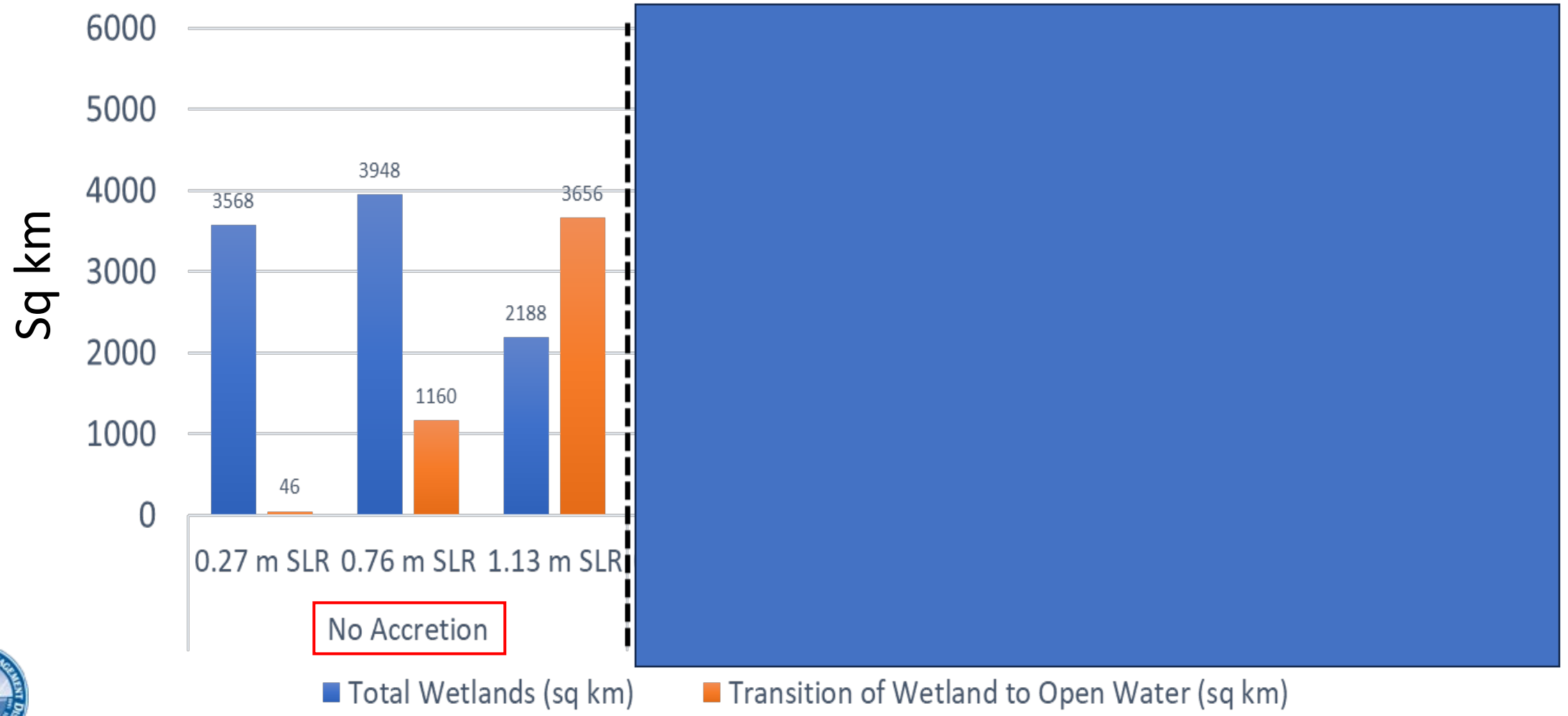


Habitat Transition with an Accretion Rate of 4.2 mm yr-1 (0.211 m by 2070).

