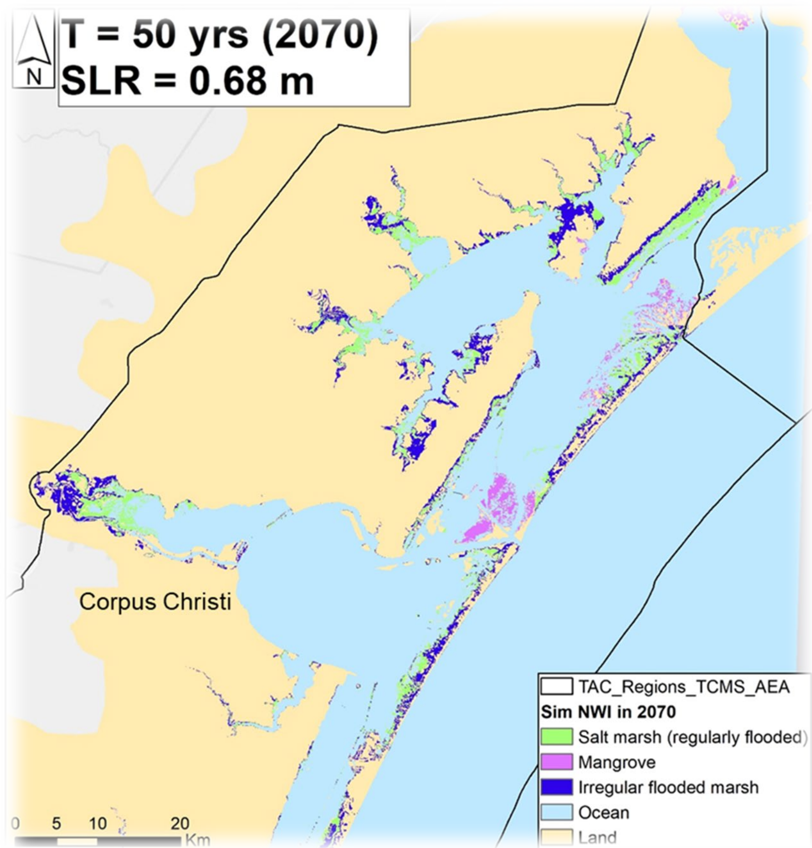
ESLR Coastal Resilience Management Transition Advisory Group Spring 2024 Meeting Report



Report of Activities, Methods, and Results from the
ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
Management Transition Advisory Group (MTAG) Meeting
June 13, 2024

Report Compiled by: Diana Del Angel and Kara Coffey
Edited by: Katya Wowk, Renee Collini, and James Gibeaut

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PI: Dr. James Gibeaut
Co-PI's: Dr. Katya Wowk, Dr. Lihong Su, Dr. Peter Bacopoulos and Dr. Chris Kees

ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend

Management Transition Advisory Group (MTAG) Meeting

June 13, 2024

Harte Research Institute for Gulf of Mexico Studies

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Workshop Summary

The MTAG and ESLR teams convened for a workshop to review project progress, modeling updates, and future steps. The meeting opened with introductions led by Dr. Katya Wowk and Dr. James Gibeaut. Dr. Del Angel provided an overview of past MTAG discussions, highlighting the development of the project's conceptual model and decisions on sea level rise (SLR) scenarios for 2024, 2050, and 2065, along with the integration of natural and nature-based features (NNBFs) into upcoming modeling efforts.

Mukesh Subedee from the ESLR modeling team presented updates on key hydrodynamic modeling components, including the completion of a 1-meter bare-earth Digital Elevation Model (DEM) and improvements in coastal marsh elevation accuracy using LiDAR and satellite data. The team is also refining land cover algorithms, with final products expected by summer 2024. Dr. Peter Bacopoulos shared insights on LSU's wetland modeling, which uses a coupled hydrodynamic-ecological model to simulate the balance between sediment accretion and SLR in wetlands. Preliminary results showed the response of marsh-mangrove distributions under changing tidal conditions.

A discussion followed on the preferred timelines for SLR projections, the need for localized data for infrastructure planning (such as the saltwater barrier in the Nueces River), and the future inclusion of subsidence in the models. The meeting concluded with a plan for the next session, where participants will engage with modeling results, refine output formats, and prioritize NNBFs for the next project phase.

Workshop Objectives

- Refresh on project concept model
- Gain understanding of modeling components being used to frame outputs
- Discuss and agree on most appropriate framing for sea level rise
- Discuss and agree on most useful timesteps and sea level rise scenarios for the MTAG

◊ ◊ ◊ ◊

Workshop Attendants

Meredith Darden, Visit CC

Peter Bacopoulos, LSU*

Kara Coffey, HRI-TAMUCC*

Diana Del Angel, HRI-TAMUCC*

Renee Collini, TWI*

James Gibeaut, HRI-TAMUCC*

Danielle Hale, Port of CC

Jin Ikeda, LSU*

Craig Casper, CC MPO

Chris Kees, LSU*

Emily Martinez, CBCOG

Lihong Su, HRI-TAMUCC*

Mukesh Subedee, HRI-TAMUCC*

Evan Turner, TWDB

Tony Williams, TGLO TCRMP

Katya Wowk, HRI-TAMUCC*

Tom Hall, US Navy Planning Department

*denotes affiliation with project team

Description of Meeting Activities and Content

Welcome and Introductions

Dr. Katya Wowk welcomed the MTAG and ESLR team to the call. Dr. James Gibeaut, Lead-PI, led the introductions for the ESLR team. Following the team introductions, MTAG participants introduced themselves, name and affiliation.

Project Concept Models and Outcomes of Previous MTAG Meetings

Dr. Del Angel presented a summary of the past MTAG meeting outcomes, emphasizing the progress made in both Spring and Fall 2023. The project's conceptual model was used to guide discussions, focusing on how MTAG's input contributed to its development (see Appendix A). For example, timelines of concern were discussed in Spring 2023. In Fall 2023, MTAG reviewed various sea-level rise (SLR) scenarios, ultimately selecting combinations for 2024, 2050 (high and intermediate-low scenarios), and 2065. Additionally, a map of natural and nature-based features (NNBF) was presented, reflecting feedback from Spring 2023, which will be incorporated into upcoming modeling efforts under SLR. The next steps will compare future habitat scenarios with and without NNBFs, informing policy, planning, and socio-economic assessments.

ESLR Modeling Update

Mukesh Subedee, a member of the TAMUCC ESLR modeling team, provided an update on the progress of key modeling components. The team successfully completed the 1-meter bare-earth Digital Elevation Model (DEM), a critical input for hydrodynamic modeling. In addition, they developed a method to improve the accuracy of elevation models in coastal marsh areas, which often experience errors due to dense vegetation. This was achieved by leveraging LiDAR point data and satellite imagery to correct for these discrepancies. Notable accomplishments include a significant upgrade from the previous 2-meter DEM, processing 1.45 terabytes of LiDAR point cloud data and over 500 gigabytes of satellite imagery. The team is also continuing work on land cover data, refining their algorithm using the same datasets as the DEM. The land cover product is expected to be completed by summer 2024.

Wetland Modeling Updates

Dr. Peter Bacopoulos provided an update on the modeling work being conducted by the LSU team, which is focused on wetland modeling under changing sea level conditions using a coupled hydrodynamic-ecological model. This model is based on research that examines the zonation of wetland habitats in relation to the frequency and depth of tidal inundation, a concept known as ecological equilibrium. This equilibrium represents the balance between sediment accretion and sea level rise. The modeling process involves updating sea level, elevation, and surface roughness through the ADCIRC (hydrodynamics) and WEADS (ecological response) models. These updates yield outputs such as tidal levels and the response of marsh-mangrove distributions. Dr. Bacopoulos presented a table detailing the time steps and corresponding sea level rise in centimeters relative to the present day (2020), along with the modeling steps that occur at each stage. He concluded by showcasing a series of maps that illustrate some of the preliminary results from this modeling effort.

