NGOM+N2E2 MTAG 2018 Workshop Report

Report of activities, methods, and results from the

NGOM+N2E2 MTAG Workshop

July 12, 2018

Grand Bay National Estuarine Research Reserve

6005 Bayou Heron Rd, Moss Point, MS 39562

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Workshop Summary

The NGOM+N2E2 team is leveraging almost a decade of transdisciplinary science and relationship building with coastal decision-makers to develop actionable data products for natural resource management and community planning in the face of sea-level rise (SLR). Progress made during the 2010-2017 Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico (EESLR-NGOM) project has generated a paradigm shift in how coastal vulnerability to SLR can be assessed. Further refinement and expansion of the Coastal Dynamics of Sea Level Rise (CDSLR) and Hydro-MEM modeling capabilities and approaches from the EESLR-NGOM efforts will enable coastal decision-makers to consider how coastal processes interact with natural and nature-based features (NNBFs) to reduce potential vulnerability.

The Management Transition Advisory Group (MTAG) and the project team for the NGOM+N2E2 project met face-to-face for the first time on June 28, 2017 to exchange knowledge, expertise, needs, and perspectives between researchers and key stakeholders. See the NGOM+N2E2 2017 Workshop Report for more details. On July 12, 2018, the MTAG and project team met again to continue strengthening their collaborative efforts, exploring project progress, and providing initial reactions to preliminary data outputs and research. All members of the MTAG (a group of natural resource managers, restoration specialists, and extension and outreach professionals from across the northern Gulf) were invited. Local stakeholders (e.g., local regional planning councils and commissions, elected officials, municipal staff, etc.) were also invited in order to provide additional perspective and local knowledge from coastal Mississippi. The majority of the NGOM+N2E2 project team was present including social scientists, biogeophysical researchers and modelers, and economists.

The workshop participants were refreshed on the NGOM+N2E2 project goals, objectives, and timeline; informed of project progress and MTAG contribution to the project; and provided input on multiple aspects of the project. Specific project areas addressed during the workshop included: identifying points of interest and opportunities for marsh sampling, gathering guidance on ecosystem services valuation framing, and reviewing research progress on the expansion of Hydro-MEM and nuisance flooding modeling. Additionally, a framework approach to evaluating barrier island management strategies was discussed and preliminary economic impact analyses data were explored for clarity, accuracy, and potential uses. The participants were engaged through multiple techniques and approaches to encourage open and robust feedback. These mechanisms included traditional PowerPoint presentations of pertinent background information and research methods with time for question and answer; open dialogue sessions; a variety of print, digital, and online mapping exercises; focus groups; facilitated discussion; and an icebreaker activity.

The workshop was a successful second meeting of the MTAG and the project team that generated critical information, maintained project momentum, and expanded productive relationships between Gulf stakeholders and researchers. Participants were reminded of the project goals, objectives, and timeline, shown how their contributions have helped to shape and improve the research to date, and gained additional knowledge on the science in the project. Concomitantly, NGOM+N2E2 researchers gained valuable information that will enhance analyses, output framing, and field sampling. Results from the workshop evaluation surveys show that participants thought that the workshop was a positive experience that was a good use of their time, increased their knowledge, and provided information to be applied to their future work.

Workshop Objectives

- To understand the NGOM+N2E2 project goals, objectives, and timeline
- To provide an update on the NGOM+N2E2 work that has been accomplished in the past year
- To understand how MTAG participation has shaped and guided the NGOM+N2E2 project to date
- To explain how Hydro-MEM has been refined for application in the NGOM+N2E2 project
- To explore preliminary results of the economic impacts assessment (EIA), ecosystem services valuation (ESV), and digital elevation adjustment
- To solicit input and feedback on preliminary data results, potential additional analyses, data sources, and a proposed morphological modeling and ADCIRC analysis framework
- To identify and understand the perceptions and needs of the MTAG and local stakeholders regarding natural and nature-based features (NNBFs)

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Workshop Attendees

L.G. Adams, Weeks Bay NERR
Karim Alizad, LSU*
Len Balthis, NOAA NOS*
Jessica Baker, Jackson County
Matt Bilskie, LSU*
Christine Buckle, NOAA NCCOS*
Renee Collini, NGOM SSC*
Stephen Deal, MASGC
Diana Del Angel, TAMU CC*
Denise DeLorme, LSU*
Jennifer Frey, MS DMR
Paul Gavin, Gulf RPC
Scott Hagen, LSU*
Marian Hanisko, NOAA OCM
Jenna Harper, Apalachicola NERR
Patric Harper, US FWS
Mikaela Heming, NGOM SSC*
David Kidwell, NOAA NCCOS*
Dina Knight, TNC Alabama
Justin McDonald, US Army Corps of Engineers
Trevor Meckley, NOAA EESLR*
Stephen Medeiros, UCF*
Sandy Parfait, LSU*
Davina Passeri, USGS*
Jereme Phillips, US FWS
Scott Phipps, Weeks Bay NERR
Jonathan Pitchford, Grand Bay NERR
Margo Posten, Grand Bay NERR
Rhonda Price, MS DMR
George Ramseur, MS DMR
Mike Shelton, Weeks Bay NERR
Sonia Stephens, UCF*
Nicole Taylor, South Alabama RPC
Will Underwood, AL DCNR
Dan Van-Nostrand, NOAA NMFS
Elaine Wilkinson, Gulf RPC
David Yoskowitz, TAMU CC*

*denotes affiliation with project team

Description of Workshop Activities and Content

Welcome, Introductions, Ice Breaker

Participants used an online geoform (electronic form with an interactive map) to identify points of interest nearby and their perception of SLR vulnerability of the location. Then the facilitator, Ms. Renee Collini, added storm surge layers from a variety of SLR scenarios (Fig 1). As individuals' points of interest were inundated, they were asked to state their name, organization, and why that particular location was important to them. The icebreaker introduced participants to the types of data layers they would be learning about and gave participants a chance to learn about the area and each other in a non-traditional way.

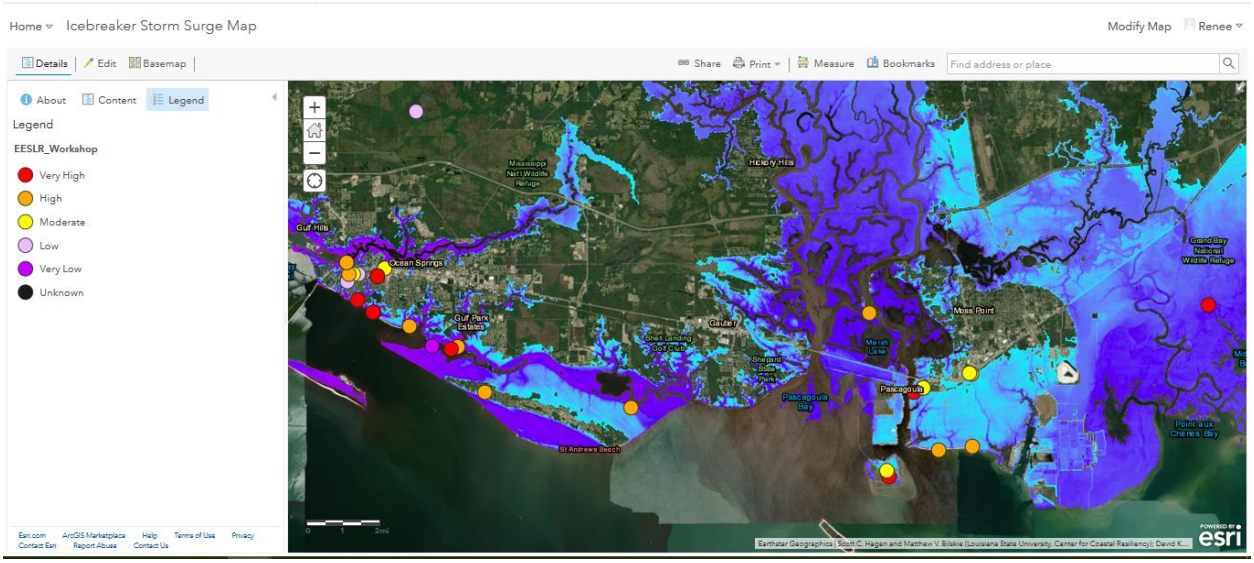

Figure 1 Screen shot of dashboard results displaying participants' points of interest and future storm surge under 0.2 m of SLR.

Project Overview & Update

Figure 2 Dr. Scott Hagen giving background on the NGOM+N2E2 project at the July 2018 MTAG workshop.

Dr. Scott Hagen, Lead-PI on the project, introduced the other PIs, collaborators, and NOAA Ecological Effects of Sea Level Rise (EESLR) Program Managers on the project (Fig 2). Scott reviewed the project acronym, **NGOM+N2E2,** to remind participants that the overarching goal of the project is to assess the ability of **N**atural and **N**ature-based features to mitigate storm surge and nuisance flooding in the **N**orthern **G**ulf of **M**exico. These analyses will include **E**conomic Impact Analyses and **E**cosystem Services Evaluation. Scott then discussed the process diagram for the NGOM+N2E2 system, identifying how the individual research components and MTAG participation fit together to achieve the transdisciplinary research outcomes and outputs from the project. See presentation in Appendix C for details.

