ESLR Coastal Resilience MTAG Fall 2023 Workshop 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) Fall 2023 Meeting
December 8, 2023

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Edited by: Peter Bacopoulos

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

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ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
Management Transition Advisory Group (MTAG) Fall 2023 Meeting
December 8, 2023
Virtual Meeting

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Executive Summary

The Harte Research Institute for Gulf of Mexico Studies (HRI), Texas A&M University-Corpus Christi, The Water Institute of the Gulf (TWIG), and the Center for Coastal Resiliency at Louisiana State University (LSU) received funding from the National Oceanic and Atmospheric Administration to launch a project called "ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend." The project, led by HRI Endowed Chair for Coastal and Marine Geospatial Sciences Dr. James Gibeaut, engages key stakeholders to improve and apply advanced modeling techniques to project how sea level rise (SLR) and natural infrastructure may impact coastal resiliency. The applied aspect of this work is guided by a Management Transition Advisory Group (MTAG), which provides researchers with key input and insights on modeling SLR scenarios to produce projections of future landscapes.

The Fall 2023 ESLR MTAG virtual meeting was held on December 8,2023 and is the third MTAG meeting for the project. The workshop focused on key objectives, including refreshing project goals, understanding modeling components, and agreeing on appropriate sea level rise (SLR) framing and scenarios. To begin the meeting, Dr. Gibeaut (HRI) contextualized the project for MTAG that is aiming to assess SLR vulnerabilities and the efficacy of Natural and Nature-Based Features (NNBFs) in mitigating flooding. The workshop had 17 participants, 10 of which are part of the ESLR Team, one representative from the funding agency and six MTAG members.

An overview of the Spring 2023 MTAG output highlighted flood concerns in various communities, guiding the development of future habitat scenarios. Current and potential NNBFs were presented, emphasizing a wide range of locations and approaches. Timelines of concern for the MTAG were outlined for 2023, 2035, 2040, 2025, and 2070.

Dr. Bacopoulos (LSU) presented "Coupled Hydrodynamic-Ecological Modeling," illustrating a dynamic modeling approach's impact on SLR understanding. The toolbox for effective modeling was discussed, emphasizing the need for data on mangroves, marsh evolution, suspended sediment concentration (SSC), and organic accretion.

Dr. Collini's (TWIG) SLR framing presentation explored different approaches, including location-based and regional framing. The MTAG engaged in a Menti exercise, revealing a balanced preference for the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report (AR6) and Us Interagency Taskforce 2022 Sea Level Rise Technical Report. Discussion highlighted considerations of believability, political factors, and alignment with federal funding requirements. Discussion on SLR rates included perspectives on local versus regional data, highlighting scenarios for 2040, 2050 and 2065. The need for a representative curve and consideration of timesteps were emphasized.

Overall, the workshop continued engagement with the MTAG, providing updates to project modeling component, a summary of previous MTAG input and a peak into upcoming work.

Workshop Objectives

- Refresh on project goals and Spring MTAG input
- 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

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Workshop Attendants

Kara Coffey, HRI-TAMUCC*

Diana Del Angel, HRI-TAMUCC*

Katya Wowk, TWIG*

Renee Collini, TWIG*

James Gibeaut, HRI-TAMUCC*

Mukesh Subedee, HRI-TAMUCC*

Lihong Su, HRI-TAMUCC*

Peter Bacopoulos, LSU, Coastal Ecosystem Design Studio*

Chris Kees, LSU Coastal Ecosystem Design Studio*

Jin Ikeda, LSU Coastal Ecosystem Design Studio*

Debalina Sengupta, Coastal Resilience Program, Texas Sea Grant

Tony Williams, Texas General Land Office

Brittany Sotelo, CC Regional EDC

Trevor Meckley, NOAA ESLR program

Clarence Feagin, US Navy Planning Department

Evan Turner, TWDB

Craig Casper, Corpus Christi MPO

*denotes affiliation with project team

Description of Meeting Activities and Content

Introduction and Project Goals

To begin the meeting, Dr. Wowk led introductions and reviewed the meeting agenda. Dr. Gibeaut reviewed the context of the project and described his work with the General Land Office (GLO) "Texas Coastal Resiliency Master Plan" as catalyst for this work. This project aims to identify vulnerability to sea level rise (SLR) and also to assess the benefit of Natural and Nature Based Features (NNBFs) to mitigate flooding and enhance the persistence of coastal habitats under changing conditions. The goals of the project are as follows:

1. Improve and adapt Hydro-MEM to the Texas Coastal Bend
    a. Improve bare-Earth elevation model
    b. Develop detailed model mesh
    c. Improve data/modeling of marsh vertical accretion
2. Assess SLR vulnerabilities and NNBF efficacy using Hydro-MEM and SLAMM as appropriate
    a. Model SLR effects with and without NNBF
3. Form a collaborative MTAG and co-produce a knowledge base for modeling and assessing SLR resiliency in the region

Overview of Spring 2023 MTAG Output

Dr. Del Angel's presentation reviewed the conceptual model of a project and identified specific components where input from MTAG is sought. In the Spring 2023 MTAG workshop, participants were queried about flood concerns and the potential for Nature-Based Features (NNBFs). In the Fall 2023 MTAG Workshop, MTAG members were asked for their opinions on Sea Level Rise (SLR) scenarios. Looking ahead, the ESLR modeling team will generate future habitat scenarios, considering the presence or absence of NNBFs, with the aim of providing guidance for planning and future project development.

Dr. Del Angel also presented a recap of the Spring 2023 MTAG sessions held in May and June. A map of "Areas of Flood Concern" was developed based on workshop discussions, with specific concerns raised for communities like Sinton, Taft, and Refugio. Several areas were highlighted as requiring attention, including Copano Bay, where Bayside experienced significant erosion from Hurricane Harvey. The San Antonio River Delta, Rockport area, Salt Lake, Lamar Beach Road, Fulton Beach Road, and other shoreline-adjacent roads were identified as occasionally prone to flooding. Aransas Pass faced flooding concerns from the backside of the peninsula and ship channel. Concerns in Ingleside included future flooding, especially in areas with oil and gas facilities, along with shoreline erosion. The City of Corpus Christi emerged as a hotspot for various concerns, including expansion to the Southside near Oso Creek, Mustang Island, downtown Corpus Christi, North Beach (Corpus Christi Beach), the aging sea wall, Flour Bluff, and the West Side of Corpus Christi. Overall, the MTAG's input is integral to identifying where the ESLR modeling could be applied and what challenges could be addressed though this project.

The presentation showcased a map outlining current and potential lNNBFs in the study region. Current NNBFs include the Bayside living shoreline, a breakwater in Copano Bay, seagrass restoration in Portland, wetland restoration at NAS, and the Corpus Christi Seawall. Potential NNBFs discussed encompass enhancing circulation in the Aransas Delta using culverts, addressing drainage and flood control needs at Oso Creek, and implementing seagrass protection in Nueces County. These examples demonstrate a comprehensive approach to utilizing nature-based solutions for environmental conservation and flood mitigation in the region.

The final segment of the presentation emphasized timelines of concern as previously identified by the MTAG, placing significant emphasis on the years 2023, 2035, 2040, 2025, and 2070.

Coupled Hydrodynamic-Ecological Modeling

A presentation titled "Coupled Hydrodynamic-Ecological Modeling" was delivered by Dr. Peter Bacopoulos. The presentation began with a cartoon illustrating the key concepts of a dynamic modeling approach to understand the impact of sea level rise. It emphasized the dynamic responses, including waves, erosion, tides, and flooding, which drive changes in the landscape. LSU utilized this approach, demonstrated through a 24-hour animation of Hurricane Harvey, showcasing water elevation and wind field changes. The modeling approach was applied to determine maximum water levels, crucial for modeling inundation above land (0m NAVD). An example using Hurricane Harvey showed inundation with a sea level rise of 0.82 meters.

The presentation then delved into adapting HydroMEM, a marsh evolution model, to the Texas coast. An example was presented featuring astronomical tides at the Nueces River delta. To describe HydroMEM, wetland migration and vertical accretion are highlighted through a cartoon, emphasizing the two components of vertical accretion: organic and inorganic. The organic component can be derived from marsh organ experiments, where a PVC pipe at different flood elevation is used to grow *Spartina alterniflora* and measurements of biomass density production are taken relative to tide level elevation. The inorganic components can be modeled using suspended sediment concentration (SSC). The presentation showcases examples from Goose Island State Park and Egery Flats, utilizing the Surface Elevation Tables (SET) to aid in developing model parameters.

The modeling toolbox requirements were discussed, emphasizing the need for mangrove data and marsh evolution data. In conclusion, the dynamic modeling approach provides a comprehensive understanding of sea level rise impacts, incorporating various factors to model landscape changes and guide adaptation strategies. The toolbox, including data on mangroves, marsh evolution, SSC, and organic accretion, is crucial for effective modeling and prediction.

Sea Level Rise Framing

Dr. Collini led an interactive presentation on sea level rise (SLR) framing, highlighting different ways to frame the issue, including location-based or regional approaches, and considering various timeframes. Projections for climate planning can focus on temperature, precipitation, and SLR. The Intergovernmental Panel on Climate Change's Sixth Assessment Report (IPCC AR6)'s Shared Socioeconomic Pathways (SSP) scenarios were introduced, exploring SLR under different emissions scenarios.

Another framing that could be used is that of the US Interagency Taskforce 2022 Sea Level Rise Technical Report (Interagency 2022 Report). This report, instead of specifying a particular temperature, uses possible scenarios which consider risks across a range of uncertainties. Dr. Collini presented SLR projection curves from the IPCC AR6 SSP scenarios and the Interagency 2022 Report scenarios, noting the recent rapid acceleration in the northern Gulf of Mexico.

An overview of the benefits of scenarios versus projections was provided, highlighting that scenarios cover the full range of risk, account for uncertainty in land cover processes, and hedge against uncertainties related to acceleration. Following the presentation, the MTAG engaged in a Menti exercise to vote on whether to prioritize IPCC AR6 or Interagency 2022 Report for the project. The results showed a balanced preference of IPCC AR6 at 4 votes and Interagency 2022 Report at 3 votes (Figure 1). Post vote discussion with participants found that consideration for factors such as believability, political considerations, and alignment with federal funding requirements is important. Some expressed the need to work with the Corps of Engineers and the desire to consider both frameworks for a greater chance of federal funding. Additionally, Dr. Gibeaut highlighted using the 2019 Interagency report but developing their subsidence grid/surface for their specific needs in the TCRMP (Texas Coastal Resilience Master Plan) project.

FIGURE 1. MENTI RESULTS HIGHLIGHTING MTAG PREFERENCE OF SLR FRAMING: IPCC ARC PROJECTIONS (4) AND THE INTERAGENCY 2022 REPORT SCENARIOS (3).