- Agriculture
- Barren Land
- Estuarine Water
- Mangrove Swamp
- Marine
- Open Water
- Palustrine Cypress
- Palustrine Marsh
- Palustrine Swamp
- Saltwater Marshes
- Saltwater Ponds
- Terrestrial
- Tidal Flats
- Urban

The Sea level Rise challenge

Three Levels of SLR by 2070:
0.27 m (0.9 ft)
0.76 m (2.5 ft)
1.13 m (3.7 ft)



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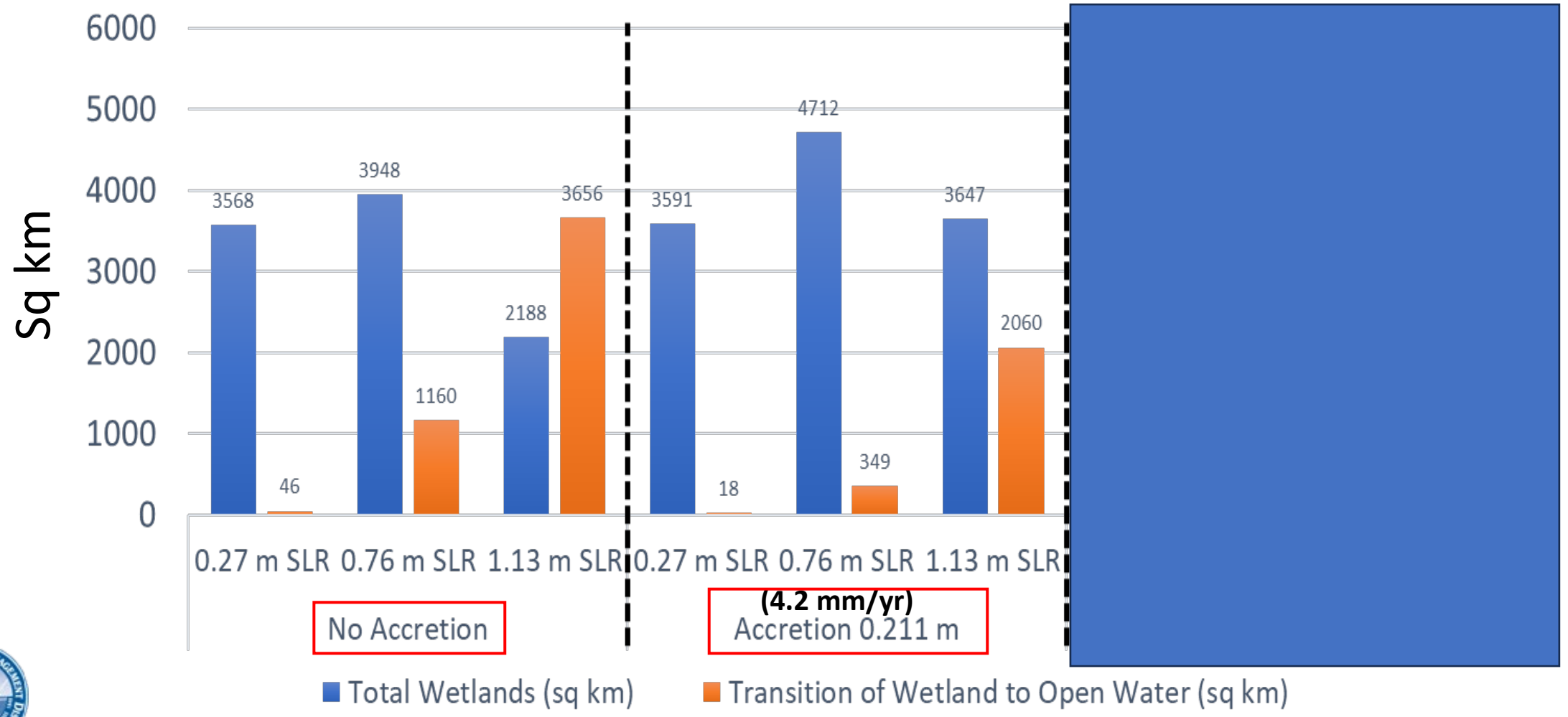