Next, Renee briefly reviewed with participants the contributions of the MTAG to project progress. She quickly touched on the principles behind the MTAG role, which is to narrow the options for analysis, improve data access and awareness, and to help shape data products to ultimately result in usable science. Renee then spent some time discussing the activities of MTAG so far and highlighted specific impacts the MTAG has had on the project. See presentation in Appendix C for details.

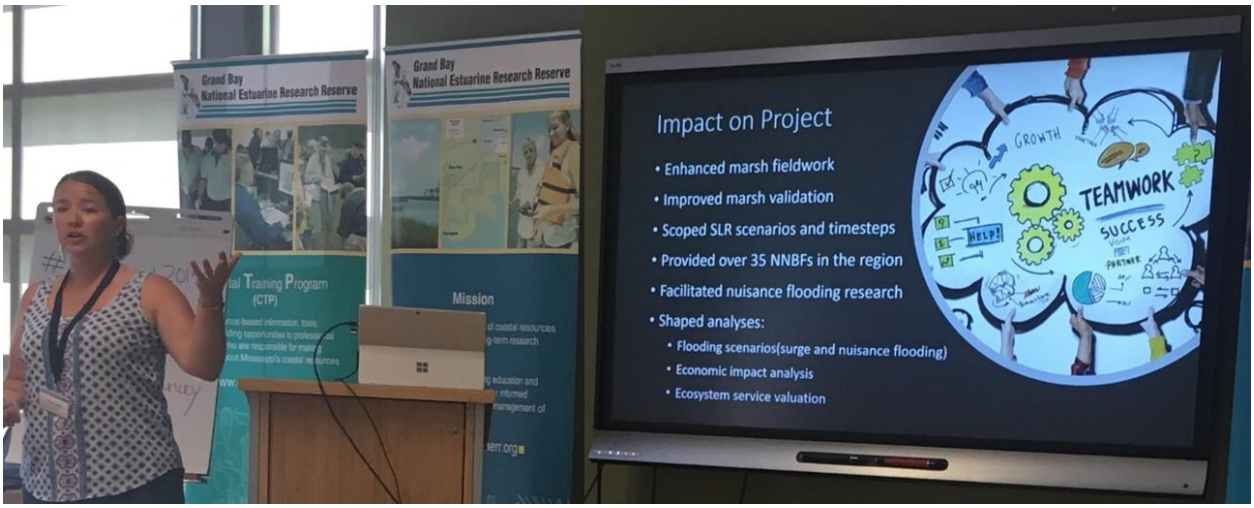

Figure 3 Ms. Renee Collini presenting the impact the MTAG has had on the project at that point.

Marsh Model Expansion and Refinement – Hydro-MEM Expansion

Dr. Karim Alizad provided a refresher on Hydro-MEM, updated workshop participants on marsh projection validation, and discussed the refinement of Hydro-MEM. Hydro-MEM, or the Hydrodynamic Marsh Equilibrium Model, combines hydrodynamic modeling with biological modeling and system data (e.g. elevation, tides, river inflow, etc.) to understand how marshes will respond to SLR. Karim then reviewed validation work that had occurred in Grand Bay NERR, where Hydro-MEM outputs had been compared to National Wetlands Inventory (NWI) and Grand Bay NERR data. There was high agreement (75% and 82%) for both datasets. Next, Karim described the capabilities that have been added into Hydro-MEM. The first was expansion of bays and creation of new creeks as the marshes respond to SLR. The second was that mudflats have been added to the marsh productivity results. Further, Karim demonstrated how migration potential could also be captured. See presentation in Appendix C for details.

Before discussing as a large group, participants raised some questions. The first was asking if the hydrodynamics captured storms or storm inputs. Karim explained that sediment transport in the Hydro-MEM model is based on an experimental constant and considered an average amount of sediment transported. This means Hydro-MEM does not model the sediment input from the storms. The second was asking about the assumptions of how forest will change to marsh. Karim informed the participants that the model identifies the areas with regular inundation and the right elevation for marsh to grow as marsh. Opportunities for migration, including forest, are identified by comparing the model-produced marsh coverage to a land cover/land use (LULC) map to check if the area is a forested area, hay land, or developed area, to categorize them as migration possible, migration possible in a private land, or migration impossible.

Participants then engaged in a large group discussion that was guided by the question: “Planned data products from these analyses are marsh productivity and migration potential. What else would be

useful?" (Appendix B). The discussion began with participants asking at what resolution barriers could be identified. Karim clarified that roads can be built in because of the availability of the data, but that features like culverts that are underneath other infrastructure are hard to capture. One suggestion that generated much interest among participants was a sensitivity analysis for the migration on the fringes. To complement this, participants suggested identifying the driving factors in migration that can be managed under a range of future scenarios.

Next, the discussion turned to thin layer placement (TLP). Scott inquired about the volume of material that would reasonably be distributed in a TLP effort. The general thought was around six inches to a foot of material deposited with silty mud material. An example of use provided by Mr. Dan Van Nostrand was that it would be useful to apply Hydro-MEM for understanding with specific types of material, where and how much would be needed to transition mudflats into marsh or to prevent marshes from becoming mudflats. Dan further clarified that this would need to be contextualized with time (e.g., apply XX inches of material in XX time frame to stay productive by XXXX year).

Hydro-MEM Feedback Key Points

- Participants would like to see sensitivity analyses on the fringe of the potential migration coupled with identifying the driving factors that could be managed.
- Hydro-MEM could provide identification of locations and TLP methods for transitioning mudflats into marshes or maintaining marshes that are susceptible to becoming mudflats.

Marsh Model Expansion and Refinement – Ecosystem Services Valuation

Dr. David Yoskowitz gave a brief presentation on the ecosystem evaluation services for NNBFs. David reviewed the definition of ecosystem services including the difference between direct-use values which is the economic or social value of ecosystem goods or benefits where the individual is physically present in the ecosystem (e.g. regulating, supportive, or provisioning services) and passive-use values where the individual may be physically separated from the resource by space or time (existence, bequest, option). Additionally, participants were reminded of what values were prioritized by the MTAG and suggested alternative naming to ensure that the ecosystem services were clear and descriptive. David then clarified that direct benefits associated with storm and flood protection are being captured in the EIA and will not be included in ESV. See presentation in Appendix C for more details.

Figure 4 Dr. David Yoskowitz leading the participants through a dialogue about the prioritized ecosystem services.

Participants were asked to explore each of the prioritized ecosystem services, focusing on the benefits humans receive (also known as final services) and how to communicate them (Appendix B). Some creative phrases that were suggested include: "guac water" for water clarity, "save our wetlands, save our seafood", and "big sponges" to describe wetlands and water movement.

Summary Benefits from Prioritized Ecosystem Services

- Nutrient Scrubbing
  - Water quality
  - Toxin reduction
  - Reduced fish kills/HABs
- Food
  - Nursery
  - Recreational fishing
  - Jobs and income
- Carbon Sequestration
- Aesthetics/Existence
  - Societal benefits
- Water movement
  - Water absorption
  - Safety/security from riverine and coastal flooding
  - Reduce saltwater intrusion
  - Buffer

Participants did discuss if carbon storage should be considered solely or if the cost of carbon from a social perspective should also be integrated. There was no consensus either way. It was strongly considered, though hard to quantify. It was generally acknowledged that it would be difficult to assess this cost accurately.

Participants were asked if there were any other "low hanging fruit" for ecosystem services. Recreation was identified and then further discussed. Activities most closely aligned with recreation were fishing, birding, kayak/boating, and hunting. There was also substantial discussion around the difficulties in identifying the proportion of these activities that are directly related to marshes. Measures that were suggested included municipal spending on infrastructure for wetland recreation (maintenance, new access points, etc.), repeat vs. new recreators, and common recreational fishing species found in the wetlands.

Marsh Model Expansion and Refinement – Field Work

Dr. Stephen Medeiros gave a brief presentation reviewing the objectives for the fieldwork and the progress made. The objectives of the data collection are to understand the marsh platform elevation, the above-ground biomass density, and the marsh accretion rate. Stephen highlighted the techniques and locations sampled in the Apalachee Bay. Further, Stephen shared preliminary results looking at the relationship between above-ground biomass density and elevation of the marsh platform. To conclude the presentation, Stephen shared the preliminary plan for sampling around the Pascagoula River Basin. See presentation in Appendix C for details.

Participants were then asked if they knew of any potential partners in the Pascagoula River Basin area for shared resources, permitting, or any unique features or areas of interest. Participants suggested several collaborators and permitting sources along with supplemental data sources.