Dr. Collini reviewed location-specific and regional sea level rise (SLR) rates for various scenarios, including low, intermediate-low, intermediate, intermediate-high, and high, focusing on tide gauges in Corpus Christi and Rockport, as well as regional Western Gulf values. The discussion that followed involved different perspectives on how to approach SLR projections:

- One participant advocated for using local data and projections if available.
- Another suggested erring on the side of higher projections and emphasized extrapolating trends. Considered the idea of focusing on a single location for better community reception.
- Another raised the question of when the saltwater dam would be overtopped and suggested tying projections to local actionable items for better impact and attention.
- Dr. Collini inquired about the modeling capacity for regional projections and proposed a middle ground approach, considering a regional Coastal Bend average.
- Another option discussed the possibility of not focusing on a single location (Corpus) but rather adopting a regional Coastal Bend average, striking a balance between a single location and the Western Gulf.
- Dr. Gibeaut emphasized the importance of choosing a representative curve for an area, and the ADvanced CIRCulation (ADCIRC) modeling will take care of the difference across the area and the importance of choosing a curve.

The discussion concluded with a suggestion of a regional curve and focus on timesteps. The timestep discussion followed. One suggestion was 2040. For the planning organization 2035 and 2050, with the possibility of extrapolating data to cover the year 2040.The Navy, has specific requirement for projections up to the year 2065, with an emphasis on minimizing risk by focusing on the highest confidence interval. There might not be much variation in scenarios in 2040 so one would be fine. One participant suggested having shorter timeframes, especially up to 2050, to reduce uncertainty. They acknowledged differences between high and low scenarios, particularly when looking further into the future.Discussion on Specifics: There was a discussion about the differences between projections within a one-foot range and the consideration of using a smaller increment, such as 20 cm (8 inches). A participant expressed flexibility in accepting extrapolations for 2035 and 2050.

One participant stated that their facilities focus on the year 2065, where the estimate was provided as 14 feet above sea level. The possibility of categorizing scenarios based on the magnitude of SLR was raised for further consideration.

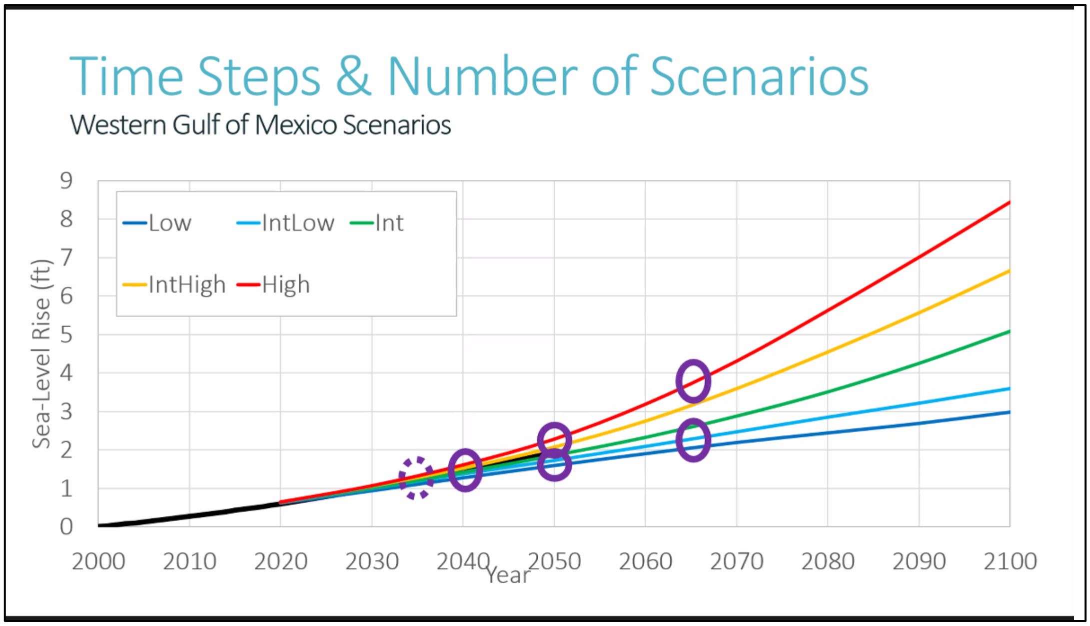

FIGURE 2. DISCUSSION ON SLR SCENARIOS AND TIMEFRAMES. PURPLE CIRCLES SHOW TIME FRAMES AND CURVES OF INTEREST TO THE MTAG.

Appendix A: Participant Agenda

ESLR Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
Management Transition Advisory Group (MTAG) Virtual Meeting
December 8, 2023
1:00-3:00 PM CST
Zoom Virtual Meeting Information Below

Workshop Objectives:

- Refresh on project goals and Spring MTAG input
- 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
12:50 pm	[meeting opens for technology check]
1:00 pm	Welcome, Around the Virtual Room & Refresh
1:35 pm	Update & Discussion on Modeling Components • Presentation • Questions & Discussion
2:00 pm	Selecting Sea Level Rise Framing (e.g., temp., emissions, risk-based) • Presentation • Voting Exercise & Discussion: Selecting a Sea Level Rise Framing for the Coastal Bend
2:30 pm	Selecting Sea Level Rise Timesteps and Scenarios • Updates • Voting Exercise & Discussion: Selecting Sea Level Rise Timesteps and Scenarios
2:55 pm	Spring '24 MTAG In-Person Meeting and Next Steps
3:00 pm	Adjourn

Appendix B: Presentations

OBJECTIVES & AGENDA

<u>Objectives</u>

- • Refresh on project goals and Spring MTAG input
- • 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

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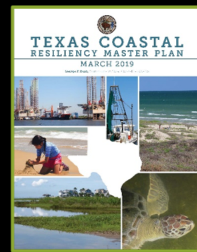
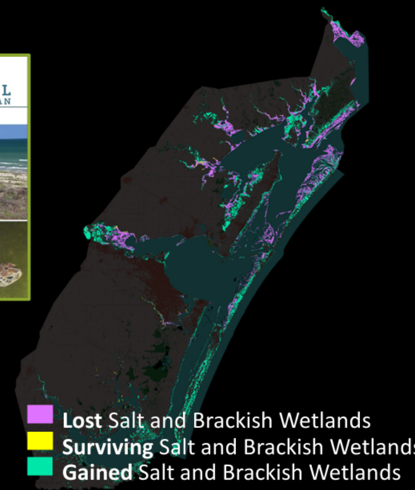
2:55 pm	Spring '24 MTAG In-Person Meeting and Next Steps
3:00 pm	Adjourn

Context

- The Texas General Land Office publishes the TCRMP which identifies coastal vulnerabilities and strategies to address them.
- HRI models the impacts of SLR and storm surge for the TCRMP using SLAMM and ADCIRC models.
- NOAA's Effects of SLR (ESLR) Program funds research for (1) describing coastal vulnerability, (2) determining benefits of Natural and Nature Based Features (NNBF), and (3) predicting effects of SLR.
- LSU developed and applied new SLR modeling techniques (Hydro-MEM) under the ESLR program.
- HRI, LSU, and TWI are partners on this newly funded ESLR project with the following goals:



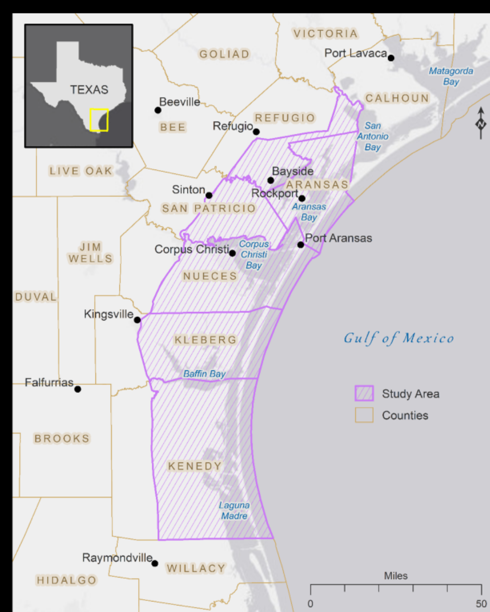


NCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE — SCIENCE SERVING COASTAL COMMUNITIES

The Effects of Sea Level Rise (ESLR) Program

Goals

- Improve and adapt Hydro-MEM to the Texas Coastal Bend
  - Improve bare-Earth elevation model
  - Develop detailed model mesh
  - Improve data/modeling of marsh vertical accretion
- Assess SLR vulnerabilities and NNBF efficacy using Hydro-MEM and SLAMM as appropriate
  - Model SLR effects with and without NNBF
- Form a collaborative MTAG and co-produce a knowledge base for modeling and assessing SLR resiliency in the region



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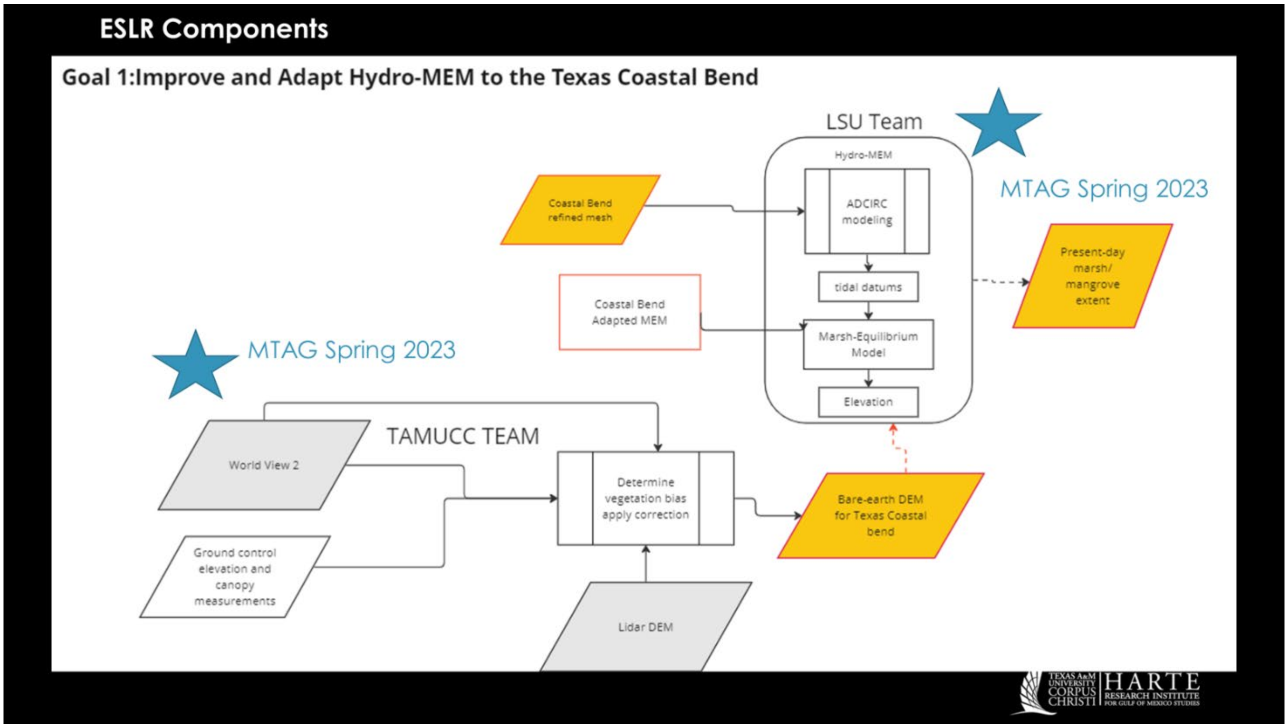
Spring MTAG Overview

