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) Kickoff Meeting
December 8, 2022
Harte Research Institute for Gulf of Mexico Studies

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

ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
Management Transition Advisory Group (MTAG) Kickoff Meeting

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Workshop Summary

The Harte Research Institute for Gulf of Mexico Studies (HRI), Texas A&M University-Corpus Christi recently 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, being led by HRI Endowed Chair for Coastal and Marine Geospatial Sciences Dr. James Gibeaut, will engage 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 will be guided by a Management Transition Advisory Group (MTAG), which will provide researchers with key input and insights on modeling SLR scenarios to produce projections of future landscapes.

The MTAG Kickoff Meeting was held online on December 8, 2022. The goal of this meeting was to introduce the MTAG to the ESLR project. There were a total of 20 attendants including 10 members of the project team. Members of the MTAG represent various local and state organizations including Coastal Bend Council of Governments, Nueces Parks, Port of Corpus Christi, Coastal Bend Bays & Estuaries, Corpus Christi Metropolitan Planning Organization, Corpus Christi Convention & Visitors Bureau, Corpus Christi Regional Economic Development Corporation, Texas Sea Grant, Texas Water Development Board, Texas General Land Office and Texas Department of Transportation.

Dr. Katya Wowk opened the meeting and Dr. Gibeaut presented a brief project summary for Living with SLR in the Texas Coastal Bend. The project is a collaboration between three entities: Harte Research Institute (HRI), Louisiana State University (LSU) and The Water Institute of the Gulf (TWI). HRI has previously been involved with local modeling of the effects of SLR and LSU has previous modeling experience with wetland change models. Project goals include: 1.) improve and adapt Hydro-MEM (Hydrodynamic-Marsh Equilibrium Model) for the region, 2.) assess SLR vulnerability and efficiency of natural and nature-based features, and 3.) co-produce knowledge and products through collaboration with the MTAG.

Dr. Peter Bacopoulos gave a brief presentation of the Hydro-MEM scientific basis, inputs, application, and example output. The presentation was followed by a few questions. Next, Dr. Renee Collini presented Practical Considerations for SLR in 5 minutes or less. She compared SLR estimated from 2017 to 2022, showing that, overall, the high end has decreased but the low end has increased, thus narrowing the range of possible SLR. By 2050, it is expected that Corpus Christi will experience over 2ft of SLR compared to the year 2000. Following the presentation, the participants reviewed some results from the pre-workshop survey and had a discussion.
Workshop Objectives

- To introduce project goals, objectives, and timeline
- To define the role of the Management Transition Advisory Group (MTAG)
- To understand MTAG management/decision making needs relating to sea-level rise
- To introduce the ESLR modeling approaches

Workshop Attendants

Meredith Dardedn, Visit CC  
Peter Bacopoulos, LSU*  
Kara Coffey, HRI-TAMUCC*  
Diana Del Angel, HRI-TAMUCC*  
Renee Collini, TWI*  
Scott Cross, Nueces County Coastal Parks  
James Gibeaut, HRI-TAMUCC*  
Danielle Hale, Port of CC  
Jin Ikeda, LSU*  
Craig Casper, CC MPO  
Chris Kees, LSU*  
Emily Martinez, CBCOG  
Debalina Sengupta, Texas Sea Grant  
Brittney Sotelo, CC Regional EDC  
Kristen Stanzel, CBBEP  
Lihong Su, HRI-TAMUCC*  
Mukesh Subedee, HRI-TAMUCC*  
Evan Turner, TWDB  
Tony Williams, TGLO TCRMP  
Katya Wowk, HRI-TAMUCC*

*denotes affiliation with project team
Description of Meeting Activities and Content
This kickoff meeting was an hour long. To capture MTAG feedback before the meeting a pre-meeting survey was sent to the MTAG group (see Appendix C for results). The meeting components included introductions, project overview and a group discussion (Also see Appendix A. Workshop Agenda).

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. Dr. Wowk emphasized that at the in-person meeting planned for Spring 2023 ample time would be provided to better introduce group members and focus on relationship building.

Project Overview
Dr. Gibeaut presented a brief project summary for Living with SLR in the Texas Coastal Bend. The project is funded by NOAA’s ESLR program, which has been active over 10 years. Project co-PI’s at LSU, had been funded through the NOAA’s ESLR program, bringing their expertise to this project. The project is a collaboration between three entities: HRI-TAMUCC, LSU, and TWI. HRI has previously been involved with local modeling of the effects of SLR for the GLO’s TCRMP. Here the team has used SLAMM and ADCIRC models to assess the impacts of SLR. The project presented here will apply new modeling techniques, in particular the application of the Hydro-MEM, with the goal of improving SLR models for the area. The project is ongoing and expected to end August 31, 2024, but may be extended 1 year.