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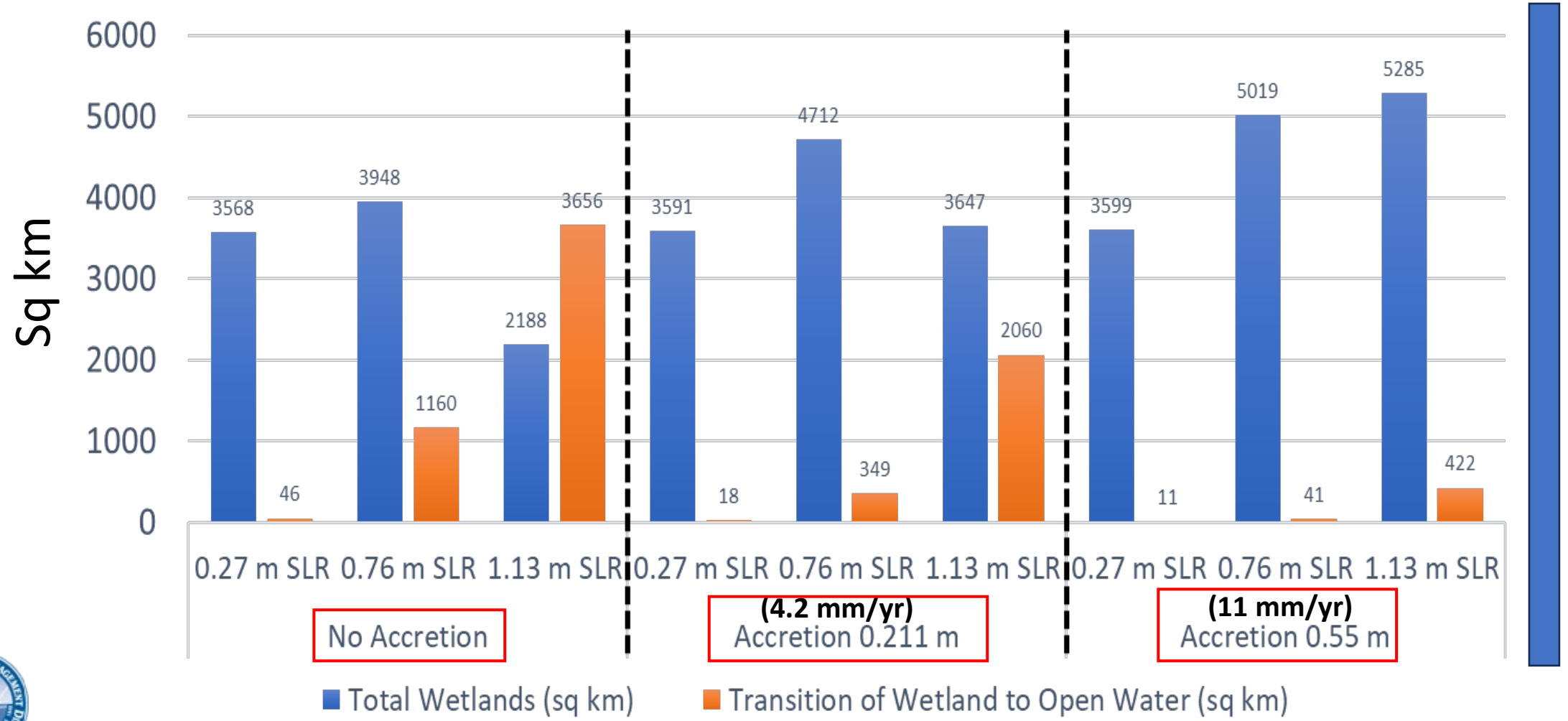
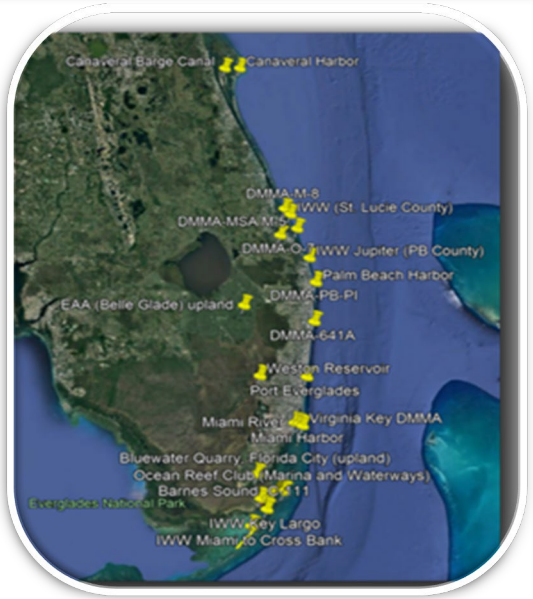


Building Elevation in Mangrove Communities: Can Thin Layer Placement (TLP) Enhance the AFR?