Diana Del Angel
Harte Research Institute

Texas A&M University Corpus Christi | Harte Research Institute for Gulf of Mexico Studies

Goals of ESLR 2021

- Goal 1:Improve and Adapt Hydro-MEM to the Texas Coastal Bend
- Goal 2.1: Assess SLR Vulnerability
- Goal 2.2: Assess Efficacy of Natural and Nature Based Solutions


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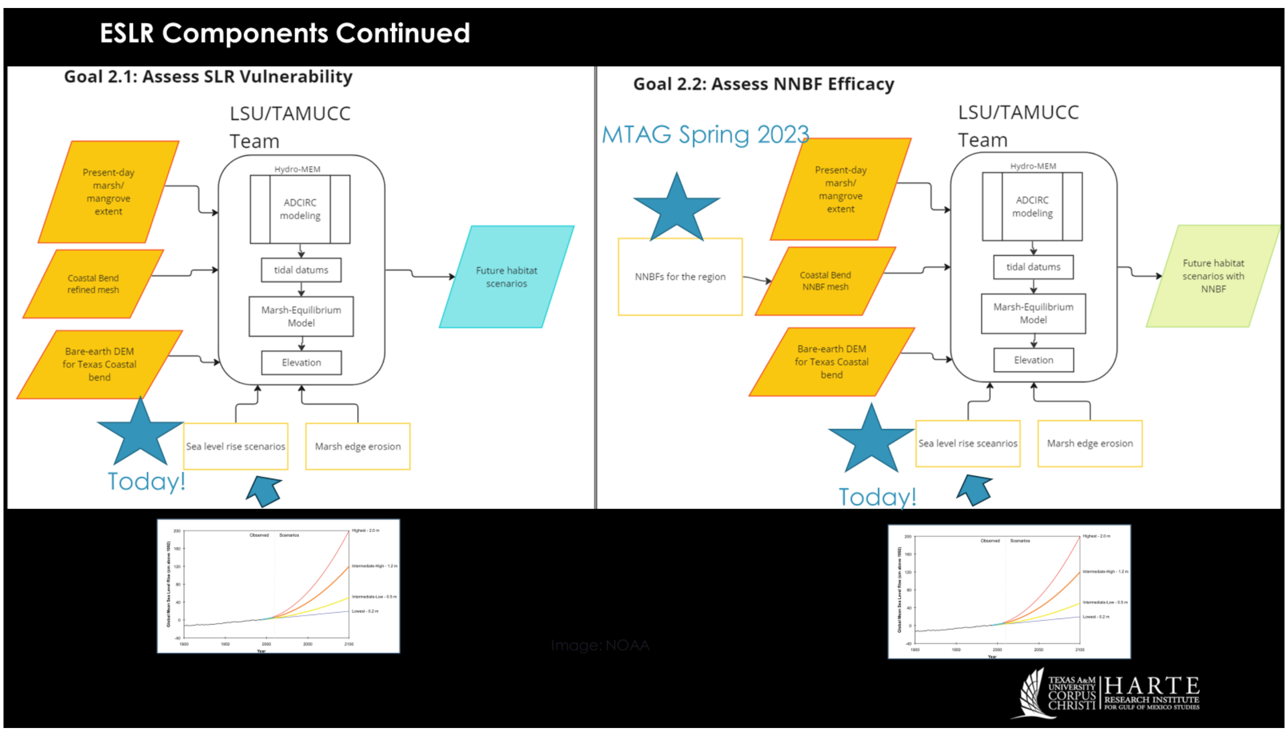
ESLR Components Continued
Goal 2.1: Assess SLR Vulnerability
LSU/TAMUCC Team
Present-day marsh/ mangrove extent
Coastal Bend refined mesh
Bare-earth DEM for Texas Coastal bend
Hydro-MEM
ADCIRC modeling
tidal datums
Marsh-Equilibrium Model
Elevation
Future habitat scenarios
Sea level rise sceanrios
Marsh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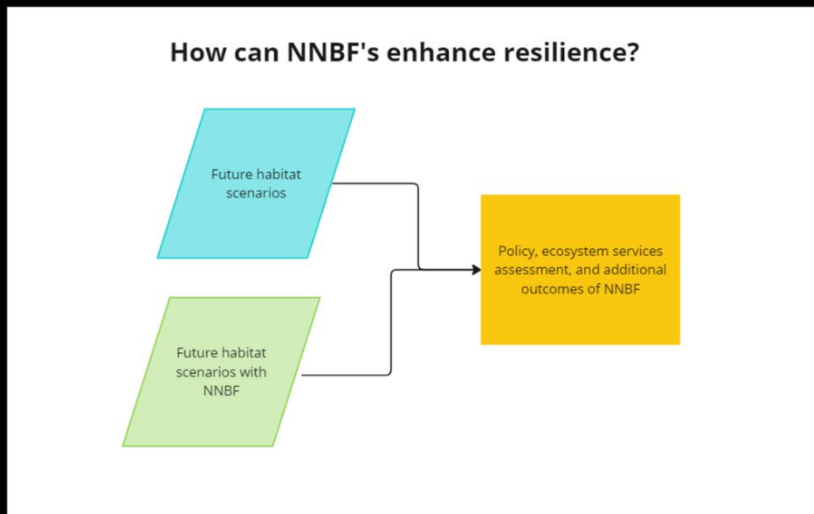
ESLR Components: End Goal

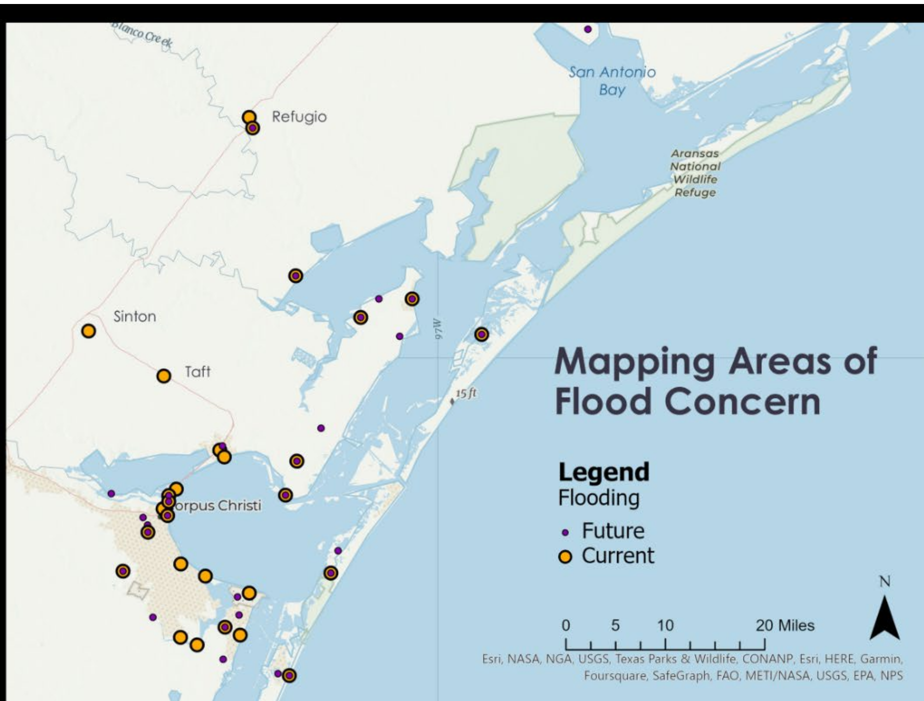


Spring 2023 MTAG Recap

- In-person Session- May 2nd 2023
- Remote session – June 21st 2023

- Review of SLR projections in the Coastal Bend
- Mapping SLR Concerns and NNBFs
- Timelines of Concern

https://www.harteresearch.org/project/living-sea-level-rise-texas-coastal-bend



- Current:
  - Communities of Sinton and Taft
  - Refugio
  - Bayside – erosion from Harvey
- Future:
  - San Antonio River Delta, currently eroding and needs mitigation.

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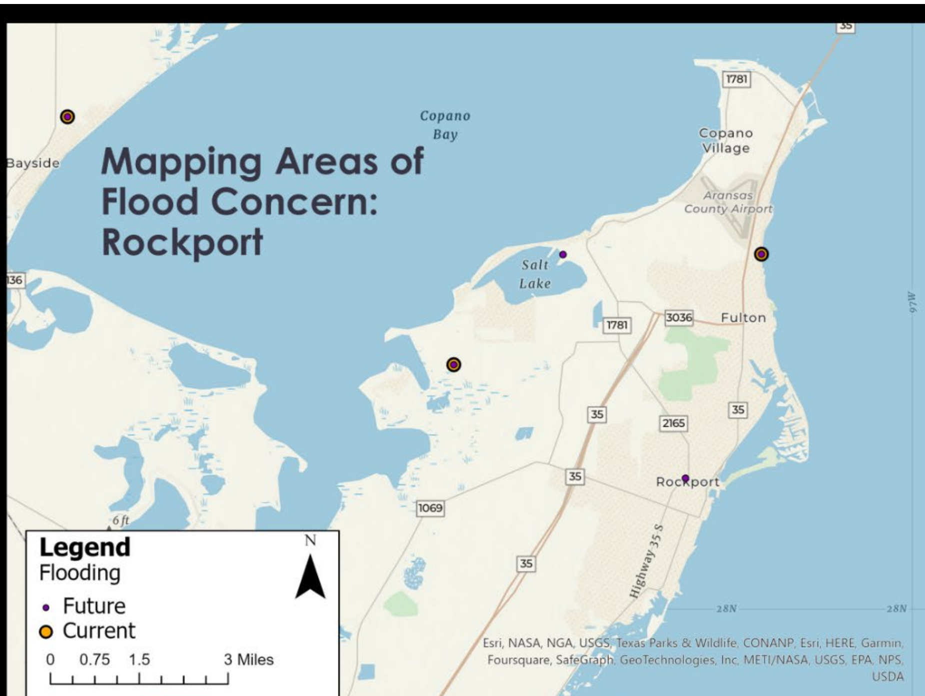