Discussion

A discussion took place regarding the scheduling of sea level rise (SLR) projections, with a preference expressed for a 25-year timeline. It was noted that aligning this schedule with the state's 50-year water supply planning report could provide actionable insights, particularly concerning the impact of SLR on structures like the saltwater barrier in the Nueces River. The team discussed the usefulness of visualizations for communicating complex information to both laypeople and management, although some participants pointed out that projections extending beyond 50 years may be less actionable due to shorter planning cycles, such as legislative terms.

The conversation also addressed the need for more localized data when considering issues like the potential breaching of the saltwater dam, which requires high-resolution modeling and possibly computer-aided design (CAD) data. Subsidence, a geotechnical concern affecting the region, was also raised. Although subsidence is currently not included in the models, the team acknowledged its importance and expressed an intent to incorporate it into future updates.

The discussion concluded with clarification on what the current models do and do not address. While the models focus on wetland habitats, questions about saltwater intrusion into freshwater supplies were noted as a potential area for future model expansion. It was emphasized that models should be adapted as needed to address emerging concerns, without straying from their original design purpose.

Next Steps

The meeting concluded with a brief discussion on next steps. Participants shared their availability, narrowing down potential meeting dates. Kara Coffey will follow up with logistics. In the next meeting, participants will have the opportunity to review and interact with some of the results, discuss output formats and potential reporting tools, and prioritize the natural and nature-based features (NNBFs) that will be used in the next phase of modeling.

Appendix A: Workshop Agenda

ESLR Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
Management Transition Advisory Group (MTAG) Virtual Meeting
June 13, 2024
9:00-10:00 AM CDT
Microsoft Teams Virtual Meeting Information Below

Workshop Objectives:

- Refresh on project concept model
- Gain understanding of modeling components being used to frame outputs
- Discuss and agree on most appropriate framing for sea level rise
- Discuss and agree on most useful timesteps and sea level rise scenarios for the MTAG

Meeting Agenda

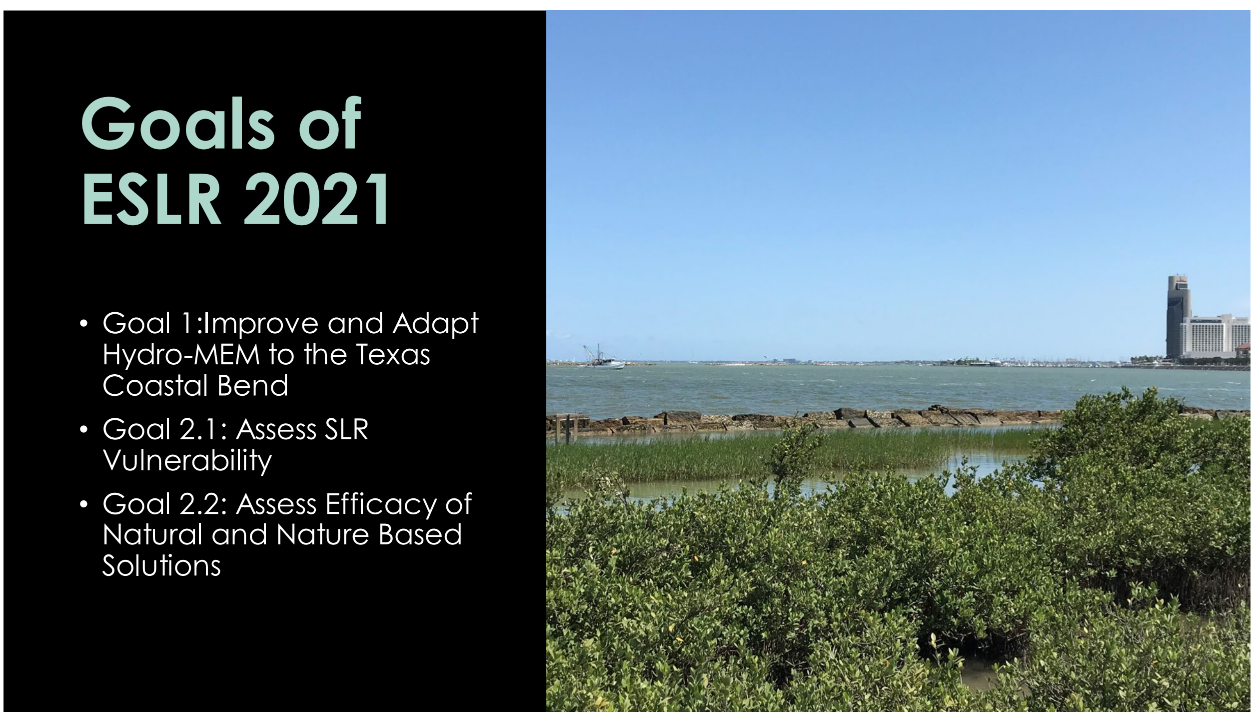
Time	Item
8:50	[meeting opens for technology check]
9:00	Welcome, Around the Virtual Room & Refresh
9:10	Concept Model Review and Updates/Outcomes of last meeting
9:20	Update & Discussion on Modeling Components • Presentation • Questions & Discussion
9:40	Discussion on Project Outputs
9:55	Fall'24 MTAG In-Person Meeting and Next Steps
10:00	Adjourn

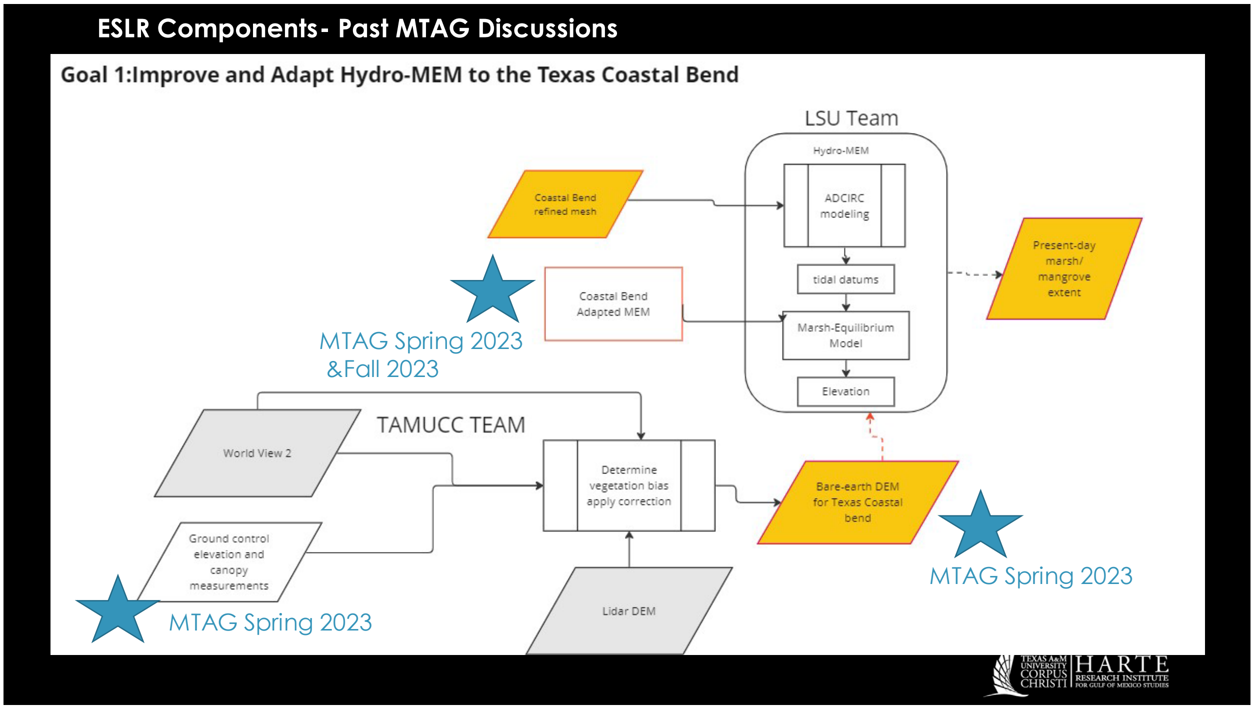
Meeting Information: Join the meeting now
Meeting ID: 213 353 623 726
Passcode: a78UdJ