Engineer Design & Research Center Website for Thin Layer Placement: https://tlp.el.erdc.dren.mil/ and a slide show is located here: https://tlp.el.erdc.dren.mil/what-is-tlp/

Known Benefits

- **Cost savings associated with use of dredged material from navigation projects;**
- **Reduction in damages associated with coastal storm hazards;**
- **Benefits to fish and wildlife, including important recreational and commercial fisheries.**



Potential Spoil/Dredge Material Locations

Everglades Mangrove Migration Assessment (EMMA)

Miami-Dade DERM

EMMA is a Resiliency pilot study to assess the foundational vegetation ability to adapt to SLR by building soil/sediment elevation as function of Thin Layer Placement, water depth, Water Quality, salinity and flow volumes.

EMMA Hypotheses

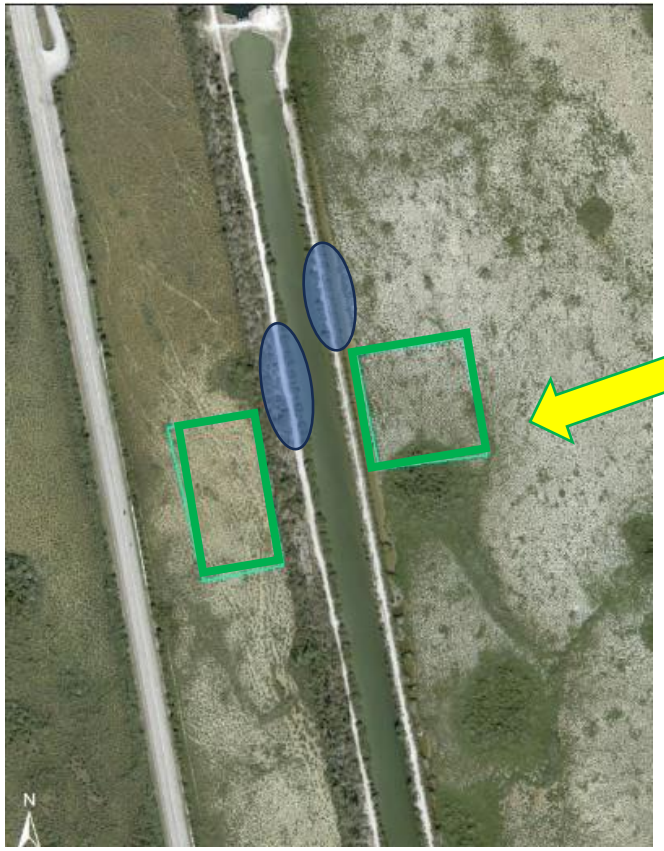
1. Thin Layer Placement enhances the adaptive capacity of red mangroves.
2. Adaptative capacity of red mangroves is positively related to plant C production, P use efficiency and increased rates of elevation >> SLR.
3. Augmented sediment elevation + mangroves + P enrichment confers greater adaptative capacity than without sediment augmentation
4. Mangroves with higher plant C production and P use efficiency influence changes in soil biogeochemistry that promote increased soil C content and accumulation