Flooding & Decision-Making – Focus Groups

Two concurrent focus groups were conducted by Drs. Denise DeLorme and Sonia Stephens: one with the core MTAG members and the other with local coastal Mississippi stakeholders. The general purpose of the focus groups was to gain insight into stakeholders' perceptions, experiences, and information needs regarding nuisance flooding, NNBFs, economic impact analyses (EIA), and ecosystem service valuation (ESV). Results from this qualitative social science research method provided the project team with a better understanding of what information is considered most critical for evaluating and making decisions between NNBFs and other project options and why. The focus groups helped the team better understand stakeholder impressions and management needs regarding nuisance flooding and nuisance

flooding mitigation. Additionally, the team gained a better understanding of perceptions and current applications of EIA and ESV. See Focus Group Executive Summary in Appendix A for details.

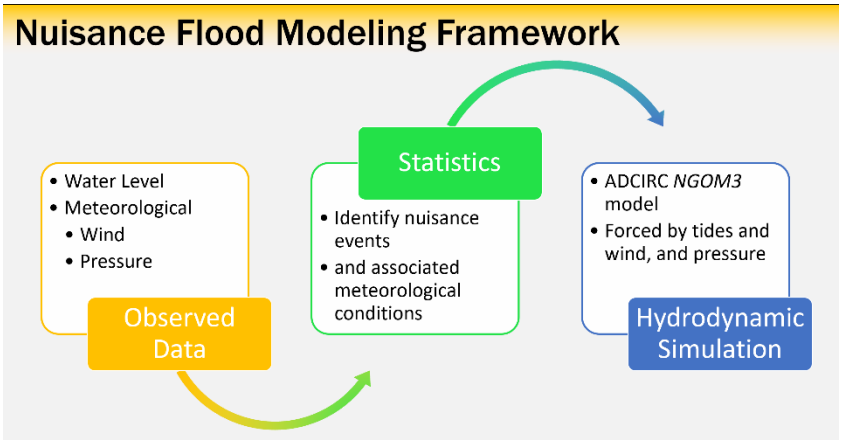

Figure 5 Screenshot from Dr. Bilskie's presentation outlining the Nuisance Flooding Modeling Framework.

Flooding & Decision-Making – Nuisance Flooding

Dr. Matt Bilskie gave a presentation on the current nuisance flooding research which utilized MTAG inputs from last year to understand nuisance flooding in the region and what has been determined so far. Matt began with definitions of nuisance or "high-tide" flooding to ensure the entire audience was working with similar definitions. Then he reviewed historical nuisance flooding in Apalachicola, FL and Mobile, AL, noting a 0.7 day/year increase in minor flooding at Apalachicola over an almost 40-year time frame. Next, Matt reviewed the differences in water level over short spatial differences (Dauphin Island, AL to Mobile, AL) during the same meteorological conditions. Last, he summarized the modeling framework and the findings to date (Fig 5). Participants were very interested in Matt's data and presentation. See presentation in Appendix C for more details.

Flooding & Decision-Making – Proposed Barrier Island Modeling Framework

Drs. Davina Passeri and Matt Bilskie opened the discussion with a presentation on a potential analysis around NNBFs that could be conducted as part of the project. Specifically, the proposed potential analysis would assess the trade-offs in periodic maintenance of dunes on barrier islands vs. only repairing dunes after major storm events. The presentation began with an introduction to expected impacts on barrier island dune systems as a result of SLR. Then Davina and Matt transitioned into speaking about their potential research question focused on understanding if there is an economic benefit to nourishing dunes in between storm events as compared to only nourishing the dunes immediately following storm events. The proposed modeling effort would compare the evolution of the dune over the course of thirty years with SLR and a series of tropical events with and without regular dune maintenance. See presentation in Appendix C for more details.

Attendees had several questions about the approach. The first was if it was possible to do non-barrier island shorelines with dunes, and Davina said it is possible to apply the modeling to mainland shorelines with dunes. There were also some methodology questions regarding how the storms were selected. Davina informed the group that they were developed from the climatology of synthetic storms generated for an ongoing cross-agency study being conducted on Dauphin Island, AL. There were also questions from the workshop participants on how maintenance costs would be defined. It was suggested that for this information to be useful, it should be a comprehensive number. The MTAG also suggested that the cost of maintenance was going to be high either way, and that to help justify any maintenance it would be critical to showcase avoided damages with a fully functioning dune system.

After the MTAG's questions and suggestions on the method, a facilitated discussion was implemented to better understand the benefit of this kind of approach and to identify information to refine the analyses (Appendix B). The first facilitated discussion question was focused on assessing general reactions to the proposed approach. Overall, participants were interested in the approach, but struggled to identify practical applications of the knowledge because there is not any ongoing regular dune renourishment

currently. A challenge also discussed was that for barrier islands wholly managed by the National Park Service, their approach is to not nourish naturally-disappearing islands. Thus, for a great deal of barrier islands in coastal Mississippi, the analysis would not be utilized.

Participants were then asked about various aspects of the analysis to ensure it will reflect common constraints. First, Davina and Matt inquired about the time frames for barrier island management strategies. Participants agreed that the overall time frame for management strategy should not extend beyond 30 to 50 years out, with evaluations at either 5, 10, or 17 years. The 17 years was specifically mentioned as the return period interval for restorations aiming at encouraging reintroduction of wildlife. Participants were queried about frequency of dune renourishment and they agreed that 5 years was probably not feasible and that without storms, every ten years would be the best-case scenario. When asked about target dune height(s), participants expressed a need for the full range of dune structures (primary through tertiary) and that currently the dunes generally get taller on the islands moving from west to east, with the Mississippi barrier islands primarily consistent of primary and secondary dune structures.

To wrap up the discussion, participants again expressed interest in the information, but that they need comparative data regarding the current strategies, which often is to do nothing to the dunes directly.

Proposed Barrier Island Modeling Framework Discussion Key Points

- Participants are interested in the information, but currently there is little opportunity to apply it because dune restoration is rare, even after hurricanes.
- Dune restoration strategies should not extend beyond 30-50 years.
- Frequency of maintenance renourishment (without a hurricane) should be no more than every 10 years.
- A range of representative dune heights should be included and generally, barrier island dunes are larger moving from west to east across the northern Gulf.

Flooding & Decision-Making – Economic Impact Analysis Outputs and Considerations

Ms. Diana Del Angel opened the activities for this topic by providing a brief presentation on economic impact analysis (EIA) to remind participants of what is considered in the EIA for this project. She began with definitions of floodplains and a refresher on the storm surge data being used, which is generated from the CDSLR model. She then reviewed the goal of the EIA, which is to understand the number of people and the value of building and contents lost and the amount of infrastructure exposed and/or damaged during storm surge under current and future sea levels. Additionally, EIA will be conducted under each SLR scenario with and without NNBFs to determine their effectiveness at reducing flood impacts (Fig 6). See presentation in Appendix C for details.

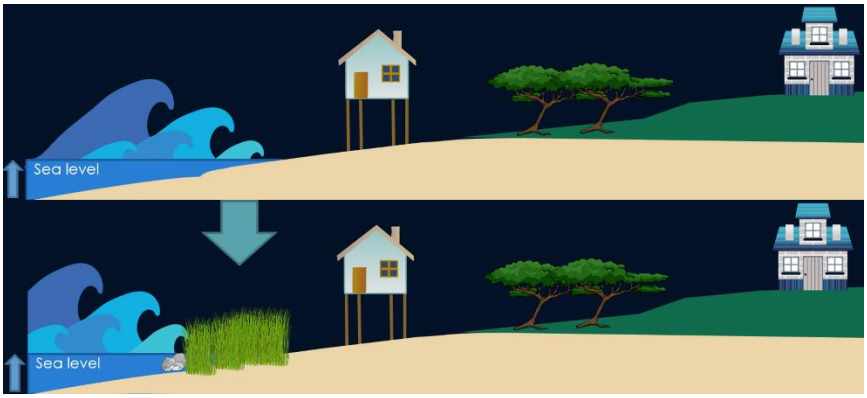

Figure 6 Screen shots from Diana Del Angel's presentation visualizing the concepts behind EIA analysis comparing with and without NNBFs. Upper panel shows without NNBF, lower panel shows with NNBF.

Participants were then given an opportunity to explore preliminary EIA results using an online map interface (Fig 7). Participants were provided a data worksheet to guide their exploration (Appendix B) through three types of data: 1) storm surge data across different SLR scenarios, 2) EIA building loss data, and 3) EIA wastewater treatment data.