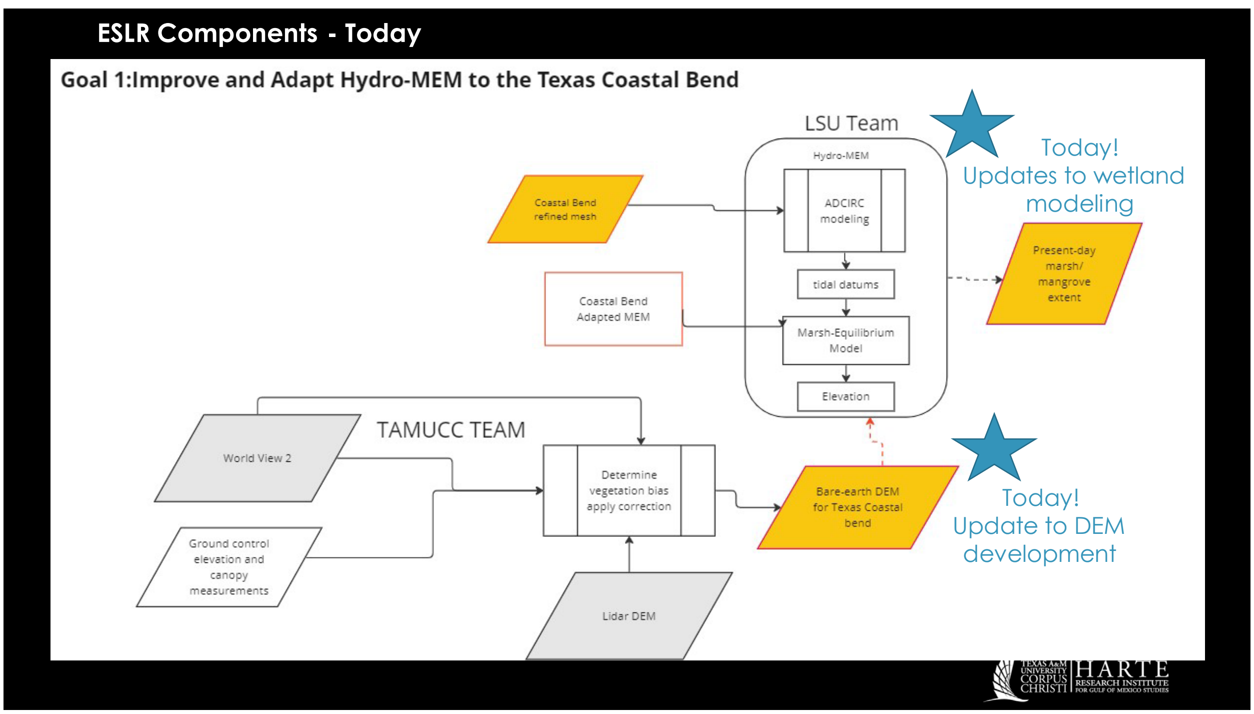
Dial-in by phone
+1 361-434-5376,,899607003# United States, Corpus Christi
Find a local number
Phone conference ID: 899 607 003#
For organizers: Meeting options | Reset dial-in PIN

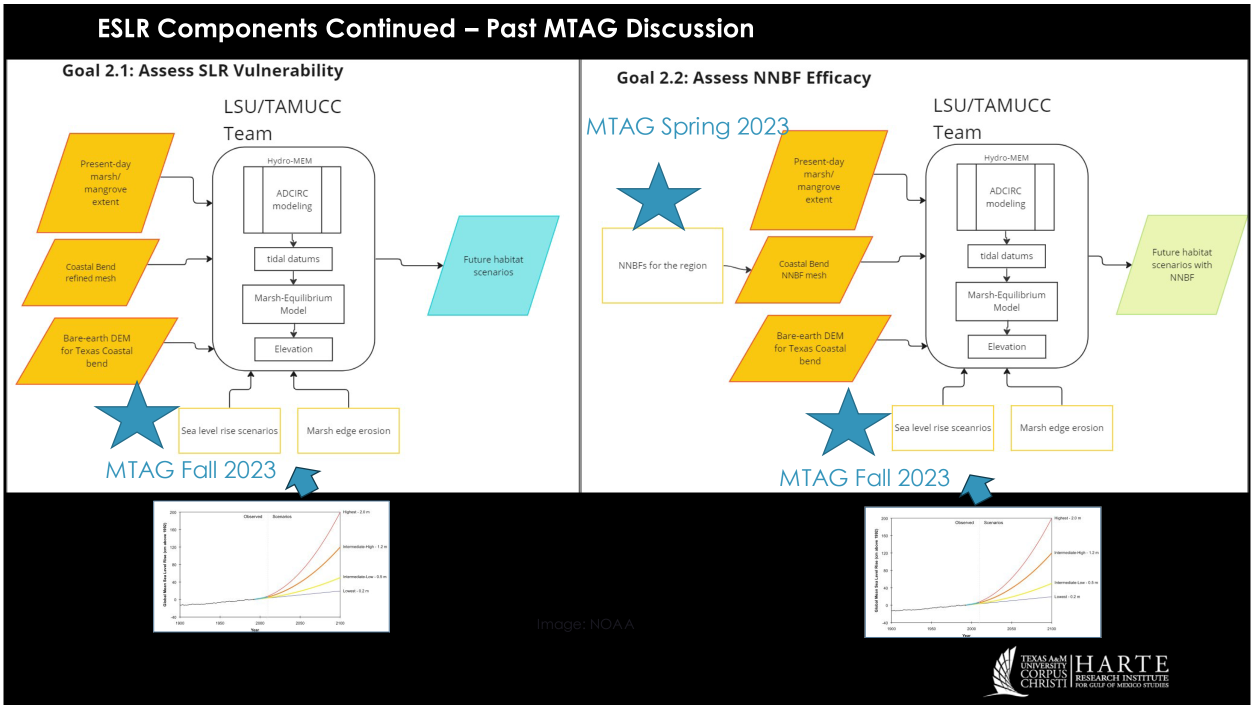
Appendix B: Presentations

Del Angel, TAMUCC Slides:




ESLR Components- Past MTAG Discussions
Goal 1:Improve and Adapt Hydro-MEM to the Texas Coastal Bend
LSU Team
Hydro-MEM
Coastal Bend refined mesh
ADCIRC modeling
tidal datums
Coastal Bend Adapted MEM
Marsh-Equilibrium Model
Elevation
Present-day marsh/ mangrove extent
MTAG Spring 2023 &Fall 2023
TAMUCC TEAM
World View 2
Determine vegetation bias apply correction
Bare-earth DEM for Texas Coastal bend
Ground control elevation and canopy measurements
Lidar DEM
MTAG Spring 2023
MTAG Spring 2023


ESLR Components - Today
Goal 1:Improve and Adapt Hydro-MEM to the Texas Coastal Bend
LSU Team
Today! Updates to wetland modeling
Hydro-MEM
Coastal Bend refined mesh
ADCIRC modeling
tidal datums
Coastal Bend Adapted MEM
Marsh-Equilibrium Model
Elevation
Present-day marsh/ mangrove extent
TAMUCC TEAM
World View 2
Determine vegetation bias apply correction
Bare-earth DEM for Texas Coastal bend
Today! Update to DEM development
Ground control elevation and canopy measurements
Lidar DEM