- Current/Future:
  - Salt Lake – area filled with debris after Harvey- sensitive habitat present.
  - Lamar Beach Road, Fulton Beach Road, and other roads adjacent to the shoreline can occasionally flood

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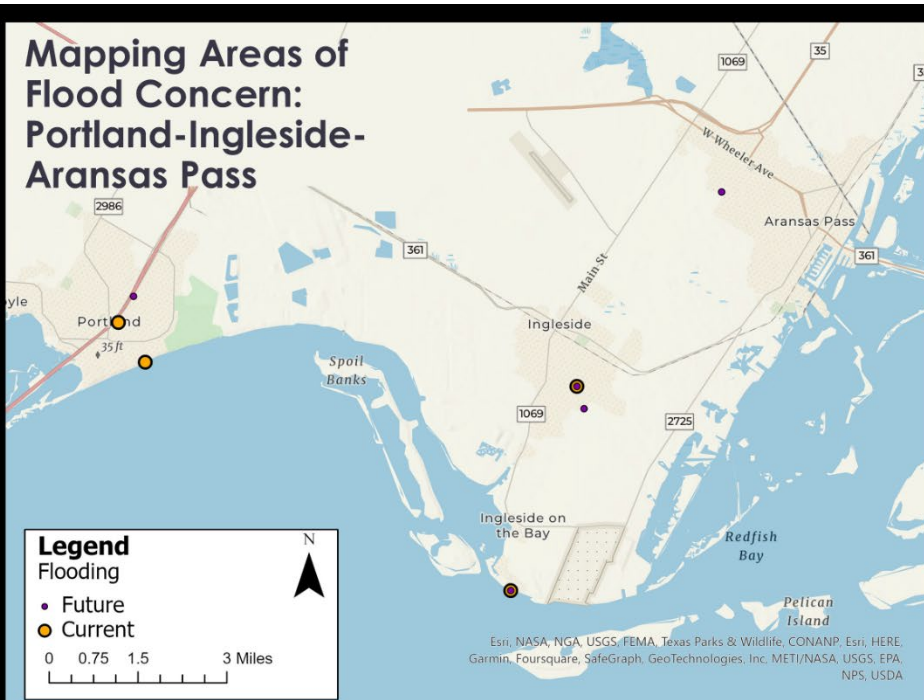
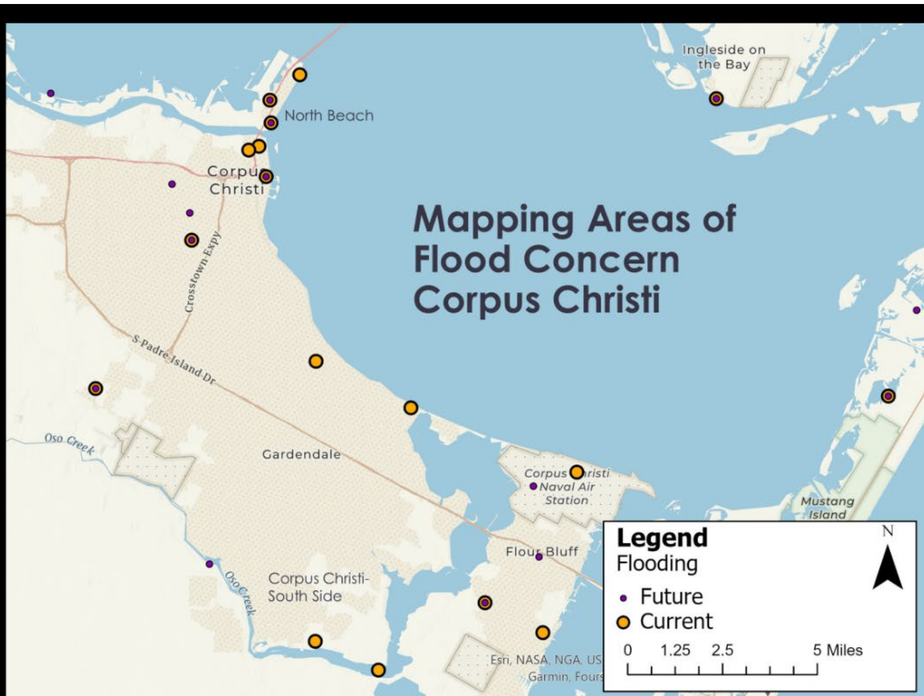
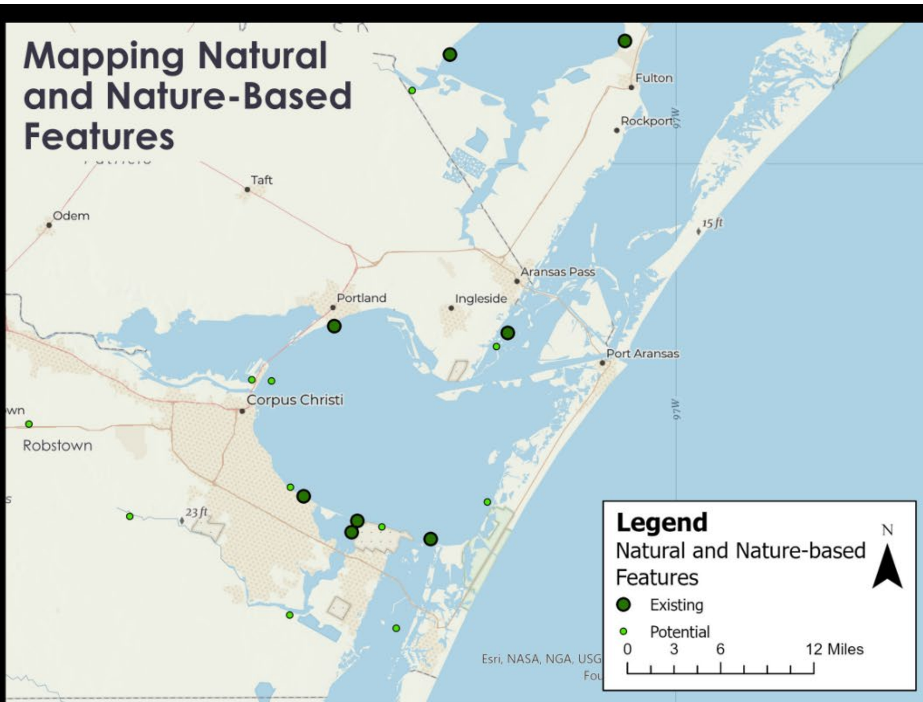


- Current:
  - Aransas Pass flooding concerns stemming from backside of peninsula & ship channel
  - Portland
- Future
  - Ingleside: flood concerns, in areas with oil and gas facilities. & shorelines erosion



- Current/Future:
  - Expansion to Southside near Oso Creek
  - Mustang Island
  - Downtown Corpus Christi
  - North Beach (Corpus Christi Beach)
  - Aging CC sea wall
  - Flour Bluff
  - West Side of Corpus Christi

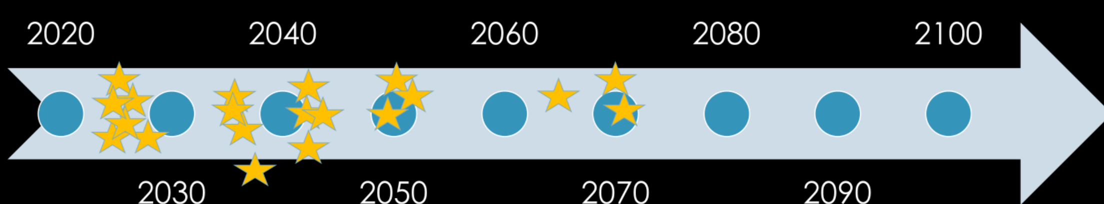
Mapping Natural and Nature-Based Features



- Current:
  - Bayside living shoreline
  - Breakwater in Copano Bay
  - Portland seagrass restoration
  - NAS wetland restoration
  - Corpus Christi Seawall
- Potential
  - Culvert is Aransas Delta to enhance circulation
  - Oso Creek Drainage and flood control needs
  - Seagrass protection needed in Nueces County

Timelines of Concern

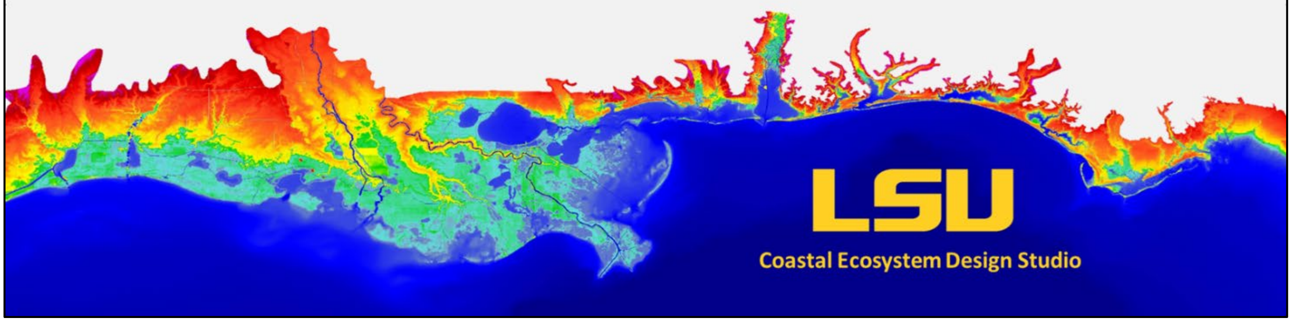
Combined responses from MTAG 2023 May and June sessions



ELSR: Living with Sea Level Rise in the Texas Coastal Bend

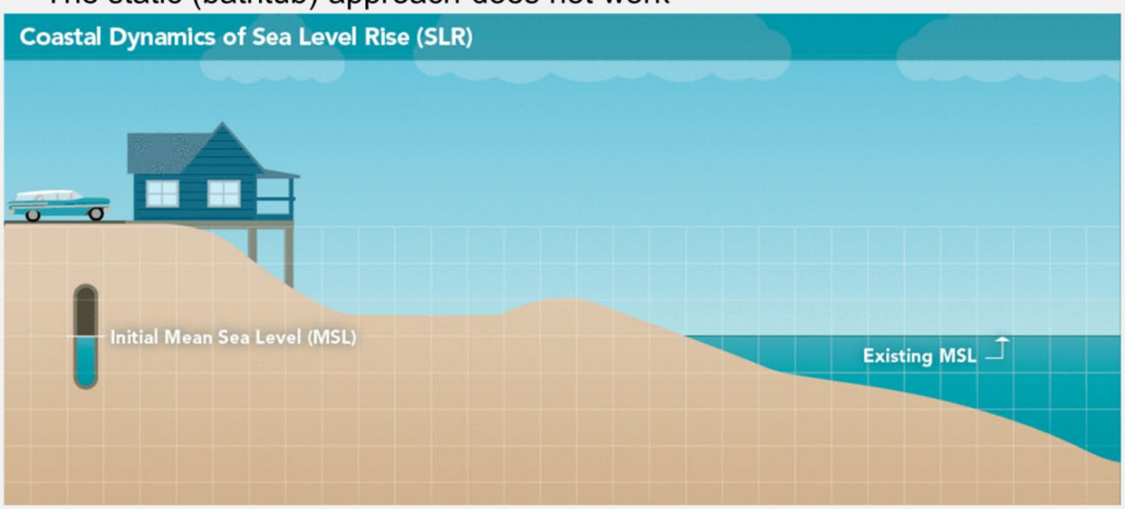
Coupled Hydrodynamic-Ecological Modeling