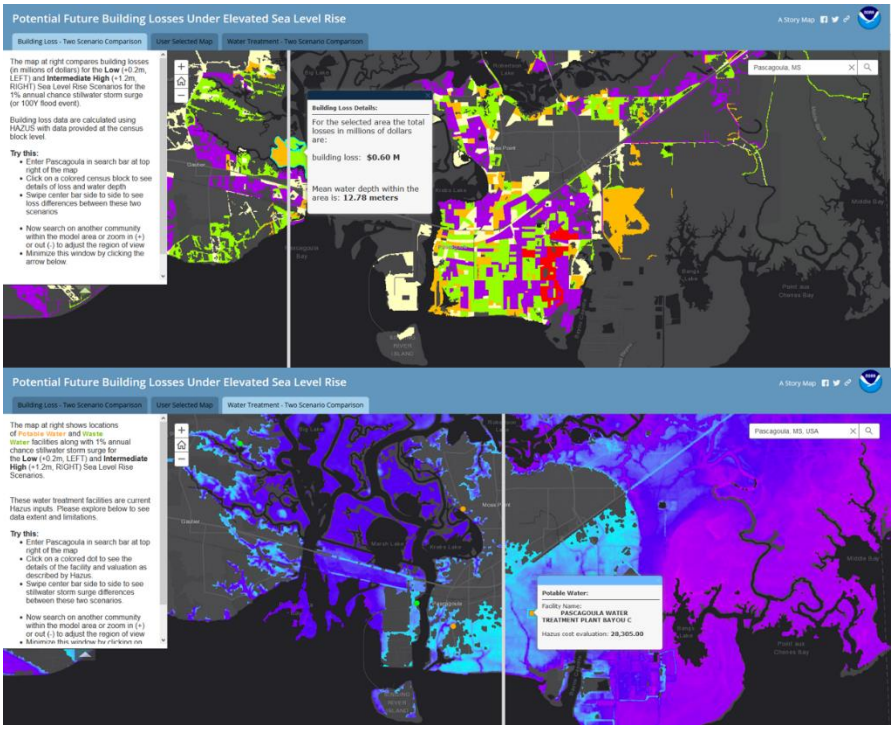

Figure 7 Screenshots of the data exploration interface. Top panel shows the building loss data and the bottom panel shows the wastewater treatment data.

After exploring the data in small subgroups, participants returned for a large-group discussion reflecting on the EIA data. The first question focused on overall impressions of the data and the data presentation. Participants expressed feeling a bit overwhelmed by the building loss data, primarily because they are not familiar with census blocks. One suggestion was to start with only the census blocks with no building loss data to allow users an opportunity to orient to those boundaries first. Additionally, the color pattern for building loss was not intuitive and made it more difficult to digest the data. Another suggestion regarding the building loss data was to allow an interface where municipalities could enter their buildings and the value of the buildings directly because there has been so much growth recently that will not be captured in the HAZUS Level 1 analysis.

Regarding the water treatment data, the participants were surprised about how few water treatment facilities there were in the region. A side effect of this discrepancy was that participants assumed that some treatment facilities were not included in the analysis. To combat this misperception, it was suggested that the coverage area for each water treatment facility be included in the map. Participants indicated this information could be obtained from each facility directly. Additional suggested information to complement water treatment data included indication of which systems are pressurized and which are not, as pressurized systems are more resilient to inundation. Further, identifying related pumping stations and how many people are serviced by each station were also perceived as very valuable information. Participants expressed a desire to also have included other critical facilities with the same kind of information (e.g., service area, critical related infrastructure).

Another topic of conversation was if the data were clear on what was being communicated. Participants felt that the building loss data were clear. However, there were questions about what the water treatment data meant. It was explained that the value expressed was in terms of replacement value, and that FEMA provided only four values for the entire country. Participants did not feel it was clear that the values were in the thousands and thought the replacement cost value might not reflect local considerations.

Next, participants discussed if the results reflected their understanding of the neighborhoods where they live and work. Focusing on the building loss data, participants had questions about the housing

stock. To them, it appeared that some of the known, established houses were missing (e.g., waterfront houses in the Fish River area --tributary to Weeks Bay, AL). These missing houses encompassed a range of ages in established neighborhoods that have existed over several census periods. However, in other areas there were opposite issues in that census blocks were valued very highly even though there were no homes/buildings there (e.g., along Biloxi Beach where there were formerly casinos, but now are none). Detailed notes were taken and plans were made to investigate what might be driving these discrepancies.

Next, participants considered more generally if they would like to see these data (building loss and wastewater treatment) presented as one summarized number for total cumulative damage. There was hesitancy to implement the summary by watershed but grouping by congressional districts seemed to be an acceptable alternative. Overall, there were concerns that if the census block accuracy cannot be resolved that all the property loss would not be captured. Participants felt that unless the summarized data were clearly a complete and accurate picture, then the best path forward would be separated "snapshots," so users are aware of any limitations or inaccuracies.

Last, participants discussed which potential parameters for inclusion should be updated with local data. Focus was initially on the facilities that impact more people (e.g. hazardous materials, medical facilities, wastewater, highways). An additional suggestion, which was echoed throughout the room, was to include power plants, water, and wastewater facilities. Another recurring theme for local data was building loss, but it was acknowledged that it would be a difficult to get this data across a large geographic area such as the entire northern Gulf. Participants suggested concentrating on areas that experience the most change as a result of NNBFs. There were also suggestions of certain MTAG members who could help provide localized data rapidly.

<u>Economic Impact Analysis Outputs and Considerations Discussion Key Points</u>

- Building Loss Data
  - Overwhelming due to lack of familiarity with census blocks and color scheme. Participants suggested introducing census blocks first without any building loss data to allow users a chance to orient to the delineations.
  - Suggested an option where municipalities can upload their own data.
  - Some building stock was missing; some building stock value was over estimated.
- Wastewater Data
  - Participants incorrectly assumed an incomplete dataset because of the scarcity of facilities. They suggested adding service/coverage areas for each facility to decrease confusion.
  - Additional suggested data were identification of which facilities were pressurized and location of pump stations.
  - As other critical facilities are added, participants would like similar information included.
  - Participants were confused that the values were in thousands of dollars and it was unclear that these values were for facility replacement.
- Participants preferred that building stock data not be summarized because of potential for inaccuracies.
- Participants' priorities for local data include: hazardous materials, medical facilities, wastewater, highways, potable water facilities, and building stock.

Wrap-up

Renee thanked the participants for their time and valuable input and encouraged everyone to immediately complete the printed workshop evaluation survey that was provided in the information packets that were distributed to participants at the beginning of the workshop. A copy of the evaluation survey instrument is provided in Appendix B.

Workshop Evaluation Survey Results

Total Participants: 21 *Total Responses:* 21

Summary of Method

The printed workshop evaluation survey was provided to all participants at the beginning of the workshop and collected immediately at the end of the workshop. The survey instrument was comprised of both closed-ended and open-ended question formats and was only distributed to MTAG participants (not to any of the project team members). The evaluation survey instrument is included in Appendix B on page 28.

Quantitative Responses

Quantitative responses indicated an overall positive experience and successfully meeting the workshop objectives. On a Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree), participants agreed that the workshop was a productive use of time (average = 4.6), increased their understanding of the project and accomplishments (4.6), increased their knowledge on specific aspects of the project and preliminary results (4.4), and had sufficient opportunities to provide input (4.7). Participants were also asked to rate their satisfaction with different aspects of the workshop on a Likert scale from 1 (Extremely dissatisfied) to 5 (Extremely satisfied). Workshop content, format, length, skill of presenters, opportunities to interact and ask questions, and overall experience were all scored very positively (average across all = 4.6). None of the elements of the workshop were rated below a 3 (Agree). Attendees were evenly split between those that had participated in previous MTAG activities and those that had not, and the majority (16 of 20) indicated they plan to attend the 2019 workshop.

Qualitative Responses

Open-ended responses also provided insight into what participants found most useful and captured additional questions the participants had. Comments around what participants found most useful highlighted learning about the project and models, the networking opportunities, and the focus groups. For example, in response to "What aspect of this workshop was most useful to you? Please explain", one respondent said "***Discussion with colleagues"*** and another said "***Interaction of the participants"***. Five of the 19 respondents to the same question directly cited the focus groups through comments such as "***Focus group – opportunity to speak directly to project and continue to add to project's past focus group"*** and "***I liked the focus group work and presentations"***.

When asked about additional questions overall or specifically about the project the participants had no overlap in their responses. Some topics mentioned were around how the focus group recommendations will be implemented (***"How to take recommendations from focus group to implementation. Conversation just got topics started"***), the modeling efforts around sediment movement (***"how much work is being done to understand how sediment moves through the system and how that will be impacted [sic] on modeling"***), and the stillwater elevation models (***"it'd be nice to learn more about the stillwater elevation maps"***).

When asked about recommendations for future N2E2 workshops responses varied across many topics. Some concrete suggestions for improvement included restructuring the timing of the focus groups to not fall directly after lunch ("***Focus group after lunch was tough. Maybe do it during lunch.***") and to shorten the workshop ("***Shave off an hour if possible***"). The comment on time reflects the scoring regarding satisfaction with workshop length, though it was still rated on average a 4.38, it was the lowest score among all the other workshop elements in the satisfaction section. Other comments were focused on providing additional information such as providing sediment movement to answer their questions and "***Summation of focus group discussions that include possible recommendations for more discussion or implementation.***" Given that so many identified the focus groups as the most or one of the most useful aspects of the workshops, further application/integration of those data into the workshop itself makes sense.