ESLR Components Continued – Past MTAG Discussion
Goal 2.1: Assess SLR Vulnerability
LSU/TAMUCC Team
Hydro-MEM
Present-day marsh/ mangrove extent
ADCIRC modeling
Coastal Bend refined mesh
tidal datums
Marsh-Equilibrium Model
Bare-earth DEM for Texas Coastal bend
Elevation
Future habitat scenarios
Sea level rise scenarios
Marsh edge erosion
MTAG Fall 2023
Goal 2.2: Assess NNBF Efficacy
MTAG Spring 2023
LSU/TAMUCC Team
Hydro-MEM
Present-day marsh/ mangrove extent
ADCIRC modeling
NNBFs for the region
Coastal Bend NNBF mesh
tidal datums
Marsh-Equilibrium Model
Future habitat scenarios with NNBF
Bare-earth DEM for Texas Coastal bend
Elevation
Sea level rise sceanrios
Marsh edge erosion
MTAG Fall 2023
Image: NOAA

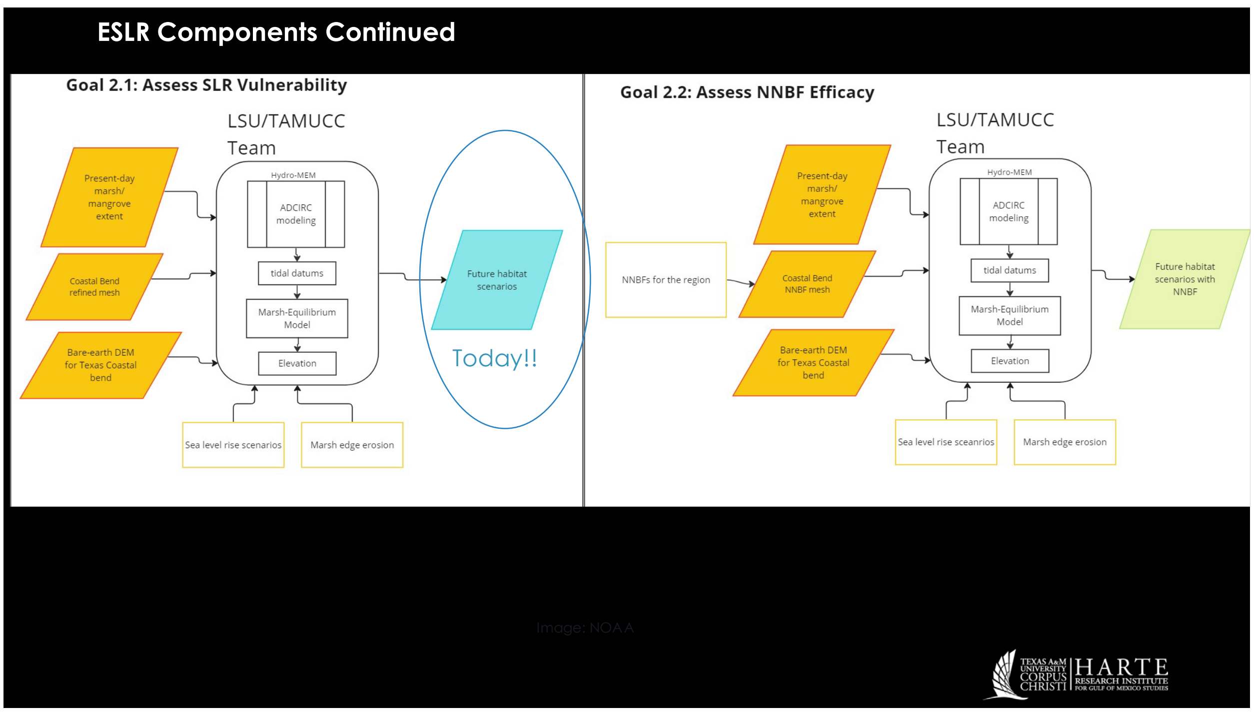

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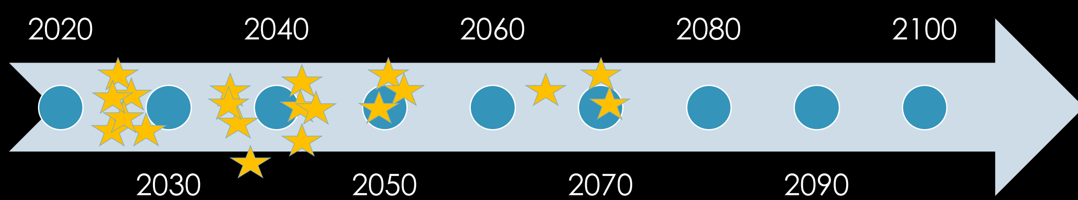
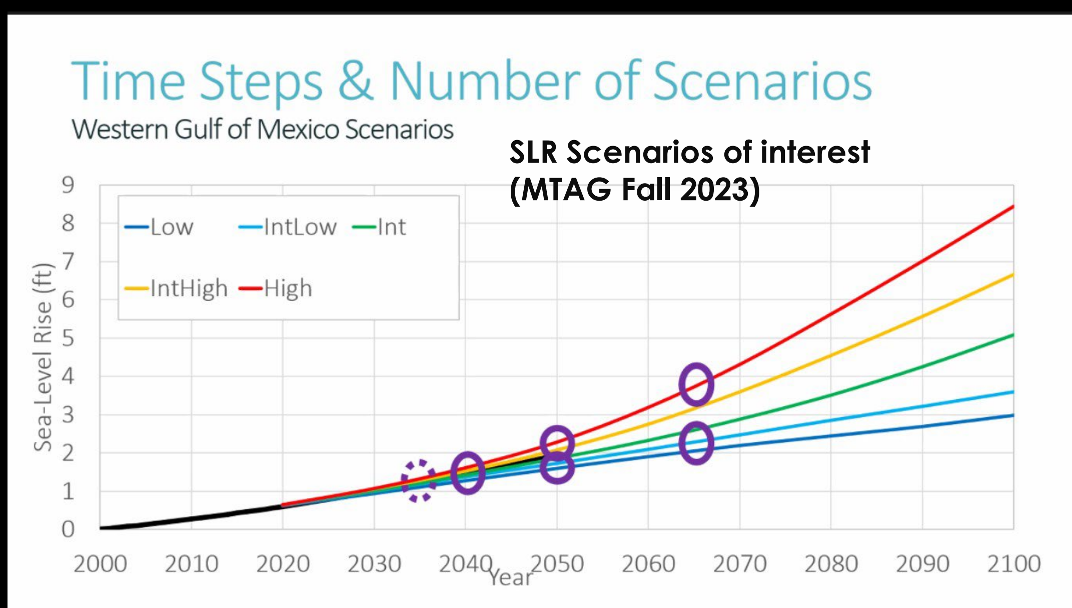
Image: NOAA