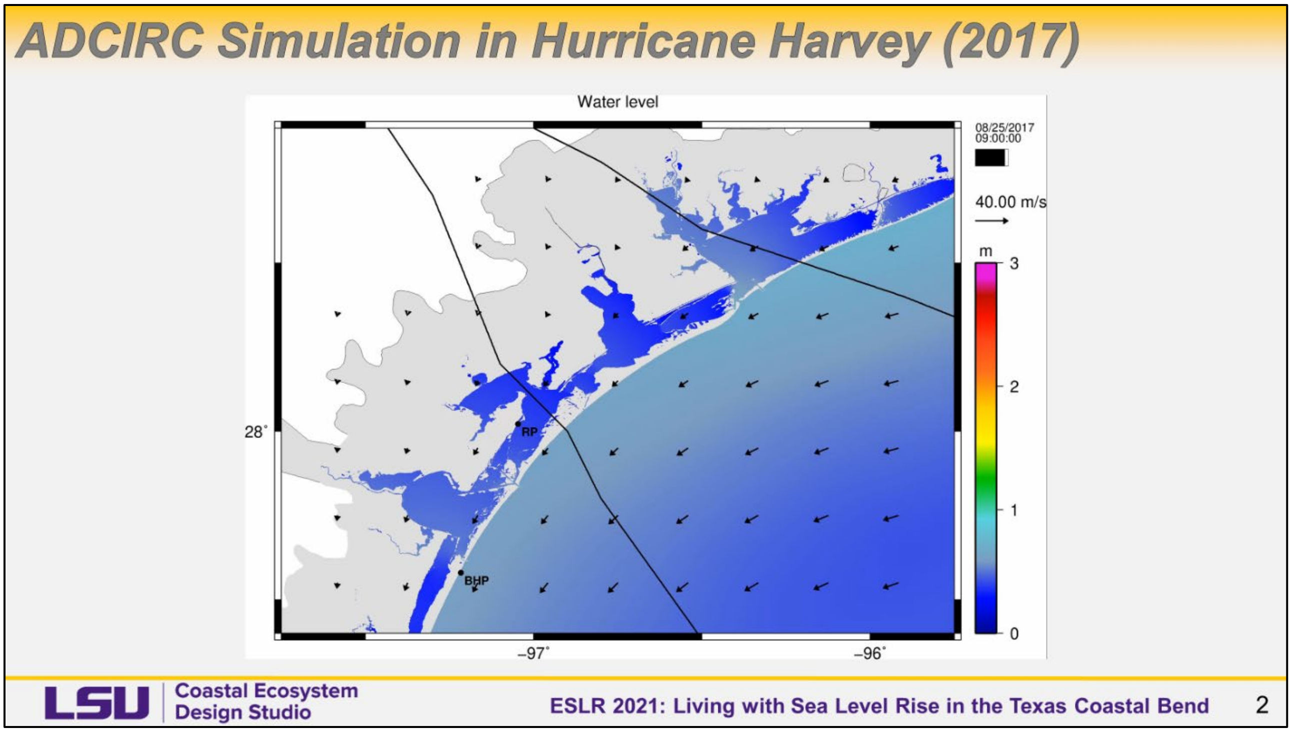
Christopher E. Kees, Peter Bacopoulos and Jin Ikeda



Sea Level Rise (SLR) Impacts

- The coastal system **dynamically** responds to sea level rise
- The static (bathtub) approach does not work




ADCIRC Simulation in Hurricane Harvey (2017)
Water level
08/25/2017
09:00:00
40.00 m/s
m
3
2
1
0
28˚
RP
BHP
–97˚
–96˚
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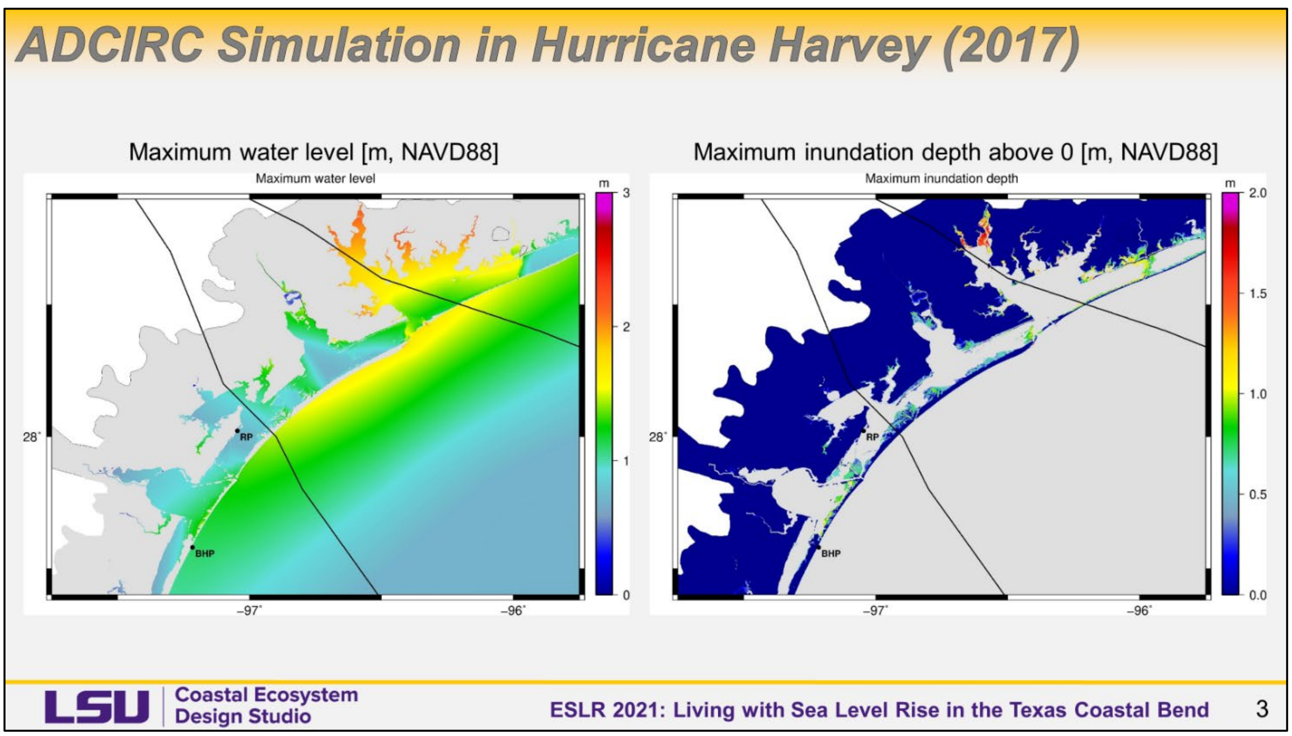
ADCIRC Simulation in Hurricane Harvey (2017)
Maximum water level [m, NAVD88]
Maximum water level
m
3
2
1
0
28˚
RP
BHP
–97˚
–96˚
Maximum inundation depth above 0 [m, NAVD88]
Maximum inundation depth
m
2.0
1.5
1.0
0.5
0.0
28˚
RP
BHP
–97˚
–96˚
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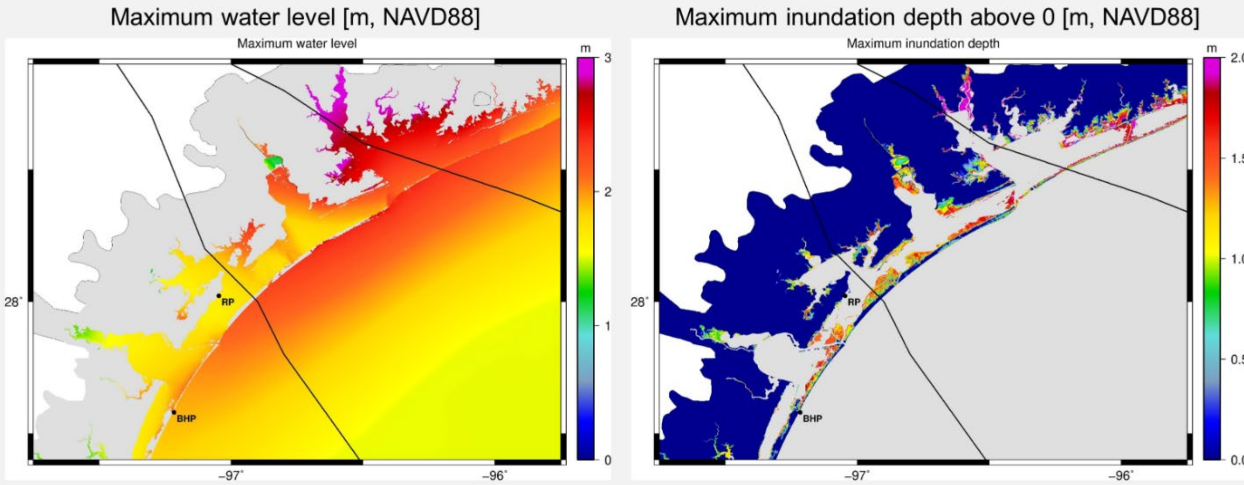
3