EMMA Assessment Sites and Spoil Locations for TLP

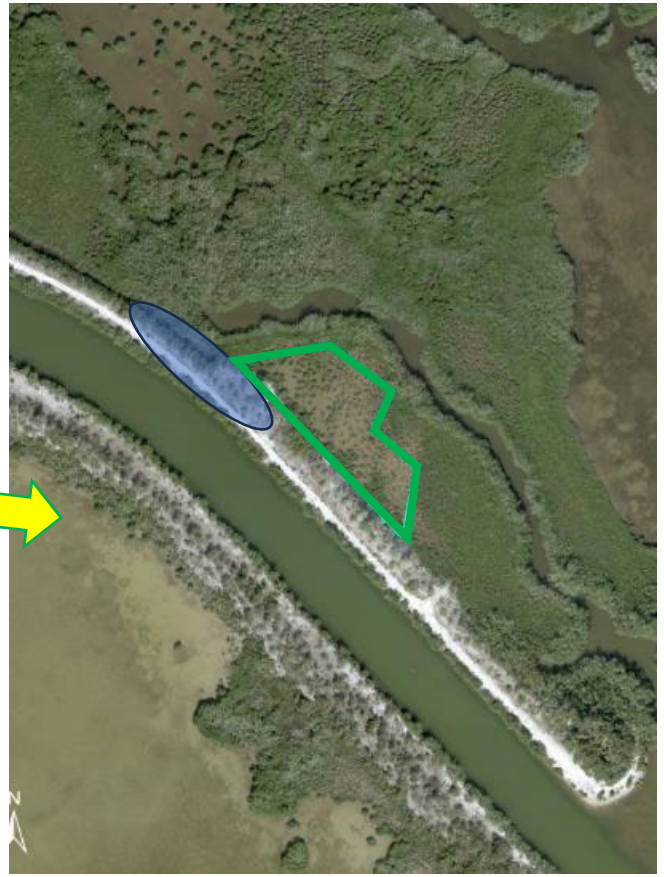
Spoil Site

TLP Treatment Site

S-197 Pocket Site



Sand Transfer System (“Sand Shooter”) used to place sediment in 2012 mangrove mitigation enhancement project (Photos courtesy of Miami-Dade County, Florida).