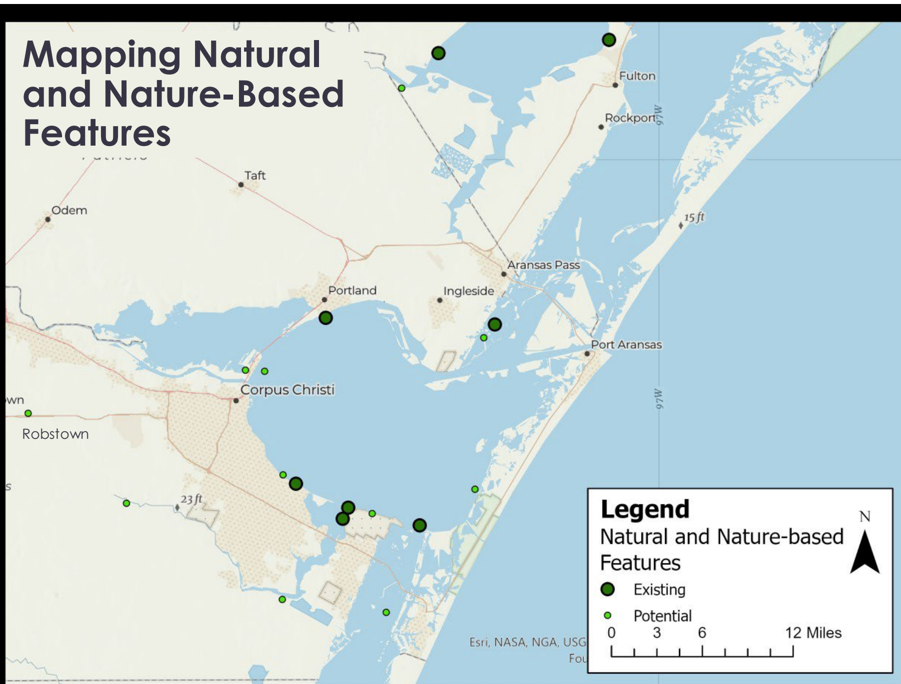
Timelines of Concern

Combined responses from MTAG 2023 May and June sessions





MTAG Spring 2023



ESLR Components Continued

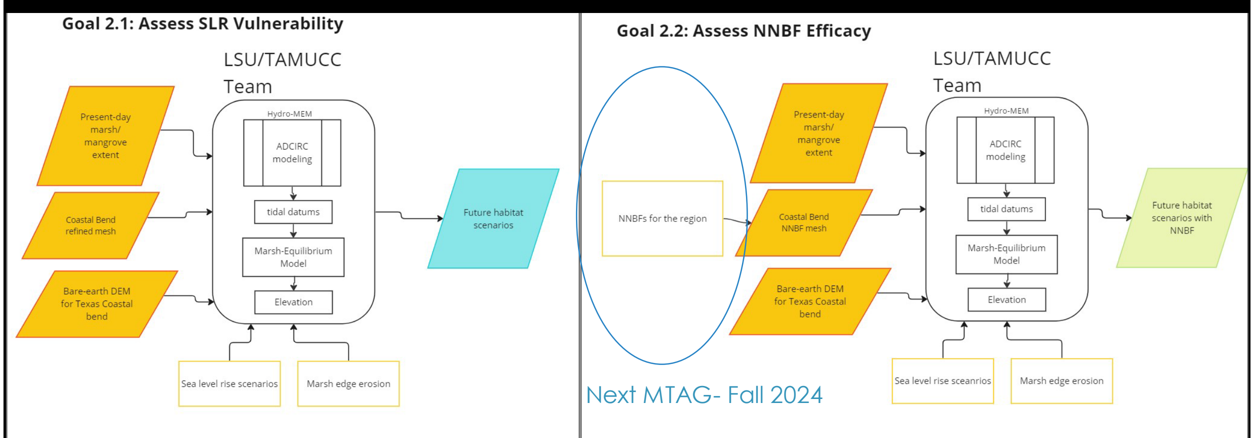
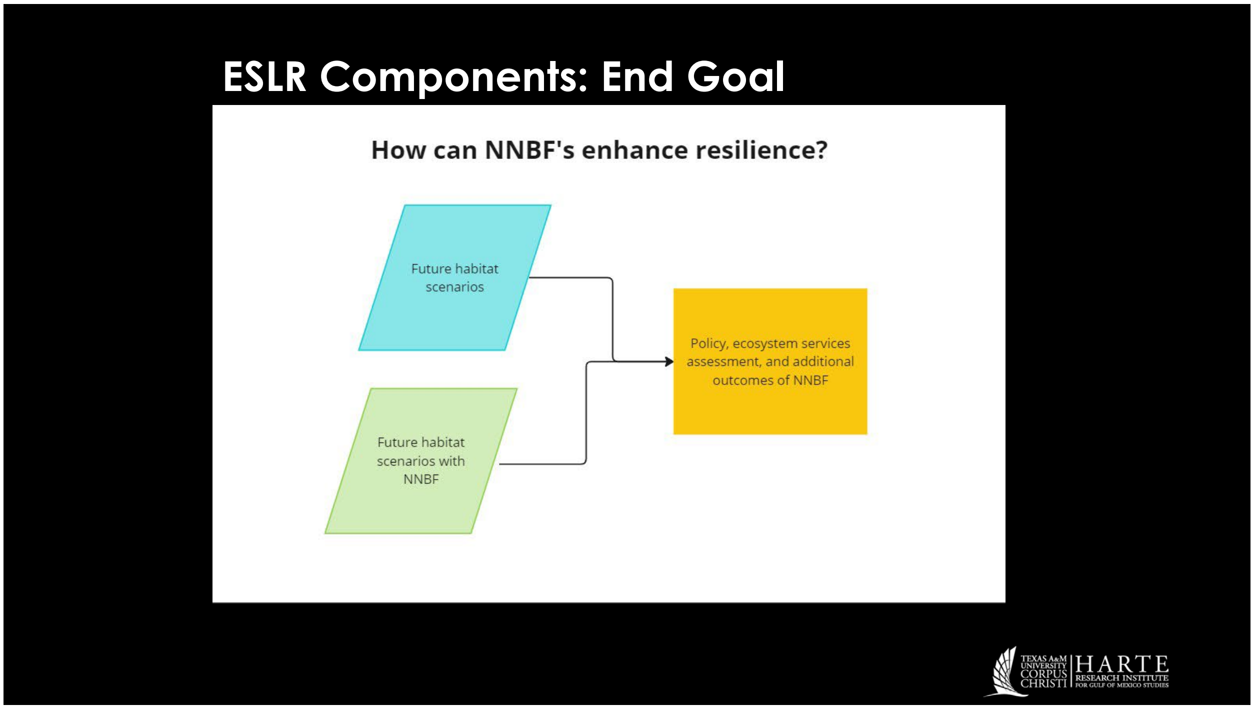