SLR impacts on storm surge and inundation: SLR=0.82m



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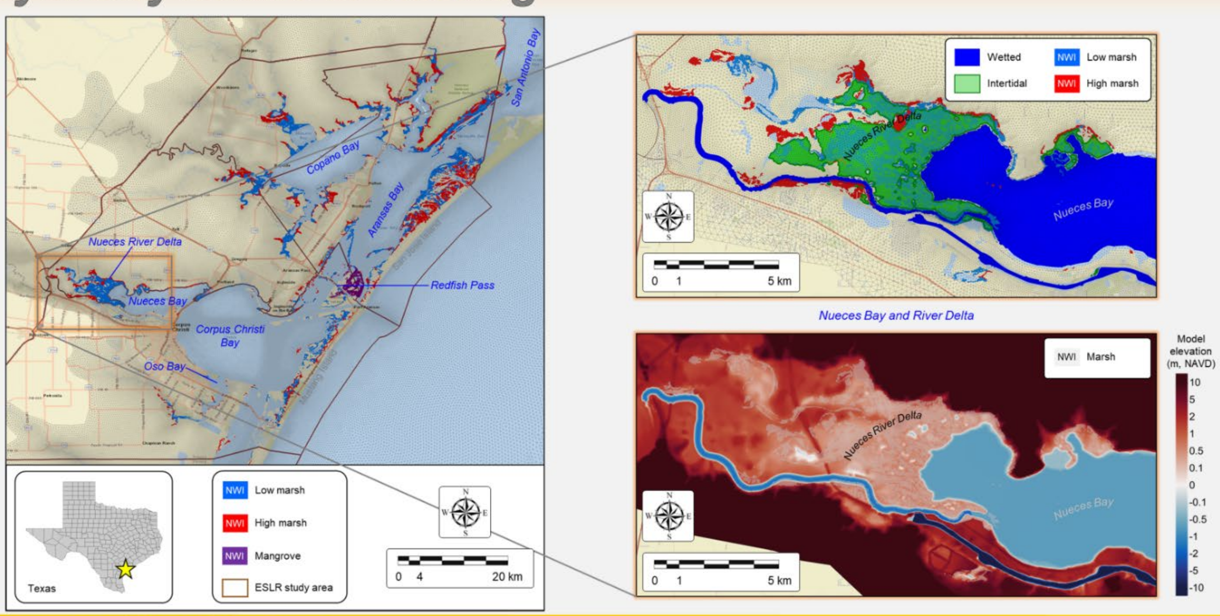
Hydrodynamic modeling



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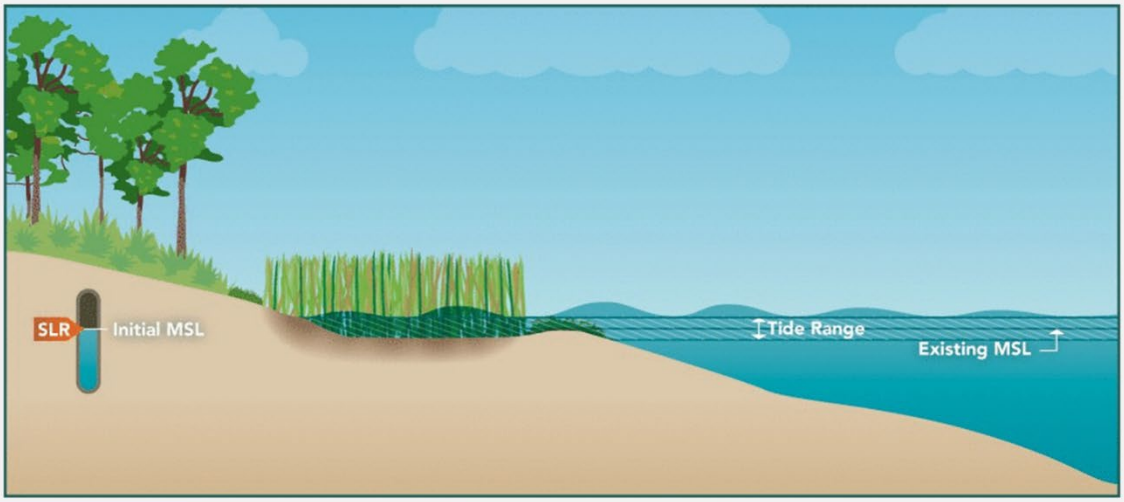
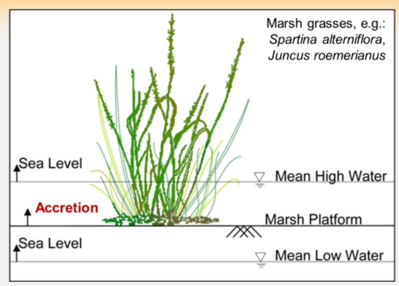
Ecosystem functions and resilience to SLR

- Wave and storm surge attenuations: Protect hinterlands
- Vertical accretion vs. SLR results in horizontal migration



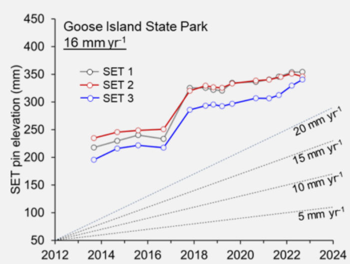
Marsh/mangrove modeling

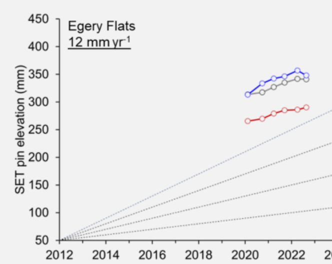
$$\underbrace{\frac{dZ}{dt}}_{\text{total accretion}} = \underbrace{\frac{dZ_{org}}{dt}}_{\text{organic accretion}} + \underbrace{\frac{dZ_{min}}{dt}}_{\text{mineral accretion}}$$



Sediment elevation table (SET) data (curtesy of Mission-Aransas NERR)

Examples shown for Copano Bay (vertical accretion of platform elevation)





Mineral accretion

Inorganic accumulation due to sediment capture by intermittently submerged vegetation

$$\frac{dZ_{\text{min}}}{dt} = \frac{M_{\text{inorganic}}}{k_2} = \frac{q \times m \times f \times D \times F_{\text{IT}}}{k_2}$$

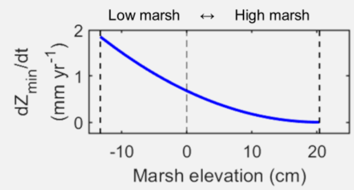
Example geared towards the Texas Coastal Bend

$$\frac{dZ_{\text{min}}}{dt} = 0.7\ \frac{\text{mm}}{\text{yr}^{-1}}$$

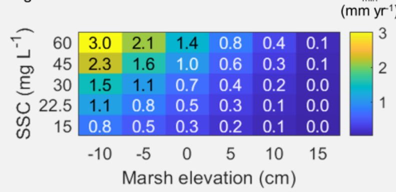
Variable	Meaning	Value
q	Unitless capture coefficient	1 (full capture)
m	Suspended sediment concentration	3×10^{-5} g cm^{-3} (assume 30 mg/L)
f	Tides per year	365 yr^{-1} (diurnal)
D	Depth of submergence at high tide: MHW – Z	20.4 cm (MHW, Aransas)
F_{IT}	Flooding frequency: D / (MHW – MLW)	0.5 (assume Z = 0 m)
k_2	Bulk, self-packing density of inorganic matter	1.99 g cm^{-3}

For a fixed value of SSC*, the modeling already can account for mineral accretion as a function of marsh elevations and tide levels

* Assumed here was SSC of 30 mg L^{-1} from literature



We need data-guided values of SSC for the TCB



Organic accretion

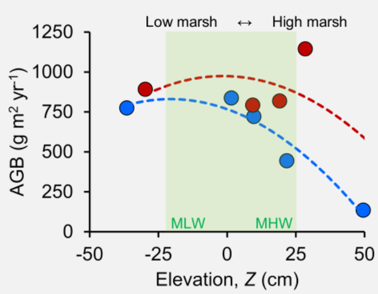
A function of
aboveground biomass (AGB) + belowground biomass (BGB)

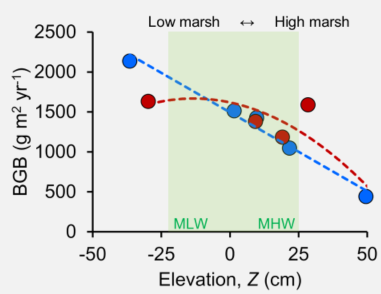
$$\frac{dZ_{\text{org}}}{dt} = C(\text{AGB} + \text{BGB}) \sim 10\ \frac{\text{mm}}{\text{yr}^{-1}}$$

Field observation geared towards the Texas Coastal Bend, Rezek et al. (2017): Analyzing data now

Another example: Marsh organ data collected in coastal LA at CRMS 322 (saline) and CRMS 399 (brackish)
Credit: Brandon Wolff, LSU thesis student

Marsh organ instrument



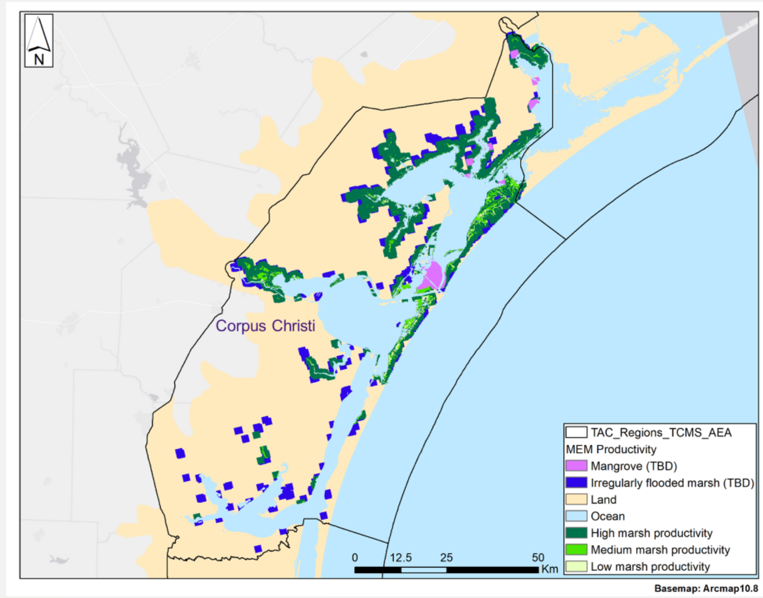


WEADS: Wetland Ecosystem and Accretion Dynamics Simulator

- ❑ **Updates**
  Incorporate local parameters into the ecological model

- ❑ **Data request**
  Need local experts help to find mangrove and marsh evolutions (e.g., SSC, organic accretion)

- ❑ **Plan**
  Present the results of the coupled hydrodynamic-ecological modeling in this spring meeting



A Bit More About Sea-Level Rise

Setting the Stage

- Discuss potential ways to frame future sea-level rise: temp, SSPs, risk-based
- Discuss single location projections or regional average
- Discuss number of scenarios needed at different time points