APPENDIX A: FOCUS GROUP EXECUTIVE SUMMARY

Northern Gulf of Mexico Natural and Nature-Based Features with Ecosystem Services Valuation and Economic Impact Analysis (NGOM+N2E2)
Second Annual Focus Groups Report Executive Summary
FINAL 8.7.19
Denise E. DeLorme and Sonia H. Stephens

Purpose and Procedures

We conducted two 60-minute focus groups, each with ten participants (one group with Management Transition Advisory Group (MTAG) members and one with local stakeholders) at NGOM+N2E2's second annual workshop at the Grand Bay National Estuarine Research Reserve in Mississippi. The purpose was to: (1) gain insight into views, experiences, and information needs regarding nuisance flooding in present conditions and with sea level rise (SLR); (2) obtain input on natural and nature-based feature (NNBF) mitigation options and NNBF-related perceptions, data needs, and evaluation recommendations; (3) capture current understandings of economic impact analysis (EIA) and ecosystem service valuation (ESV); (4) solicit suggestions for engagement and outreach; (5) gather feedback on the NGOM+N2E2 process and products (models and tools); and (6) collect comparative data for longitudinal analysis. Each group started with an introduction and explanation of objectives and procedures. The moderators (Dr. Denise DeLorme, Dr. Sonia Stephens) asked open-ended questions using the same flexible, collaboratively-developed interview guide. Both groups were audio-recorded and had an assistant taking notes. Data analysis involved a qualitative interpretive approach to identify patterns and themes.

Key Findings

The key findings of the focus groups are summarized into the following seven topic areas.

1. Nuisance Flooding Conceptualizations

Similarly to last year, participants had a general understanding of nuisance flooding. They distinguished it from more serious storm-driven flooding, and characterized it as localized, sporadic, recurring geographically (e.g., *"I can tell you which neighborhoods, I can tell you which roads…Throughout the whole community, there are repetitive…nuisance flood locations"*), and a minor rather than major interruption.

Participants described various causes of nuisance flooding, including environmental and societal issues. Environmental causes included heavy rain, high tides, and sea level rise. Societal causes included overdevelopment, weak infrastructure, and poor local planning. SLR–and to a lesser degree, climate change–was largely discussed in relation to local planning, (e.g., *"I don't think it's just one thing. I mean, the climate's changing and that's one aspect of it. But I think it's how we've built out our communities and we're building in places that we shouldn't be building…the nuisance flooding that we're having now, it is a combination of how we're building…our communities and then also the impact of weather."*)

2. Nuisance Flooding Experiences

Firsthand descriptions of nuisance flooding included some observed characteristics but included more emphasis on the impacts. Flood-related encounters affected both home and work, and primarily involved changes to roadways with travel implications. A couple of participants reported purchasing particular products to cope with repetitive nuisance flooding, such as boots or a new car.

Participants generally agreed that nuisance flooding occurs regularly and is becoming more frequent in their areas. This was based on their direct experiences and the accounts of others. Several participants had received some community complaints about nuisance flooding as part of their jobs. While participants appear to have accepted and adapted to nuisance flooding, they shared some broader concerns about the impacts of these events in conjunction with climate change and sea level rise over time.

3. Nuisance Flooding Mitigation Options

The focus groups discussed mitigation approaches and specific examples of mitigation projects, including building structures higher, digging ditches deeper, and buying out property owners in flood-prone areas. They also perceived challenges and limitations to mitigation, including implementation feasibility and effectiveness. Four main project type categories were: (1) protecting or restoring certain ecological areas, (2) modifying development strategies and regulations such as building codes, (3) identifying and elevating critical yet vulnerable infrastructure, and (4) providing community information and resources for assistance.

These findings suggest that nuisance flooding mitigation efforts would benefit from a multi-pronged approach with clear communication and decision-making that balances various ecological, economic, and society-related interests. Participants emphasized that stakeholder groups at different levels (e.g., city governments, neighborhood associations, individual homeowners) have responsibility and should be considering the issue and making decisions now.

4. NNBF Project Awareness and Involvement

Participants discussed several types of NNBFs and were aware of existing or planned NNBF projects in the region (primarily at the federal or state instead of local levels). There were indications that local stakeholders are becoming more familiar with and interested in NNBF projects, especially from an economic standpoint, e.g., *"They're beginning to recognize that…these are not just add-ons but that these are a real attribute of a solid project.*" Most participants reported they were involved in NNBF projects as part of their job responsibilities and expected to continue doing so in the future.

5. Perceptions of NNBFs

Participants perceived benefits as well as drawbacks of NNBFs, some of which echoed those identified in last year's focus groups. Two major interrelated perceived benefits of NNBFs were (1) storm surge protection and erosion management, and (2) ecosystem services provision. There were five major perceived interrelated NNBF-related drawbacks (or challenges): (1) questions about functionality, (2) potential financial expense, (3) difficulty measuring benefits, (4) public preferences, and (5) lack of political support. A diverse array of needs was identified to address these challenges, including additional primary research, the collection of existing information in a clearinghouse or repository location, better communication with stakeholders and local political leaders, and development of better methods for assessing NNBF benefits.

6. Information Needed for NNBF Decision Making

Participants stated that NNBF-related decision-making requires multiple types of interrelated ecological and social information in order to be feasible. Four key types of information included: (1) understanding the project's specific geographic location, (2) permitting procedures and other social factors, (3) obtaining technical guidance on design, and (4) economic and other information needed to conduct a cost-benefit analysis.

7. Economic Impacts Assessment (EIA) and Ecosystem Service Valuation (ESV)

The topics of EIA and ESV were addressed specifically in the focus groups this year. Participants were generally familiar with EIA and ESV, some likely due to their participation in NGOM+N2E2 workshops and virtual meetings. While the general sense of some participants was that both EIA and ESV have potential for providing important and useful data for NNBF-related communication and decision-making, others were not entirely clear or confident in their knowledge about these concepts and methods (e.g., participants defined EIA with brief and tentative phrases).

There were also some concerns and skepticism about EIA and ESV methods and results, including: (1) concerns that EIA calculations were challenging and confusing (e.g., *"ecosystem service valuation is based on assumptions…there's always faulty assumptions"*), and (2) the related concern that this could be especially problematic for stakeholder and public communication, acceptance, and support of NNBF projects. Of particular concern was the lack of accuracy with ESV, especially in measuring intrinsic values of ecosystem services, e.g., "*I've always been a little nervous about economic valuation because I'm always concerned that it will be undervalued...not giving enough value to certain components of the natural system…*" With respect to the NGOM+N2E2 project, participants cautioned that underlying modeling assumptions (e.g., ecosystem valuations, range of SLR considered) have the potential to affect the overall credibility of the project. There were also some perceptions that NNBFs can compound the complexity of ESV calculations.

Participants' direct experiences with EIA and ESV were varied, but overall relatively limited, though the majority expected they would be using these methods in the future. Five major factors considered important for EIA of NNBFs emerged in the discussions, including: (1) scale of analysis, as related to size of the NNBF, (2) type of infrastructure or habitat the NNBF is expected to protect, (3) future land use and land cover changes, (4) values and concerns of local stakeholders, and (5) communication of risk and uncertainty.

Conclusion

The focus groups were successful in engaging the MTAG and other stakeholders and contributing valuable local knowledge to assist NGOM+N2E2's scientific research and planned products. Participants had positive reactions to the process overall, and offered suggestions for future development of the NGOM+N2E2 project related to data for nuisance flooding mitigation, design of NNBFs, and EIA/ESV approaches. In comparison to last year's focus groups, participants spent more time on details of developer perspectives about NNBFs and community responses to NNBFs, and seemed more comfortable discussing EIA/ESV for decision-support. We recommend that the NGOM+N2E2 team consider this input carefully in preparing to further enhance the usefulness, usability, and dissemination of the NNBF-related scientific research findings and decision-support tools throughout the Northern Gulf of Mexico.