Image: NOAA

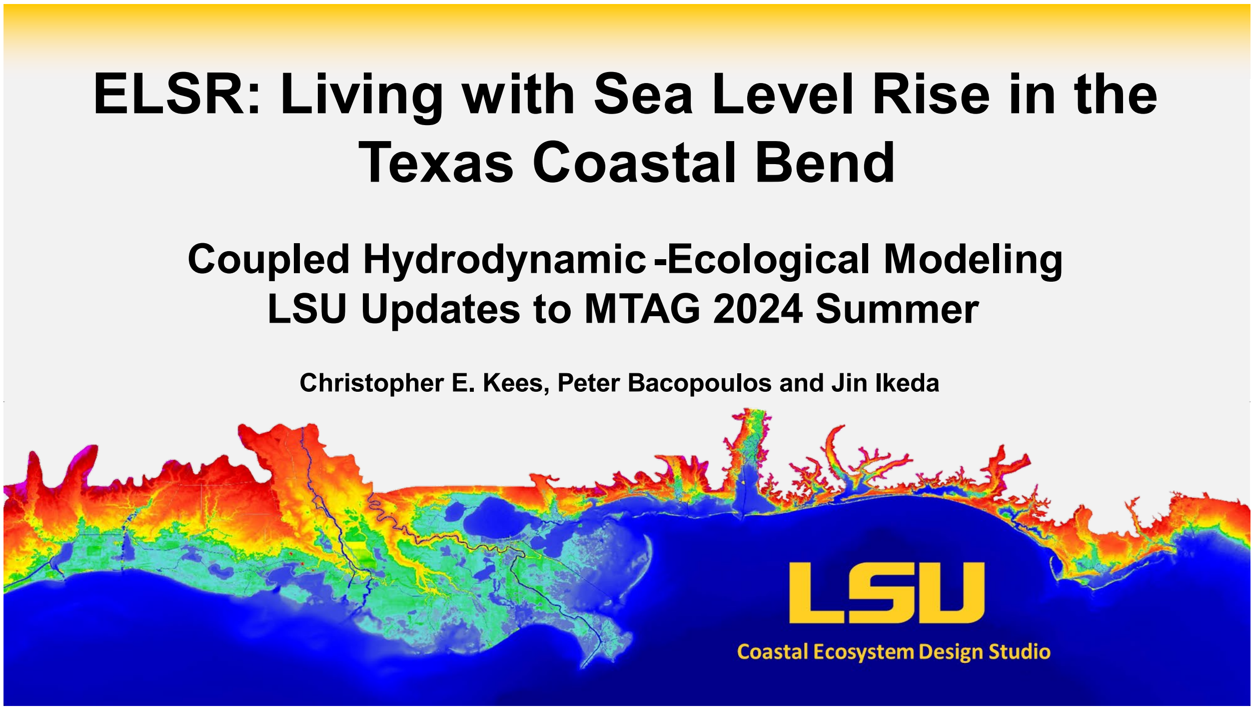


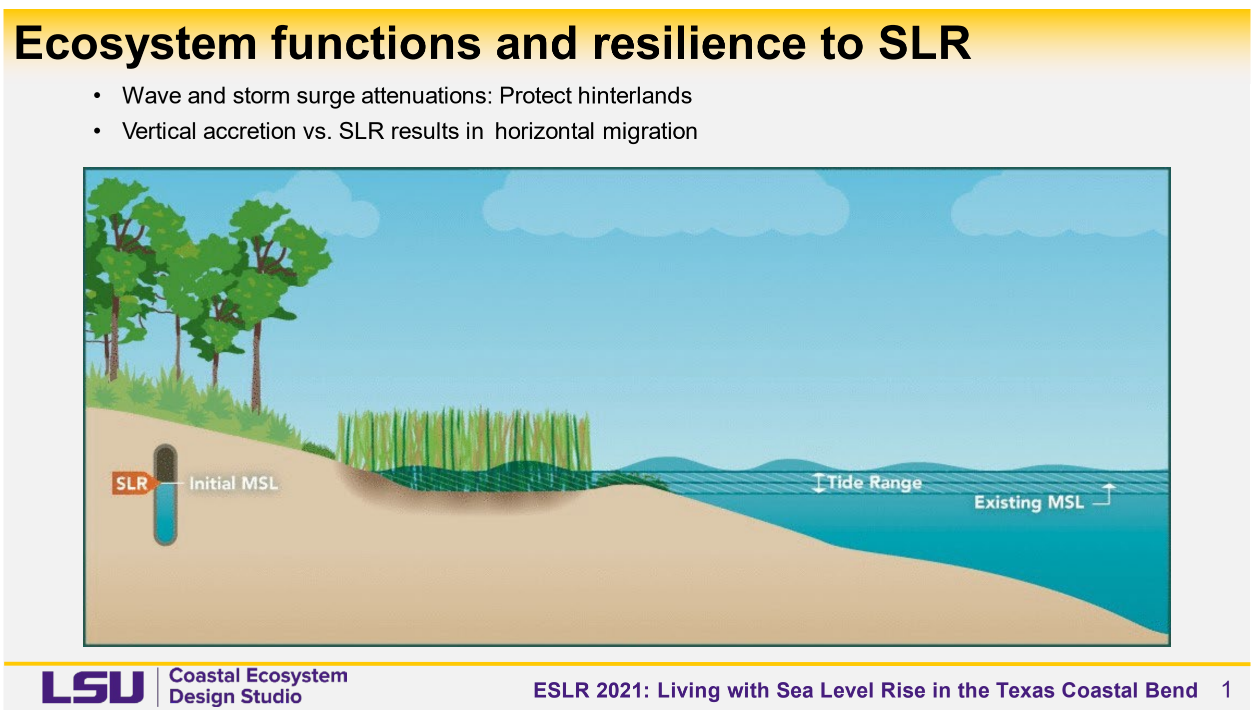
Subedee TAMUCC Slide:

DEM and Land Cover Data Development

- 1 m bare-earth DEM – complete!
  - Developed a method to getthe substrate of coastal marshes
  - Big upgrade from the 2 m DEM developed for the Texas Coastal Resiliency Master Plan
  - Used Lidar point clouds and satellite imagery (WorldView -2 and Sentinel -2)
  - Processed 1.45 TB of lidar point cloud files and 500+ GB of satellite imagery
- Land Cover data – ongoing!
  - Working on refining our algorithm to get land cover product
  - Using the same datasets as in the DEM
  - Expected to complete this summer

Bacopoulos LSU Slides:



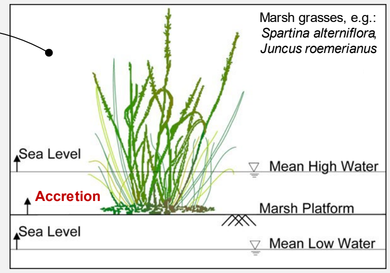


Marsh/mangrove modeling

Ecological equilibria:
Competition between accretion and sea -level rise

dZ_{org}/dt	*organic accretion*
$+ \, dZ_{min}/dt$	*mineral accretion*
dZ/dt	*total accretion*

productivity ∝ elevation



Biomass productivity

- Surface measurements (AGB)
- Core measurements (BGB)

Informs of the organic - inorganic proportion

Vertical accretion

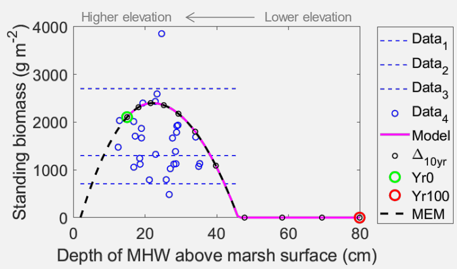
- Feldspar measurements
- Sediment elevation tables

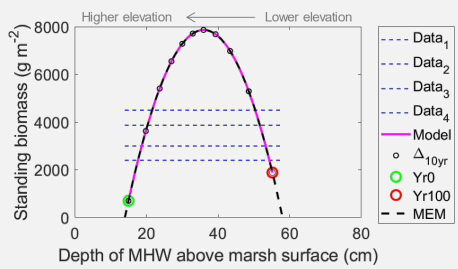
WEADS model configuration and parameterization