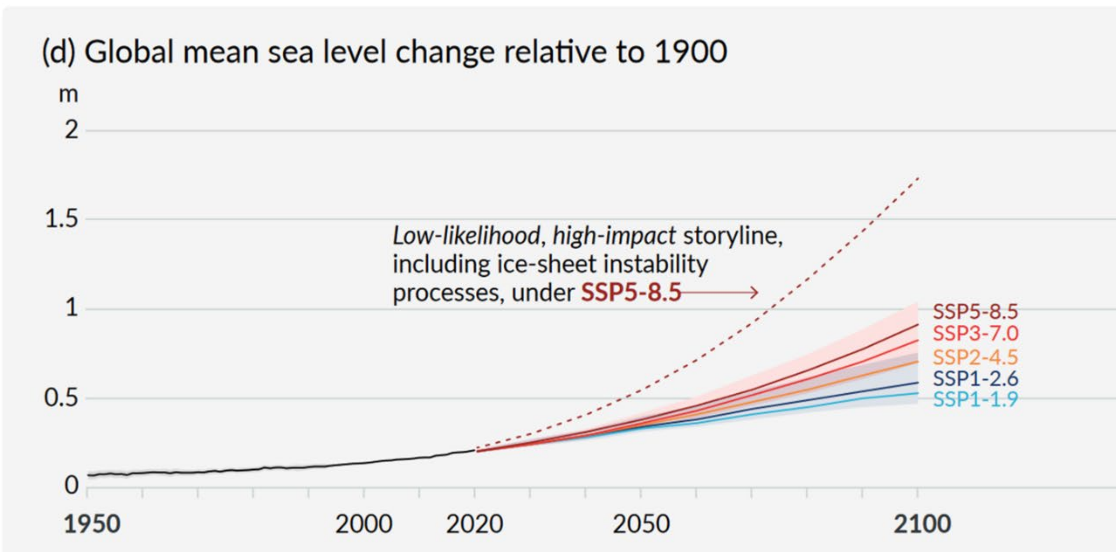
Framing Sea-Level Rise - Considerations

- Gulf sea-level rise acceleration
- Low confidence, high-impact processes
- Projections vs scenarios
  - Temp projections
  - Emissions projections
  - Risk-based scenarios

Projections

- Some states & municipalities are aligning climate planning across different issues (temp, precip, sea-level rise) to projections of future conditions
- IPCC AR6 developed projections based on SSPs
  - Shared socioeconomic pathways = storylines of the future
  - Separated out low-confidence processes

AR6

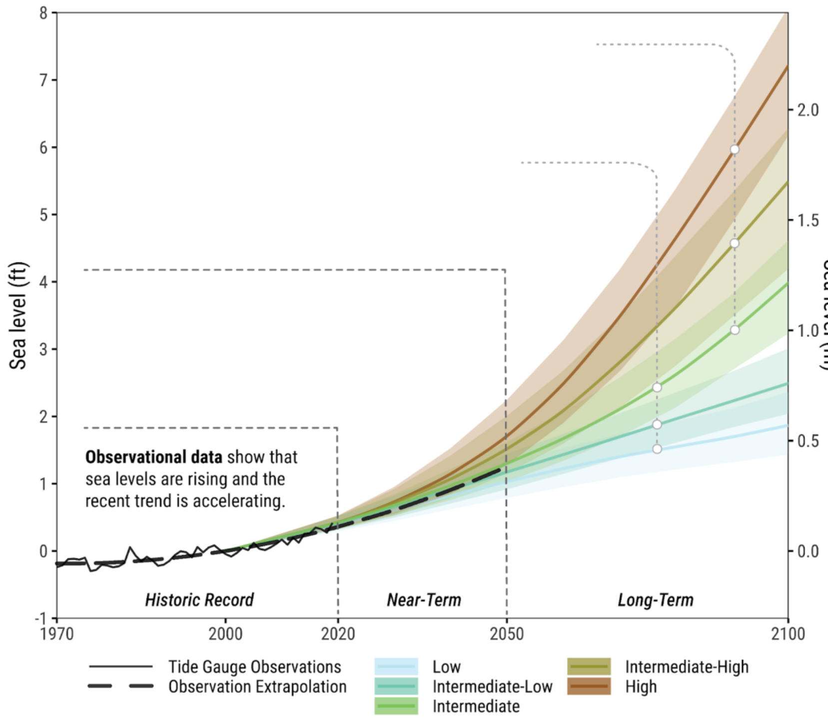


Scenarios

- Some stakeholders want to plan to the range of what is possible
- US Interagency Taskforce developed a risk-based suite of scenarios
  - Span the range of uncertainties

US Army Corps of Engineers
USGS science for a changing world
RUTGERS UNIVERSITY | NEW BRUNSWICK
FEMA
FIU Institute of Environment
FLORIDA INTERNATIONAL UNIVERSITY

US SLR Task Force

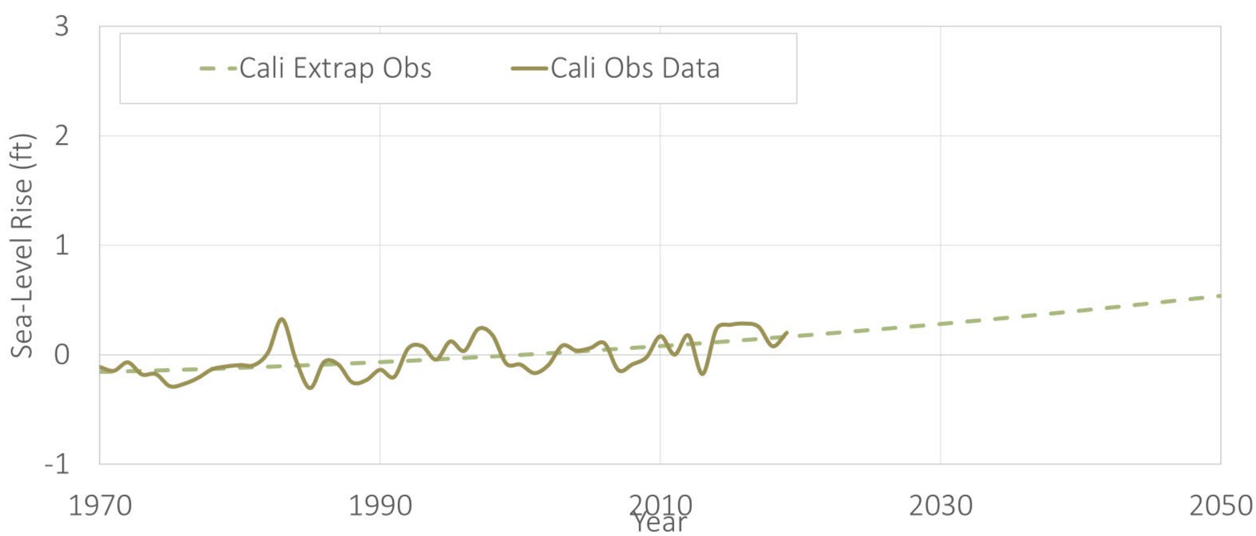


TEXAS A&M UNIVERSITY CORPUS CHRISTI | HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES
LSU Center for Coastal Resiliency
THE WATER INSTITUTE OF THE GULF

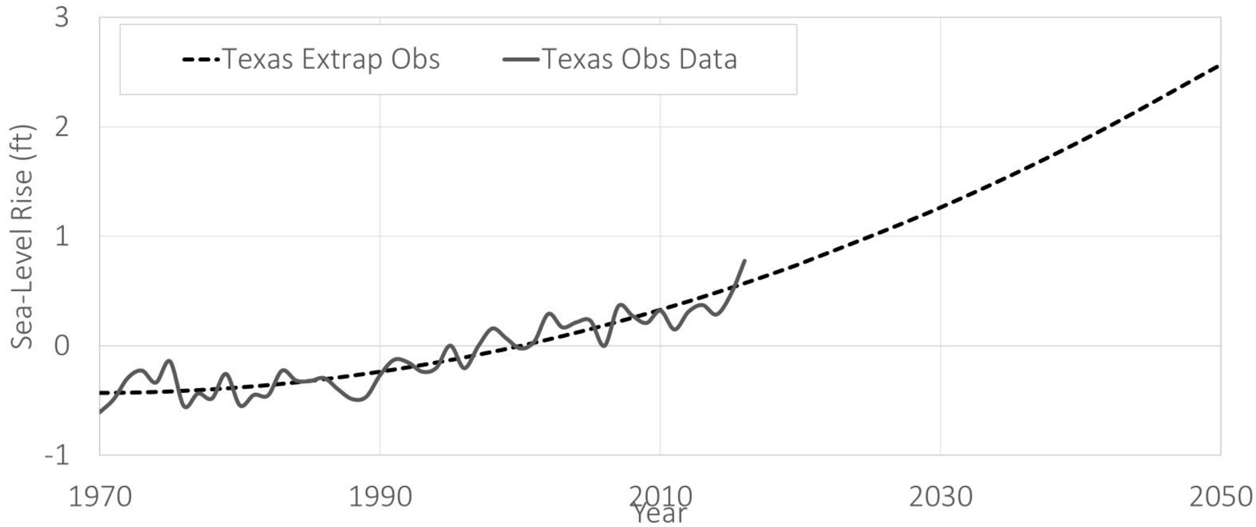
Rapid, recent acceleration

- The Gulf has seen rapid acceleration – not due to vertical land motion
- Several theories being tested currently as to why
  - Narrowed down to likely being related to heat content
  - Still questions about the duration long-term
  - Has implications for near-term planning & adjustments to scenarios/projections