APPENDIX B: WORKSHOP MATERIALS

NGOM+N2E2 MTAG Workshop

July 12, 2018

Grand Bay National Estuarine Research Reserve

6005 Bayou Heron Rd, Moss Point, MS 39562

Agenda

Meeting Objectives

- To understand the NGOM+N2E2 project goals, objectives, and timeline
- To provide an update on the NGOM+N2E2 work that has been accomplished in the past year
- To understand how MTAG participation has shaped and guided the NGOM+N2E2 project to date
- To explain how Hydro-MEM has been refined for application in the NGOM+N2E2 project
- To explore preliminary results of economic impacts assessment (EIA), ecosystem services valuation (ESV), and digital elevation adjustment
- To solicit input and feedback on preliminary data results, potential additional analyses, data sources, and a proposed morphological modeling and ADCIRC analysis framework
- To identify and understand the perceptions and needs of the MTAG and local stakeholders regarding natural and nature-based features

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8:00 a.m. **Breakfast and Check-In**

Welcome, Objectives, and Introductions

Who's Flooding First? Ice breaker activity

Project Overview & Update

Speakers

Scott C. Hagen, PhD, LSU Center for Coastal Resiliency

Renee Collini, NGOM Sentinel Site Cooperative

Marsh Modeling Expansion and Refinement

Speakers

Karim Alizad, PhD, LSU Center for Coastal Resiliency

Activity: Large group discussion

10:20 a.m.	**Break**
10:30 a.m.	**Marsh Modeling Expansion and Refinement cont.** *Speakers* David Yoskowitz, PhD, Harte Research Institute Stephen Medeiros, PhD, PD, University of Central Florida *Activities:* Mapping and identification of areas of interest for marsh sampling Large group discussion
11:40 a.m.	**Lunch** Lunch will be provided on site.
12:30 p.m.	**Flooding & Decision-Making** *Activity:* Focus Groups
1:45 p.m.	**Break**
2:00 p.m.	**Flooding & Decision-Making** *Speakers* Matt Bilskie, PhD, LSU Center for Coastal Resiliency Davina Passeri, PhD, U.S. Geological Survey Diana Del Angel, Harte Research Institute *Activities:* Large-group discussion Hands-on evaluation of available EIA data
4:15 p.m.	**Wrap-up** *Activity:* Workshop evaluation survey
4:30	**Adjourn**

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DISCUSSION QUESTIONS

The following document outlines planned discussion questions throughout the workshop. Please review these questions in advance of each presentation. ***This worksheet will not need to be turned in, it is meant to serve as a guide to discussing aspects of the NGOM+N2E2 project.***

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Marsh Model Expansion and Refinement

Hydro-MEM (Hydrodynamic – Marsh Equilibrium Model) New Capabilities (Karim Alizad)

1. Planned data products from these analyses are marsh productivity and migration potential. What else would be useful?

2. Referencing the map of the Apalachicola region, how far inland do you expect the tides and marsh to migrate? Why?

Refining ESV (Ecosystem Service Valuation) Measures (David Yoskowitz)

1. What suggestions, if any, do you have for measures for the following priority ESV metrics?
    a. Nutrient cycling

    b. Food

    c. Aesthetics & Existence

    d. Water Regulation

    e. Gas Regulation

Field Work (Stephen Medeiros)

1. Do you know of any potential partners in the Pascagoula River Basin area for shared resources (especially a real-time GNSS reference network), permitting or access, or any unique features or areas of interest?

2. Are you aware of any of the following data available in the Big Bend Region or in the Pascagoula River Basin?
    a. Topographic data
    b. Bathymetric data
    c. Habitat map data
    d. Permanent benchmark locations and position data
    e. Salt marsh Surface Elevation Table (SET) data
    f. Biomass density data
    g. Soil core data
    h. Updated land use/land cover (more recent than 2010)

Flooding & Decision-Making

Proposed Barrier Island Modeling Framework (Matt Bilskie & Davina Passeri)

1. What is your overall reaction to this approach? What kind of decisions or work would this information support?

2. What do you see as strengths or benefits of this approach? What do you see as limitations or concerns with this approach?

3. What are appropriate timeframes for barrier island management?

4. We want the framework to be feasible and applicable. What is a reasonable dune height to consider? How does this vary across selected islands, if at all? How does dune height vary across the region, if at all?

5. What is a reasonable frequency of nourishment to consider? What is the average cost to nourish a beach? How does this vary across the region, if at all?

EIA (Economic Impact Analysis) Outputs and Considerations (Diana Del Angel)

See worksheet titled “Data Exploration Worksheet” in your participant packet.

Thank you for your valuable input!!!!!

NGOM+N2E2 Natural and Nature-Based Feature (NNBF) Survey

Please submit your NNBF project/idea. We are looking for actual projects, either already completed, being implemented, or planned, to include in the evaluation. In addition, we are interested in natural systems (i.e., an existing marsh complex) to evaluate ecosystem services and where future mitigation may be necessary.

1. Please provide a brief title for your NNBF.
    a. 50 characters or less.
    b. Some examples might be: NERR living shoreline, marsh near primary school, etc.

2. Please provide a general description of your NNBF.
    a. A brief description of the NNBF project type and why it is needed.
    b. Please identify type of vegetation involved with the project (e.g. SAV, salt marsh, wetland, maritime forest/shrub).

3. Which of the following categories best characterizes your NNBF? Select one only.
    - **Beach & Dune:** the dune is the mount, hill or ridge of sand behind the part of the beach affected by tides. A number of beach and dune feature characteristics impact nuisance flooding and storm surge attenuation capacity. Important characteristics influencing storm surge include height, width, slope, sediment grain size and supply, dune height, dune crest, dune width, and vegetation characteristics.
    - **Vegetated Feature:** low elevation regions with emergent and submergent vegetation with a range of salinity and hydraulic tolerances comprise this feature type but include a number of habitats including coastal wetlands, marshes, and SAV, etc. Important characteristics include elevation, plant type, plant density, and spatial extent of the feature.
    - **Coastal Forest:** a coastal woody vegetated feature that includes pine savannah and cypress swamps and occurring at higher elevation than beach and dune, but still within the reach of salt spray. Similar to vegetated features, important characteristics to know include forest elevation, forest dimensions, vegetation height and density, and sediment composition.
    - **Artificial Reef:** a reef structure that would not be primarily constructed of oyster shell. The reef could be fully or partially submerged. Important coastal protection characteristics include reef width, elevation, and roughness.
    - **Oyster Reef**: a reef structure primarily constructed of oyster shell. Reef width, elevation, and roughness, are key aspects that will mitigate storm surge.
    - **Barrier Island:** a long narrow offshore deposit of sand and sediment running parallel to the coast. Important characteristics include elevation, length, width, land cover, breaching potential and proximity to shore.
    - **Combination (i.e., Living Shorelines/Hybrid):** this category is a catchall when a combination of features is utilized. It ranges from a collection of natural features to including some hardened features such as rock sills that create semi-natural conditions **(Living Shorelines),** and continues on to a continuum of more hardened features **(Hybrid Natural/Gray Infrastructure).** We won't list every term that different groups may use; instead please describe the NNBF in Question #2 and indicate what term you use to describe it. See individual natural features to think about the characteristics of importance.
    - **Natural Feature of Importance:** an existing natural system or feature of importance or concern with no anticipated action being taken. For example, this would be an area (i.e., marsh) you are aware of that provides a beneficial service landward and is at risk of being lost/impacted by SLR.
    - **Don't Know or Other:** feel free to use this answer option if you're not sure or your project type doesn't fall within one of these categories, but first check with a facilitator -- they may be able to provide clarity.

4. Describe the following actions that associate with the implementation of your NNBF? Select only one, if more than one is needed - select the first one you will need to complete for this activity.
    - **Conservation Acquisition:** preserving land through purchase or easement.
    - **Restoration:** an activity focused on returning a site to its original or preferred state.
    - **New Build/Construction:** creating habitat or structures where none existed before.
    - **Maintenance:** routine actions. Some examples would include routine beach re-nourishment.
    - **Other, None, or Don't Know:** Please explain in more detail in question #2.

5. What are the approximate dimensions for your NNBF?
    - Provide approximate dimensions (i.e. length and width) along with units of measure.
    - Or a general description / approximation of the project size.

6. What is the estimated design life of your NNBF?
    - How long would you expect the project to remain in-tact and effective.
    - Select one only.

7. What is the estimated cost of your NNBF?
    - if you are far enough along in your planning process, please provide an estimated cost.
    - Cost ranges are acceptable here, too.

8. When is your NNBF estimated to begin?
    - It has already been completed.
    - It is currently under construction.
    - It will begin in the next two years.
    - It will begin if and when funding is obtained.
    - It has not been proposed.
    - Don't know.

9. Where is the general location of the project?
    - Using the map, place a point in the approximate location of the NNBF project identified above.

NGOM+N2E2 MTAG Second Annual Workshop

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Moss Point, MS

DATA EXPLORATION WORKSHEET

The following document outlines steps to explore the economic impact assessment (EIA) data from future storm surge under SLR. This worksheet will work you through steps so that you can be prepared to discuss ways to improve the EIA outputs and format.

This worksheet will not need to be turned in, it is meant to serve as a guide to exploring the data efficiently and prepare you to discuss the EIA data. Please take notes as you go.

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Storm Surge Data with SLR (10 min)

The EIA data are based on the stillwater storm surge data from the EESLR-NGOM project. This provides economic damage due to flooding. As a quick refresher, first review the stillwater surge data.