Marsh

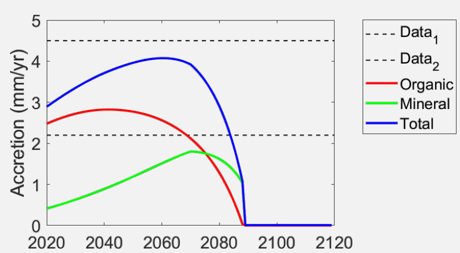
Mangrove

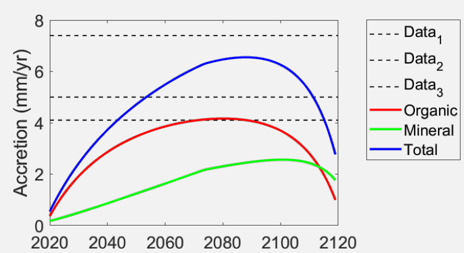
Biomass curve



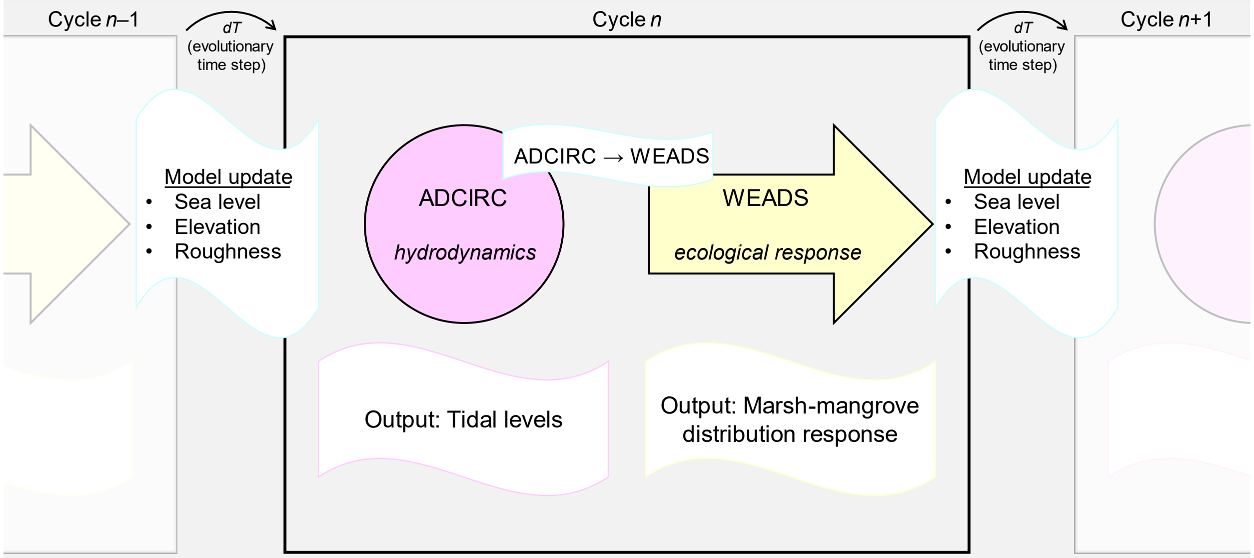


Accretion response





Modeling process for long-term system evolution



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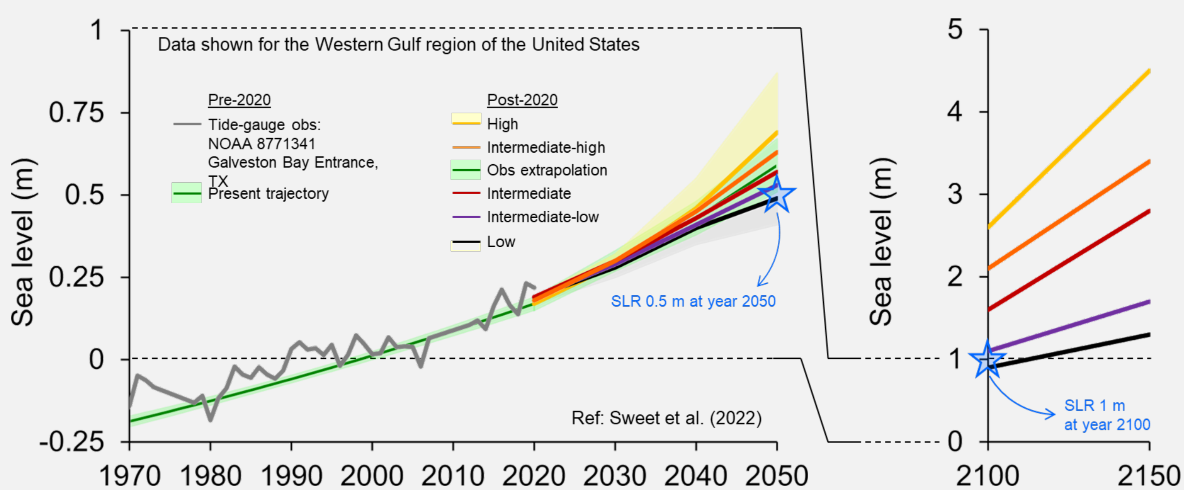
Sea level projections for modeling scenarios



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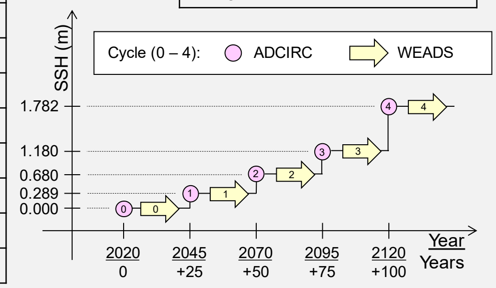
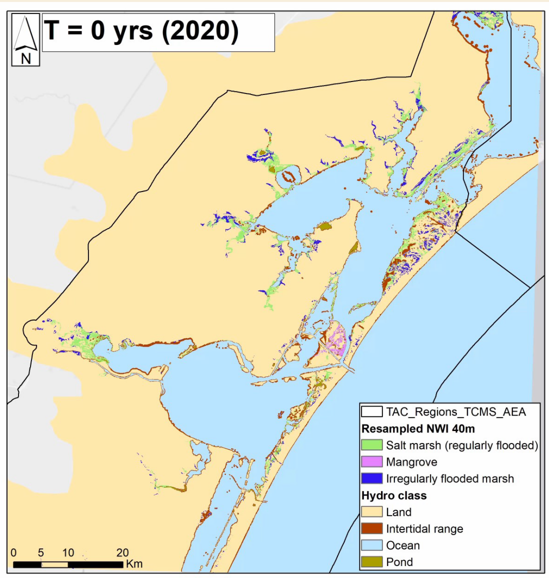
		SLR scenario (Sweet et al., 2022)				
Year	Years	Low	Int-Low	Int	Int-High	High
2000	0	0.000	0.000	0.000	0.000	0.000
2010	10	0.062	0.064	0.068	0.071	0.076
2020	20	0.127	0.134	0.154	0.164	0.184
2030	30	0.196	0.212	0.256	0.280	0.324
2040	40	0.268	0.297	0.375	0.418	0.496
2050	50	0.344	0.389	0.511	0.578	0.700
2060	60	0.424	0.488	0.664	0.760	0.936
2070	70	0.507	0.594	0.834	0.964	1.204
2080	80	0.594	0.708	1.020	1.191	1.504
2090	90	0.684	0.828	1.224	1.440	1.836
2100	100	0.778	0.956	1.444	1.711	2.200
2110	110	0.875	1.090	1.682	2.004	2.596
2120	120	0.976	1.232	1.936	2.320	3.024
2130	130	1.080	1.381	2.207	2.658	3.484
2140	140	1.188	1.537	2.495	3.018	3.976
2150	150	1.300	1.700	2.800	3.400	4.500

ADCIRC-WEADS run schedule		
Year	Years	SSH
2020	0	0.000
2045	25	0.289
2070	50	0.680
2095	75	1.180
2120	100	1.782
SSH = Sea-surface height attribute setting in ADCIRC simulation		



Texas Coastal Bend: Animation between 2020 and 2120



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LSU Center for Coastal Resiliency
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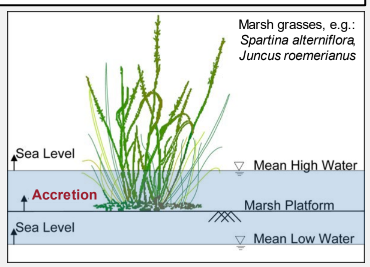
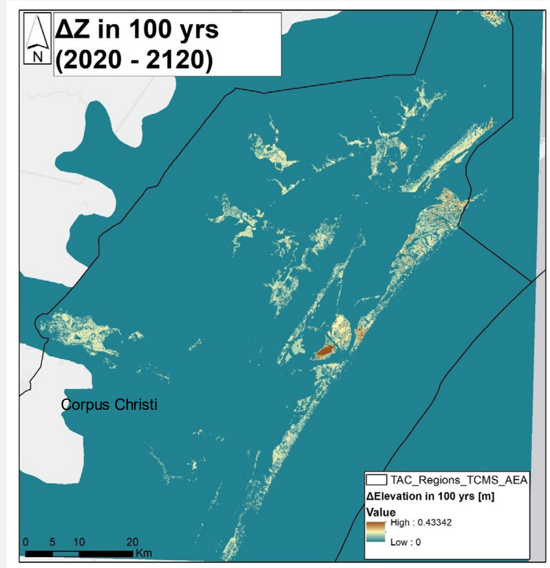
NOAA

Texas Coastal Bend: Mitigation effect on elevation by vegetation

- ❑ Vegetation Survivability
  - ✓ Coastal vegetation cannot withstand intermediate SLR scenario (SLR > Accretion)
  - ✓ However, horizontal migration is likely possible inside bays
- ❑ Mitigation effect by vegetation
  - ✓ Vegetation can accumulate up to 0.4 m depositions, which mitigates SLR effects compared to no - vegetation case