The project study extent covers the six coastal counties of the Coastal Bend. One goal is to improve and adapt the HydroMEM model for the region. This includes improvements to the bare-earth digital elevation models (DEMs) and updates to the HydroMEM, which is specific to spartina, to adjust to local vegetation, such as mangrove. Then, with these inputs, SLR vulnerability can be better assessed based on model results. Dr. Gibeaut explained that the MTAG input is important, particularly when designing and modeling the effects of potential solutions, such that solutions are based on priority decision-making needs, including where we might protect coastal habitat to mitigate or adapt to SLR. Potential questions include: Which areas do we prioritize for modeling the effects of potential solutions? What techniques should be employed? These questions will be addressed through co-producing knowledge with the MTAG for improved modeling and potential application in the region.

MTAG Role
Dr. Wowk spoke briefly to the MTAG about a charter. The charter will define MTAG roles and responsibilities, and will be crafted jointly between project leads and the MTAG. Dr. Wowk and Mrs. Coffey will be reaching out to the MTAG to organize individual calls to assess how the output of this project can best be incorporated into their work and programs.
Introduction to Hydro-MEM Modeling

Dr. Peter Bacopoulos gave a brief presentation of the Hydro-MEM scientific basis, inputs, application, and example output. Originally developed in the 70’s by Dr. Jim Morris, the MEM model relates the surface elevation of the marsh surface to the water elevation (tidal frame) to determine how productive a marsh will be. Marsh production is measured as biomass, and through a series of mesocosm experiments (marsh organs deployed in the field) a marsh biomass curve (see slides for figure). There is not a marsh organ experiment for the coastal bend therefore the data will be determined from a collection of biomass curves based on a variety of locations. The HydroMEM uses ADCIRC for modeling water movement and to help determine the water level, which is the input to the MEM model to then estimate biomass density. Dr. Bacopoulos explained that the model will be adapted to the meteorology and ecology of the Texas Coastal Bend.

Planning for Sea Level Rise

Dr. Renee Collini kicked off this section with a short presentation titled, Practical Considerations for SLR in 5 Min or Less. She compared SLR estimated from 2017 to 2022; overall, the high end has decreased but the low end has increased, thus narrowing the range of possible SLR. By 2050, it is expected that Corpus Christi will experience over 2ft of SLR compared to the year 2000. Dr. Collini encouraged the workshop participants to visit the Application Guide online, which translate the science within the updated technical report and special considerations for planning using the range of projected SLR. Approaches to decision-making in the face of uncertainty are risk tolerance, scenario planning, and adaptation pathways.

Group Discussion

Following the presentation, the participants reviewed some results from the pre-workshop survey and had a discussion. One participant asked if the project would generate inundation frequencies. The research team suggested that the hydroperiod is an intermediate product of the marsh model, yet this does not include open coast areas. Further, Dr. Gibeaut clarified that sedimentary processes at the beach shoreline will not be modeled. Another participant asked if the soil type affects the MEM model output. The response from the research team stated that the inorganic component is modeled using suspended sediments. Lastly, a question was pointed at mangroves: Specifically, how will mangrove expansion be included in the model? The team responded that marsh productivity for mangrove is not yet available, and it is expected that mangroves will have a different curve than the spartina.

Action Items

- The ESLR team will send an email follow-up with resources and meeting summary.
- The MTAG team will be scheduling a Spring MTAG meeting.
- Follow-up will include individual meetings with MTAG members to engage in more in-depth discussion on survey responses.
- Complete and adopt an MTAG Charter, including roles and responsibilities.
ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
December 8, 2022
Harte Research Institute for Gulf of Mexico Studies
Management Transition Advisory Group (MTAG) Kickoff Meeting

Workshop Objectives:
- To introduce project goals, objectives, and timeline
- To define the role of the Management Transition Advisory Group (MTAG)
- To understand MTAG management/decision making needs relating to sea-level rise
- To introduce the ESLR modeling approaches

Meeting Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:50 pm</td>
<td>Meeting opens for technology check</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>Welcome &amp; Introductions</td>
</tr>
<tr>
<td>1:15 pm</td>
<td>MTAG Role</td>
</tr>
<tr>
<td>1:25 pm</td>
<td>Introduction to Hydro-MEM Modeling Component</td>
</tr>
<tr>
<td>1:40 pm</td>
<td>Planning for Sea Level Rise (Review MTAG survey results)</td>
</tr>
<tr>
<td>2:00 pm</td>
<td>Adjourn</td>
</tr>
</tbody>
</table>

Meeting Information:

Click here to join the meeting

Meeting ID: 238 697 875 675
Passcode: vBXcNe

Or call in (audio only): +1 361-434-5376,,585489635# Phone Conference ID: 585 489 635#
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) predict effects of SLR under varying management strategies.
- LSU developed and applied new SLR modeling techniques (Hydro-MEM) under the ESLR program.
- HRI, LSU, and MSU are partners on this newly funded ESLR project with the following goals:
Goals

- Improve and adapt Hydro-MEM to the Texas Coastal Bend
  - Improve bare-Earth elevation model
  - Develop model mesh
  - Add wetland species
  - Validate Hydro-MEM
- 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
Hydro-MEM (ecological basis)
Hydrodynamic – Marsh Equilibrium Model

Marsh Equilibrium Model for *Spartina alterniflora* system
Marsh is productive if the surface elevation resides within the tidal frame (MLW < E < MHW)
Hydro-MEM Workflow

- **ELEVATION**
- **ASTRONOMIC TIDES**
- **BOTTOM FRICTION**

**Hydrodynamic Model**
- ADCIRC
  - Tidal Constituents: Amplitude, Phase & Frequency
- Tidal Datums: MLW, MHW
  - Biomass Density
  - ELEVATION based on accretion

**Bottom Friction**
- Sea Level Rise
  - \( t = t + \Delta t \)
  - No: \( t = t_{\text{total}} \)
  - Yes

**ArcGIS Toolbox**

**OUTPUT**
- TIDAL HARMONICS
- MLW & MHW
- BIOMASS PRODUCTIVITY
- ACCRETION
- ELEVATION
Hydro-MEM Workflow

- ELEVATION
- ASTRONOMIC TIDES
- BOTTOM FRICTION

Hydrodynamic Model
- ADCIRC
- Tidal Constituents
  - Amplitude, Phase & Frequency

Biomass Density
- MLW, MHW
- Biomass & Accretion
  - ELEVATION based on accretion

ArcGIS Toolbox

OUTPUT
- TIDAL HARMONICS
- MLW & MHW
- BIOMASS PRODUCTIVITY
- ACCRETION
- ELEVATION

Bottom Friction
- Sea Level Rise
  - $t = t + \Delta t$
  - No
  - Yes
  - $t = t_{total}$
Adapting Hydro-MEM to Texas Coastal Bend

- Mesh development/refinement
  - Current mesh resolution useful for storm surge modeling
  - New: Refine the mesh at the land-water interface for ecological modeling

- Tidal datums
  - Original method based on astronomic tides only
  - New: Adapted method based on astronomic tides + wind forcing

- Biomass curve
  - Original method based on site-specific observations (parabolic)
  - New: Adapted method based on regional marsh observations (exponential)
**Mesh refinement strategy**

Sub-mesh polygon encompasses local refinement
Sub-mesh boundary is 3 km away from NWI polylines
Ensures seamless connection with global mesh

Redistribute polylines to DX
Transition away from DX_{polylines} via gradation: DX(x,y)

**Mesh refinement only**
If DX(x,y) > EXISTING(x,y), then DX(x,y) = EXISTING(x,y)

**Sub-mesh size relates with DX**

Tabulated values are for the sub-mesh region

<table>
<thead>
<tr>
<th>Resolution (m)</th>
<th>Num nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-existing</td>
<td>121 ± 59</td>
</tr>
<tr>
<td>Refined (DX 100 m)</td>
<td>159 ± 75</td>
</tr>
<tr>
<td>Refined (DX 30 m)</td>
<td>0 ± 0</td>
</tr>
<tr>
<td>Refined (DX 10 m)</td>
<td>0 ± 0</td>
</tr>
</tbody>
</table>
PRACTICAL CONSIDERATIONS FOR SEA LEVEL RISE

In less than 5 minutes!

Renee Collini | December 8, 2022
2022 SLR Technical Report

- Updates to SLR Projections
- Extrapolated Tide Station Data
- Analysis of Changes in Extreme Water Levels
Sea-Level Rise in Corpus Christi

• Describe tech report contents

• Discuss considerations when planning for sea level rise

• Review approaches addressing uncertainty in SLR planning

• Additional resources

Approaches for Addressing SLR Uncertainty

- Risk tolerance
- Scenario planning
- Adaptation pathway
Maybe time for questions??