1. Go to www.gomsurge.org – this will take you to the storymap that provides background on the data, access to the complete data package, and enables exploration of a subset of the data.
2. Take a few minutes to orient to the storymap layout (Fig 1)
    a. Section 1 (blue box): Informational page about what is being displayed in the graphics page. Often there are tips to navigating the data being displayed. This section is often longer than displayed, scroll up and down in this section to see all available information.
    b. Section 2 (red circle): Navigation page indicating which section you are viewing. Hovering over the dots provides the section names.
    c. Section 3 (labeled graphic indicated with a white 3): Graphics pane, where informational and interactive graphics, maps, and other data are displayed.

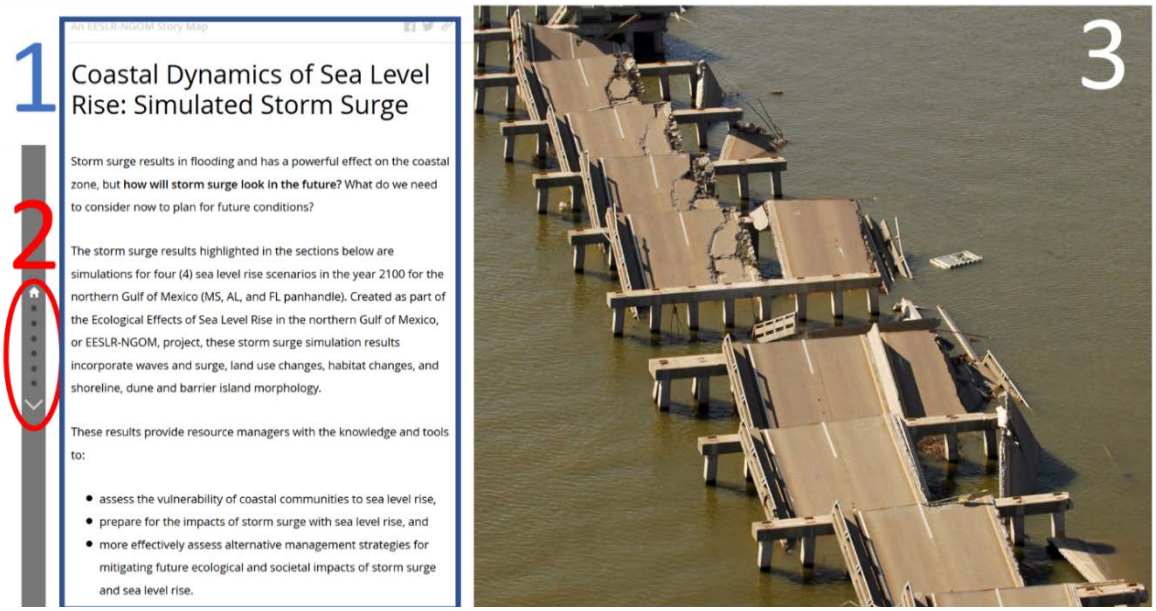


Figure 1 Screenshot of the surge story map.

3. Navigate to the section “Stillwater Storm Surge” by selecting the second to the last dot or scrolling through the informational pane.
4. These inundation data have been utilized to conduct the EIA (Fig 2).
5. Explore and become familiar with the data.

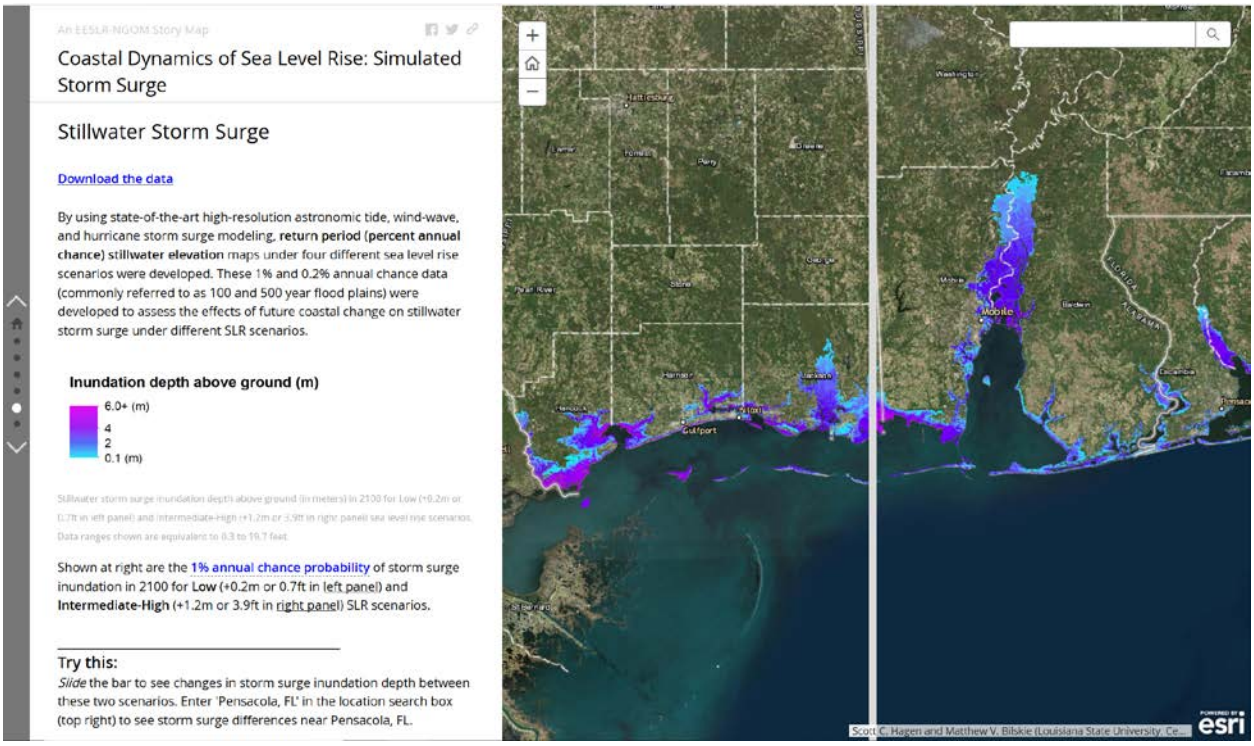


Figure 2 Screenshot of the inundation data being utilized in the EIA.

Exploring Building Loss EIA Data (15 min)

This section guides exploration of the EIA data. There are two different EIA outputs we will be exploring today. This section focuses on the Building Loss data.

1. Go to http://arcg.is/1eKPKT.
2. There are two different ways to explore the data (Fig 3):
    a. "Building Loss - Two Scenario Comparison" – has fixed data displayed that can be compared by using the slider bar in the middle of the map.
    b. "User Selected Map" – provides options for which data are displayed. Data can be compared by turning different layers on and off.

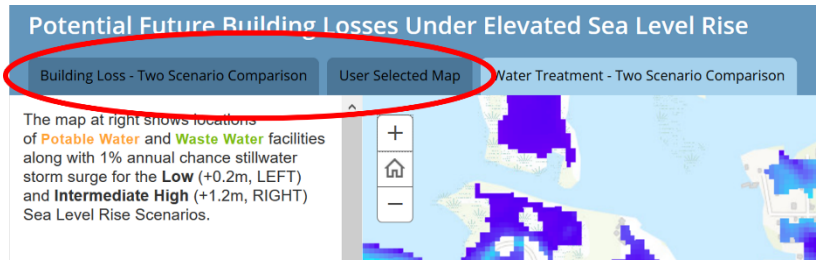


Figure 3 Partial screenshot of the web-interface for the EIA data. Red circle indicates where to select the method of data exploration.

3. Select one of the approaches.
4. If you selected "Building Loss - Two Scenario Comparison" continue on, if you selected "User Selected Map" skip to number 5.
    a. Enter "Pascagoula, MS" into the address navigation bar.
    b. Click on a colored census block to see details of building stock and content loss. The colors represent total building loss according to the legend in Fig 4.
    c. With the census block selected, swipe the center bar left and right to see how the details change under two different SLR scenarios. (Low and Intermediate High).
    d. Continue to explore the data, becoming familiar with how they are presented and the content.
    e. Proceed next to number six

Figure 4. Building loss map color scheme in millions of dollars.

5. If you selected "User Selected Map" continue on, if you selected "Building Loss - Two Scenario Comparison", go back to number 4.
    a. On the right, expand the layer selection window (Fig 5).
    b. The layer: "Building Loss – Int High" should be selected. That indicates the Intermediate High SLR Scenario Building Loss data are being displayed.
    c. Enter "Pascagoula, MS" into the address navigation bar.
    d. Click on a colored census block to see details of building stock and content loss.
    e. Next turn off the layer: "Building Loss – Int High" and select the "Building Loss – Low" to turn on the Low Scenario SLR Building Loss data. See Fig. 4 for building loss color scheme.
    f. Click on the same colored census block for the new layer and contrast. See Fig 4. For color scheme.

Figure 5. Map tools in the top right of the map banner. From left to right these are: layer selection, legend, and bookmarked locations.

g. Continue to explore the layers individual and comparing them by turning them on and off.
h. Proceed to number six.