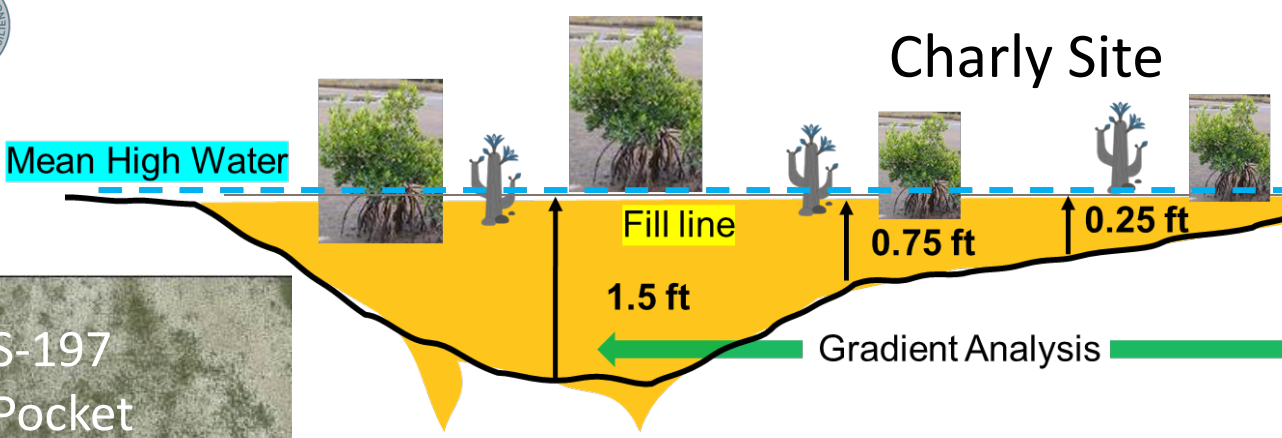
Charly Site

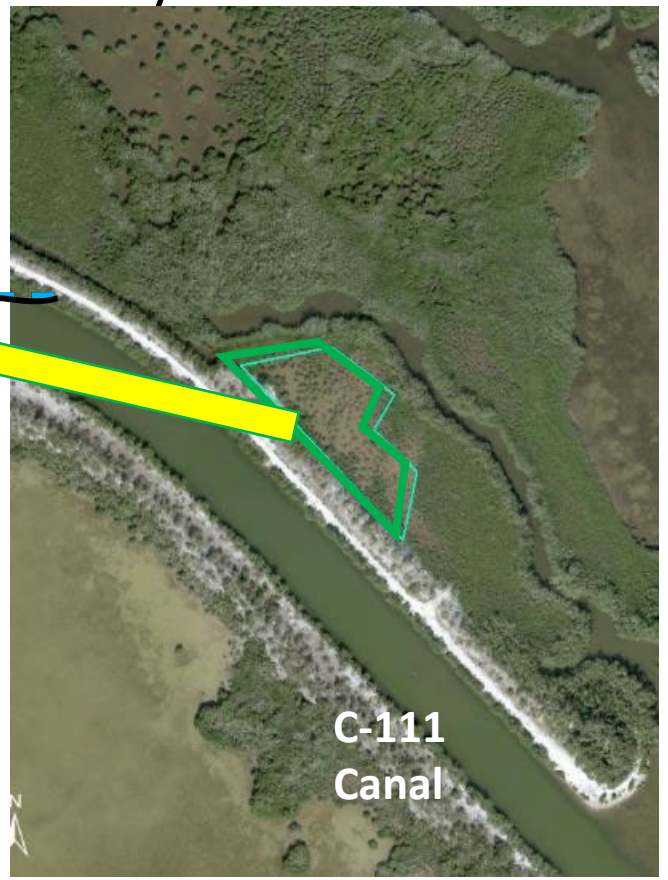
EMMA Experimental Design

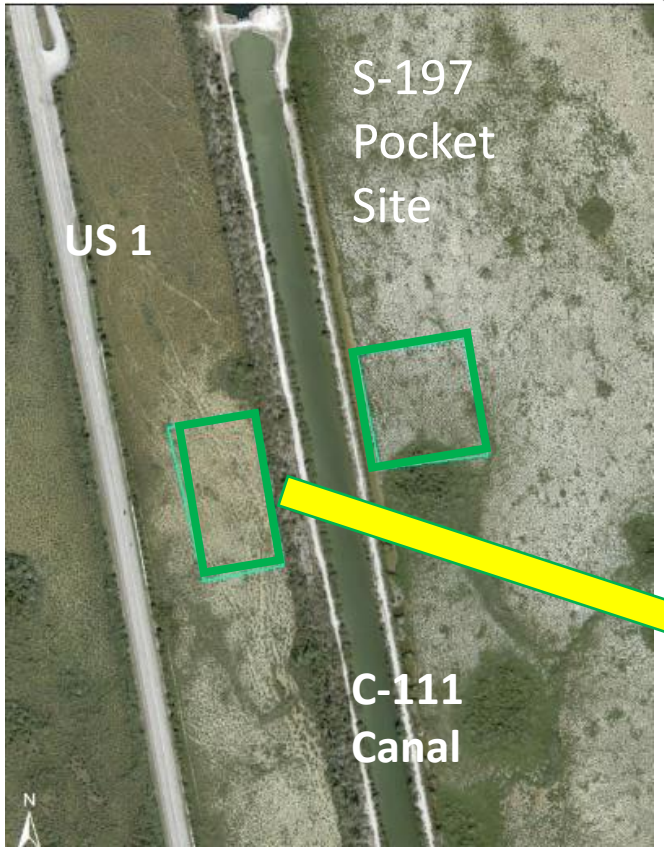
Miami-Dade DERM

FIU

Charly Site







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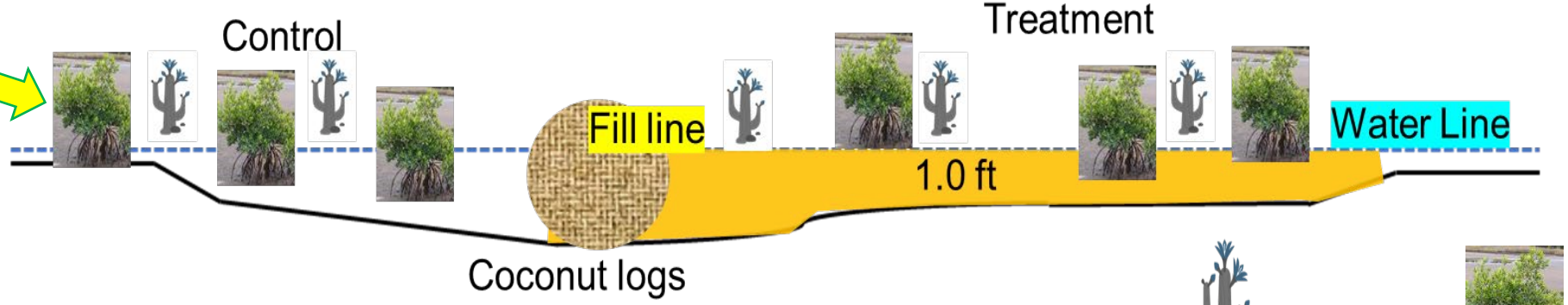

Mangrove Seedling

Scrub Mangrove

In Conclusion:

Coastal wetland loss due to SLR in Florida can be mitigated (to some degree) if society can find ways to increase the Adaptive Resilience of the Foundational vegetation, as it transgresses upstream.

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