Renee Collini r.collini@msstate.edu
Survey Report

ESLR 2021 Coastal Resilience: Living with Sea Level Rise in the Texas Coastal Bend
Management Transition Advisory Group (MTAG) Kickoff Meeting
Pre-Meeting Survey

December 8, 2022
Q2 - 1. Please state your name and the institution you represent

<table>
<thead>
<tr>
<th>1. Please state your name and the institution you represent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debalina Sengupta, Texas Sea Grant</td>
</tr>
<tr>
<td>Evan Turner, Texas Water Development Board</td>
</tr>
<tr>
<td>Danielle Hale - Port of Corpus Christi Authority</td>
</tr>
<tr>
<td>Matthew Mahoney Texas Department of Transportation</td>
</tr>
<tr>
<td>Craig Casper; Corpus Christi Metropolitan Planning Organization</td>
</tr>
<tr>
<td>Meredith Darden, Visit Corpus Christi</td>
</tr>
</tbody>
</table>
Q3 - 2. In a brief response, please let us know: "why do you care" about this issue, i.e., why did you agree to join this group?

<table>
<thead>
<tr>
<th>2. In a brief response, please let us know: &quot;why do you care&quot; about this issue, i.e., why did you agree to join this group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>As Coastal Resilience Program director of Texas Sea Grant, coastal hazards and water issues are in our purview for the NOAA Sea Grant Program.</td>
</tr>
<tr>
<td>Critical for planning water needs of Texans for the future; directly relates to all of our collected observations and model data.</td>
</tr>
<tr>
<td>Want to ensure sound principles of emergency management are appropriately represented for the betterment of our community.</td>
</tr>
<tr>
<td>Because we need to develop a Regional Resiliency Plan for the transportation system and we should collaborate on development.</td>
</tr>
<tr>
<td>One of our strategic initiatives at Visit CC is to balance the need for growth with responsible and sustainable development.</td>
</tr>
</tbody>
</table>
Q4 - 3. Do you have a source of information you use to understand the anticipated rate or amount of sea level rise, and if so, what is it?

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>%</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Yes and that source is:</td>
<td>40.00%</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>I look at varied sources</td>
<td>40.00%</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>20.00%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100%</td>
<td>5</td>
</tr>
</tbody>
</table>
Q4 - 3. Do you have a source of information you use to understand the anticipated rate or amount of sea level rise, and if so, what is it?

Q4_4_TEXT - Yes and that source is:

<table>
<thead>
<tr>
<th>Yes and that source is: - Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASGC Sea Grant Team</td>
</tr>
</tbody>
</table>
Q5 - 4. Do you use a specific rate of sea level rise in your planning efforts, and if so, what rate?

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>%</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I use a specific rate of SLR in planning efforts and that rate is:</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>I use varied SLR rates in planning efforts</td>
<td>20.00%</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>I do not use SLR rates in planning efforts</td>
<td>80.00%</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100%</td>
<td>5</td>
</tr>
</tbody>
</table>
Q6 - 5. What timelines are you concerned about with respect to sea level rise and/or flood risk?

<table>
<thead>
<tr>
<th>5. What timelines are you concerned about with respect to sea level rise and/or flood risk?</th>
</tr>
</thead>
<tbody>
<tr>
<td>we are seeing impacts already, so immediate response is required in some places.</td>
</tr>
<tr>
<td>near-term to long-term planning: all important factors</td>
</tr>
<tr>
<td>near term/daily for flood risk</td>
</tr>
<tr>
<td>2050 primarily, but also 2035.</td>
</tr>
</tbody>
</table>
Q7 - 6. Are there any particular locations you are concerned about with respect to sea level rise and/or flood risk? Please briefly describe.

<table>
<thead>
<tr>
<th>6. Are there any particular locations you are concerned about with respect to sea level rise and/or flood risk? Please briefly describe.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas Coast</td>
</tr>
<tr>
<td>the entire coastline, changes to inflow gaging at the downstream most gage station to an estuary.</td>
</tr>
<tr>
<td>Roadways</td>
</tr>
<tr>
<td>Corpus Christi Metropolitan Planning Area (generally Nueces,</td>
</tr>
<tr>
<td>San Patricio, and possibly part of Aransas Counties.</td>
</tr>
</tbody>
</table>
Q8 - If there is anything else you'd like to tell us about sea level rise or flood risk in the coastal bend, please do so here.

<table>
<thead>
<tr>
<th>If there is anything else you'd like to tell us about sea level rise or flood risk in the coastal bend, please do so here.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at this time, looking forward to learning more, and provide inputs as necessary</td>
</tr>
<tr>
<td>High tides have an exceptional impact on flooding by blocking/backfilling outfalls</td>
</tr>
<tr>
<td>We will likely develop multiple scenarios for how much rise as part of the MPO resiliency plan. I have also been contemplating how to use this source in planning.</td>
</tr>
<tr>
<td><a href="https://hazards.fema.gov/nri/expected-annual-loss">https://hazards.fema.gov/nri/expected-annual-loss</a></td>
</tr>
</tbody>
</table>
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
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