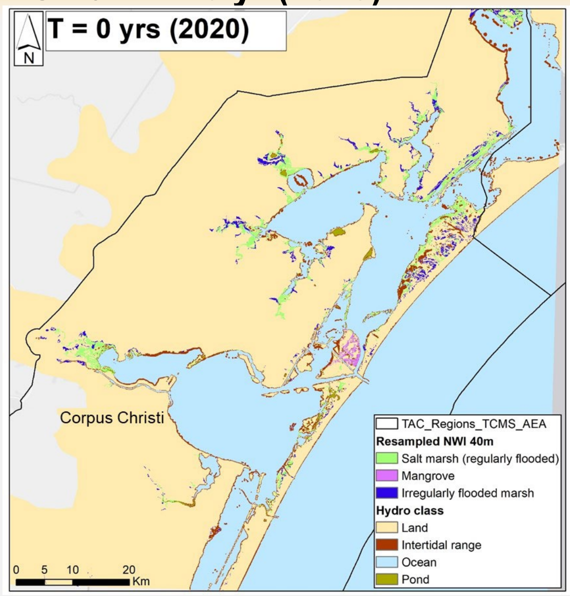




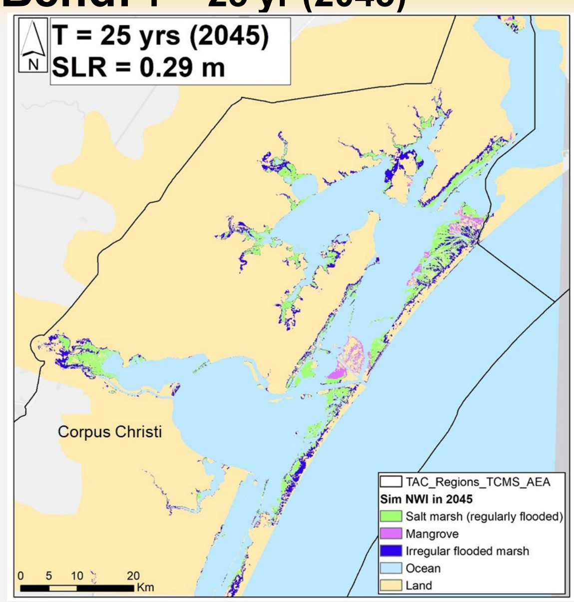
WEADS model configuration and parameterization

Parameter	Description	Value (marsh)	Value (mangrove)
Biomass curve			
D_{min}	Lower depth limit of productivity	2 cm	24 cm
D_{max}	Upper depth limit of productivity	46 cm	66 cm
B_{max}	Peak productivity	2400 g m^{-2}	7800 g m^{-2}
D_{opt}	Depth at peak productivity	22 cm	45 cm
Mineral accretion			
q	Sediment capture coefficient	2.8	2.8
m	Suspended sediment concentration	25 mg L^{-1}	25 mg L^{-1}
f	Flooding frequency	353 yr^{-1}	353 yr^{-1}
k_2	Self-packing density of inorganic matter	1.99 g cm^{-3}	1.99 g cm^{-3}
Organic accretion			
k_r	Lignin concentration	0.1	0.1
R_{RS}	Root-to-shoot ratio	2.0	1.8
B_{TR}	Belowground biomass turnover rate	0.50 yr^{-1}	0.25 yr^{-1}
k_1	Self-packing density of organic matter	0.085 g cm^{-3}	0.085 g cm^{-3}

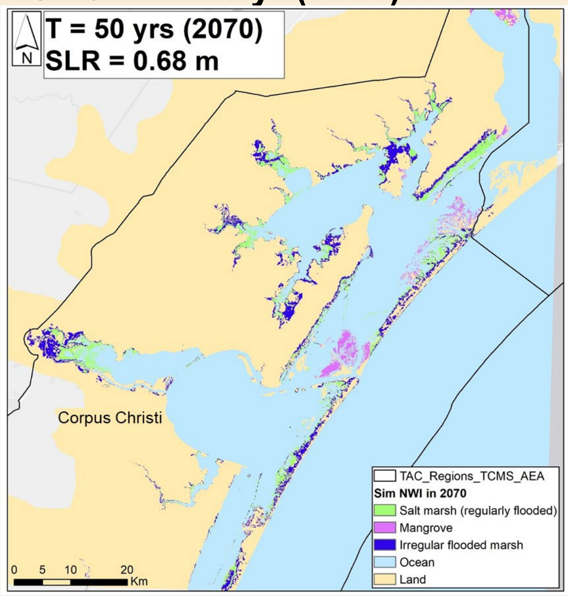
Texas Coastal Bend: T = 0 yr (2020)



Texas Coastal Bend: T = 25 yr (2045)



Texas Coastal Bend: T = 50 yr (2070)



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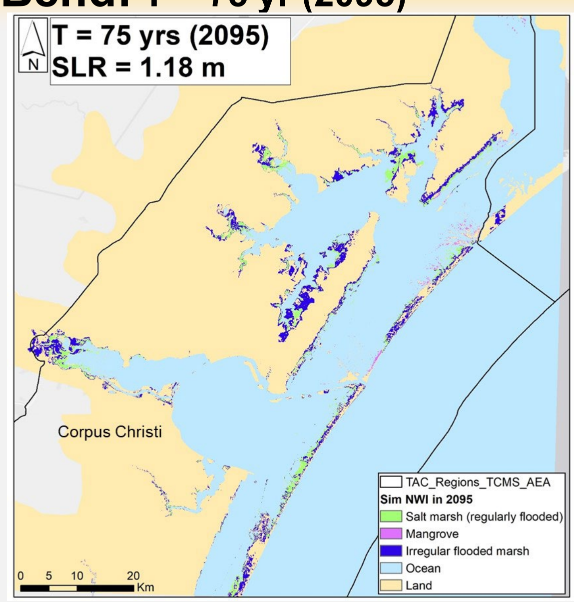
Texas Coastal Bend: T = 75 yr (2095)



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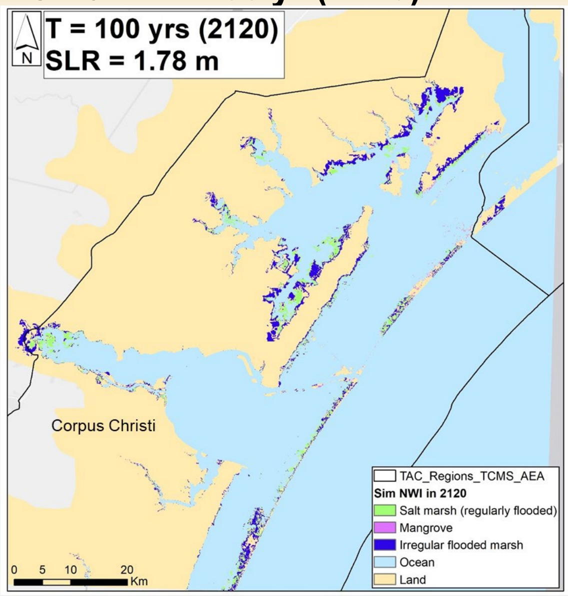
Texas Coastal Bend: T = 100 yr (2120)



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Appendix C: Acronym List

Organizations and Agencies

CBCOG – Coastal Bend Council of Governments

CC Regional EDC – Corpus Christi Regional Economic Development Corporation

HRI – Harte Research Institute for Gulf of Mexico Studies

LSU – Louisiana State University

MSU – Mississippi State University

NOAA – National Oceanic and Atmospheric Administration

PLACE-SLR – Program for Local Adaptation to Climate Effects: Sea-Level Rise

TAMUCC – Texas A&M University – Corpus Christi

TGLO – Texas General Land Office

TWDB – Texas Water Development Board

CBBEP - Coastal Bend Bays and Estuaries

CC MPO - Corpus Christi Metropolitan Planning Organization

Other Acronyms

ADCIRC – ADvanced CIRCulation (hydrodynamic model)

DEM – Digital Elevation Model

ESLR – Effects of Sea Level Rise Program

MEM – Marsh Equilibrium Model

MTAG – Management Advisory Group

SLAMM – Sea Level Affecting Marshes Model

SLR – Sea level rise

TCRMP – Texas Coastal Resiliency Master Plan