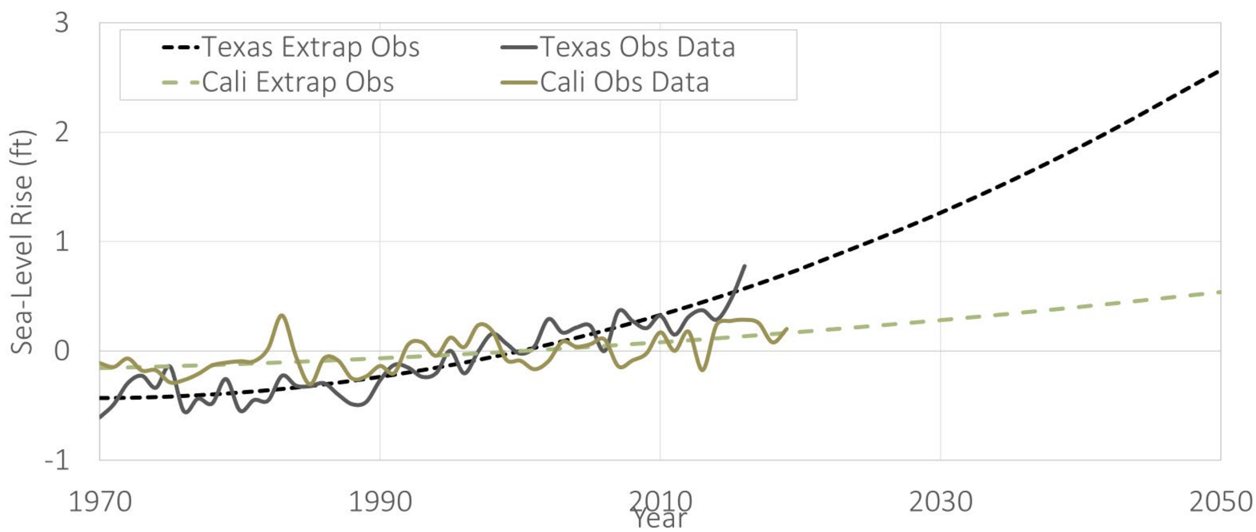
Recent Acceleration in the Gulf



Recent Acceleration in the Gulf



Recent Acceleration in the Gulf



Benefits of Different Framings in the Gulf

SCENARIOS

Cover full range of risk

Account for uncertainty around LC processes

Hedge on uncertainties around acceleration

PROJECTIONS

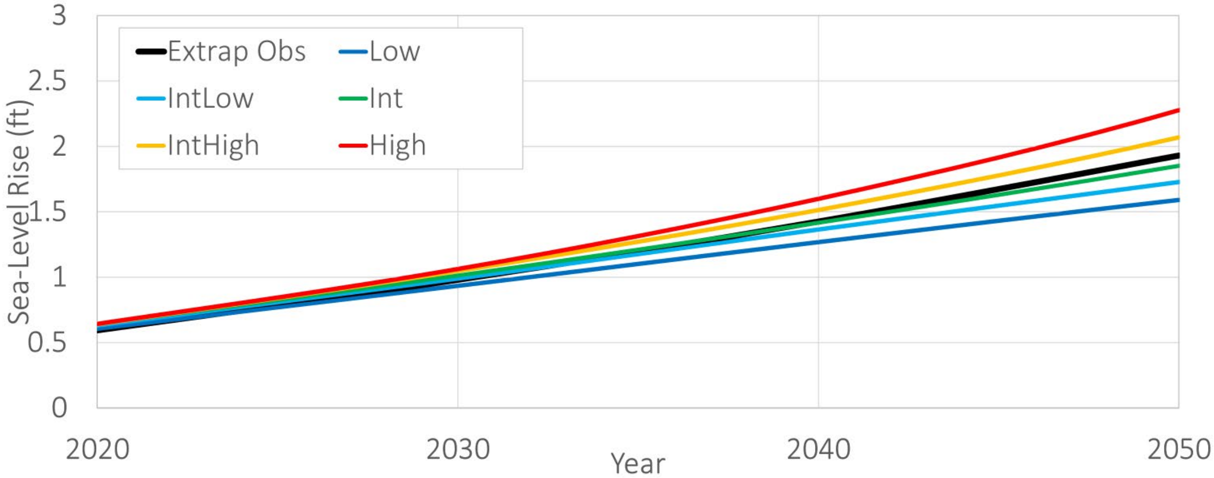
Easier to relate to other types of planning – e.g., temperature or precipitation changes

Location specific or regional

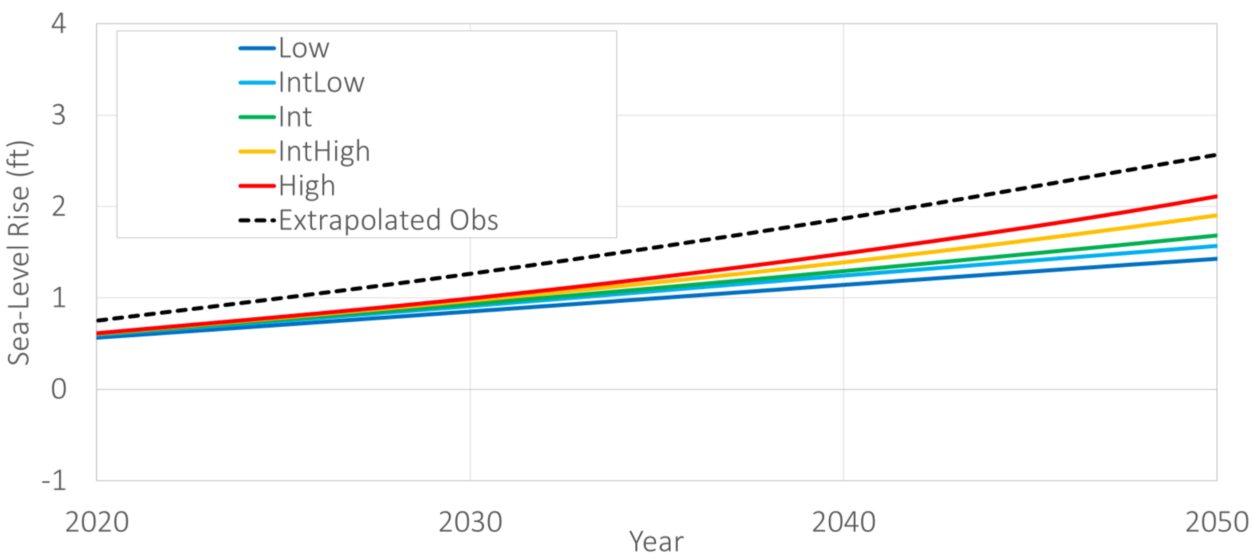
Scenario	Corpus	Rockport	Western Gulf
Low	2.1	2.6	3.0
Int-Low	2.8	3.2	3.6
Intermediate	4.3	4.7	5.1
Int-High	5.9	6.3	6.7
High	7.7	8.0	8.5

Western Gulf of Mexico Scenarios

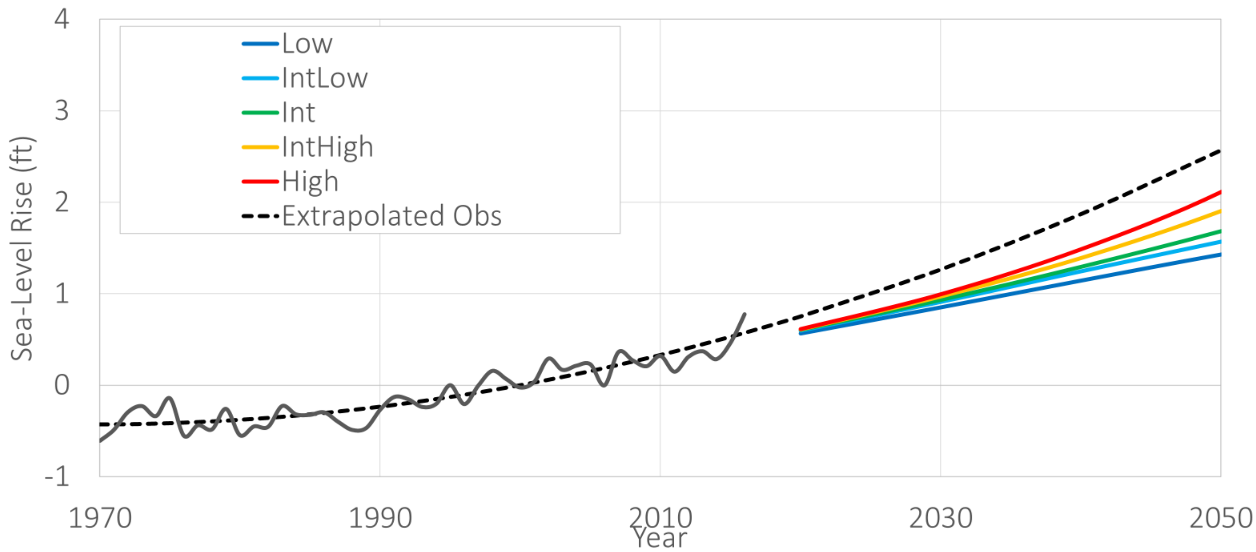
Between Intermediate and Intermediate-High



Rockport Scenarios



Rockport Scenarios

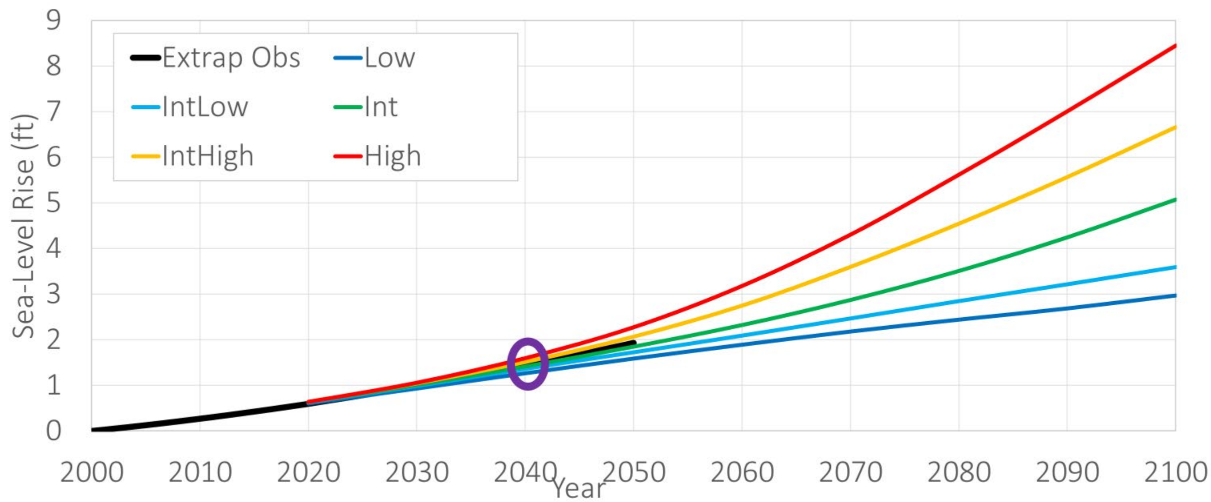


Time Steps & Scenarios

- We will use the selected time steps and scenarios to describe changing flood risk with SLR at each time step.
- How much range is needed to justify multiple SLR scenarios evaluated?
  - Example: in 2050 the entire range is 1 ft of SLR. Is that enough for two scenarios?
- First though – need time steps

Time Steps & Number of Scenarios

Western Gulf of Mexico Scenarios



Appendix D: 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

TWIG- The Water Institute of the Gulf

NOAA – National Oceanic and Atmospheric Administration

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

NAS Naval Air Station

Other Acromyms

ADCIRC – ADvanced CIRCulation (hydrodynamic model)

DEM – Digital Elevation Model

ESLR – Effects of Sea Level Rise Program

MEM – Marsh Equilibrium Model

MTAG – Management Transition Advisory Group

NNBF - Natural and Nature-Based Features

SLAMM – Sea Level Affecting Marshes Model

SLR – Sea Level Rise

TCRMP – Texas Coastal Resiliency Master Plan

IPCC AR6 - Intergovernmental Panel on Climate Change, 6th Assessment Report