6. Continue to explore the data, looking at your neighborhood and other areas with which you are familiar. Keep in mind these questions while exploring the data.
    a. What are your overall thoughts on these data?

    b. Is it clear what the data are communicating? If not, what is unclear?

    c. Do the results accurately describe your understanding of the area? Why or why not?

Exploring Water Treatment EIA Data (10 min)

This section guides exploration of the EIA data. There are two different EIA outputs we will be exploring today. This section focuses on the Water Treatment Facilities data. These data are presented in a different format and contain discrete data points, instead of the continuous-style Building Loss data.

1. Go to http://arcg.is/1eKPKT.
2. Select the "Water Treatment – Two Scenario" tab (Fig 6).
3. Enter "Pascagoula, MS" into the address navigation bar.
4. Click on a colored dot to see the details of the facility and valuation as described by HAZUS.

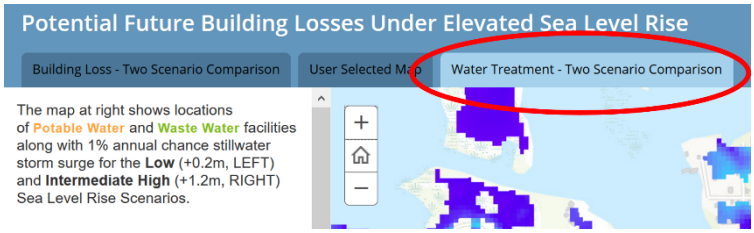


Figure 6 Partial screen shot of the web-interface for EIA data. Red circle indicates the tab to select to view the Water Treatment data.

5. Swipe center bar side to side to see stillwater storm surge differences between those two scenarios to see if the facility becomes inundated.
6. Continue to explore the data, looking at your neighborhood and other areas with which you are familiar. Keep in mind these questions while exploring the data.
    a. What are your overall thoughts on these data?

    b. Is it clear what the data are communicating? If not, what is unclear?

    c. Do the results accurately describe your understanding of the area? Why or why not?

General Questions for Consideration

1. Would you like to see these data (building loss and wastewater treatment) presented as one summarized number for total cumulative damage? Why or why not?

2. If you had to prioritize EIA parameters to be updated with local data, which would you select? Why? Full list of parameters below.
    a. Building Loss ($)
    b. Content Loss ($)
    c. Schools ($)
    d. Police Stations ($)
    e. Medical Facilities ($)
    f. Hazardous Materials Facilities ($)
    g. Highway Bridges ($)
    h. Railway Segments ($)
    i. Highway Segments
    j. Potable Water System Facilities
    k. Waste Water Treatment ($)
    l. Power Plants ($)
    m. Displaced People
    n. Shelter Needs

Participant Evaluation Survey of *NGOM+N2E2* 2018 Workshop:
Grand Bay National Estuarine Research Reserve, Moss Point, MS
July 12, 2018

Instructions: The following questions ask about your workshop experience today. Please reflect on your experience and mark the choice closest to your opinion for each of the items below or write in the information requested. Your constructive feedback is very important in helping us plan and improve future NGOM+N2E2 workshops and related research products. This survey should take less than 10 minutes to complete and all individual responses will be confidential.

(1) Please indicate how much you agree or disagree with the following statements on a scale of 1 to 5 where 1 means "Strongly disagree" and 5 means "Strongly agree." If you are not sure or don't know, please mark DK for "Don't know."

	Strongly disagree				Strongly agree	
This workshop was a good use of my time.	1	2	3	4	5	DK
This workshop increased my understanding about the NGOM+N2E2 project and accomplishments.	1	2	3	4	5	DK
I learned how MTAG participation has shaped and guided the NGOM+N2E2 project to date.	1	2	3	4	5	DK
I learned about how Hydro-MEM has been refined for application in the NGOM+N2E2 project.	1	2	3	4	5	DK
I learned about preliminary results of economic impacts assessment, ecosystem services valuation, and digital elevation adjustment.	1	2	3	4	5	DK
I was provided with opportunities to provide input on preliminary data results, potential additional analyses, data sources, morphological modeling, and ADCIRC analysis framework.	1	2	3	4	5	DK
I was provided with opportunities to provide input about natural and nature-based features.	1	2	3	4	5	DK
I learned something that I will apply in my work, either now or in the future.	1	2	3	4	5	DK
I would recommend this workshop to professional colleagues.	1	2	3	4	5	DK

(2) Please rate your satisfaction with each of the following dimensions of this workshop on a scale of 1 to 5 where 1 means "Extremely dissatisfied" and 5 means "Extremely satisfied." If you are not sure or don't know about a particular dimension, please mark DK for "Don't know."

	Extremely dissatisfied				Extremely satisfied	
Workshop content	1	2	3	4	5	DK
Workshop format	1	2	3	4	5	DK
Workshop time length	1	2	3	4	5	DK
Communication skills of presenters	1	2	3	4	5	DK
Opportunities to interact	1	2	3	4	5	DK
Opportunities to communicate my resource management needs	1	2	3	4	5	DK
Opportunities to give input	1	2	3	4	5	DK
Opportunities to ask questions	1	2	3	4	5	DK
Overall workshop experience	1	2	3	4	5	DK

(3) What aspect of this workshop was <u>most useful</u> to you? Please explain.

(4) What aspect of this workshop was <u>least useful</u> to you? Please explain.

(5) What questions, if any, do you have as a result of participating in this workshop?

(6) What else related to the NGOM+N2E2 project would you like to learn, if anything?

(7) What recommendations, if any, do you have for future NGOM+N2E2 workshops?

(8) Did you attend last year's NGOM+N2E2 annual workshop?

Yes ____ No ____ Don't know ____

(9) Did you participate in the NGOM+N2E2 virtual meeting in February this year?

Yes ____ No ____ Don't know ____

(10) Did you participate in the NGOM+N2E2 virtual meeting in June this year?

Yes ____ (please progress to 10a) No ____ (skip to 11) Don't know ____

(10a) If you participated in the NGOM+N2E2 virtual meeting in June, how much would you say that it prepared you for this July workshop in Grand Bay?

A lot ____ Some ____ A little ____ Not at all ____ Don't know ____

(10b) If you participated in the NGOM+N2E2 virtual meeting in June, how much would you say that it increased your knowledge about potential economic impact assessment outputs?

A lot ____ Some ____ A little ____ Not at all ____ Don't know ____

(10c) If you participated in the NGOM+N2E2 virtual meeting in June, how satisfied were you with the overall virtual meeting experience?

A lot ____ Some ____ A little ____ Not at all ____ Don't know ____

(10d) What comments or recommendations, if any, do you have for the June virtual meeting?

(11) Do you plan to attend the NGOM+N2E2 workshop again next year?

Yes ____ No ____ Don't know ____ If "No," why not: _____

(12) Please list and provide contact information (phone number, email address) for any individuals, groups, or organizations who you think would benefit from participating in future NGOM+N2E2 workshops and/or webinars. Also, please indicate if they should be specifically considered for participation on the NGOM+N2E2 Management Transition Advisory Group (MTAG).

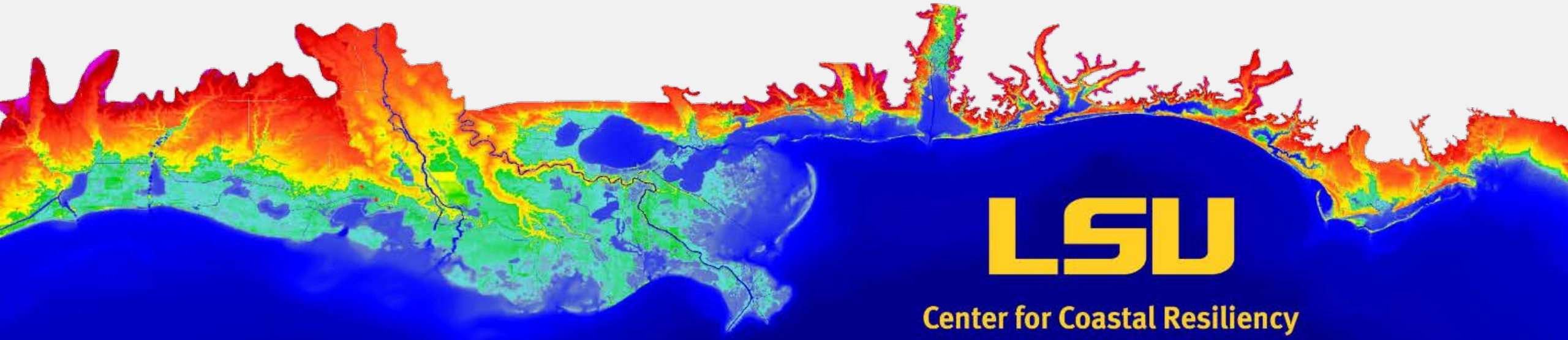
Thank you!

*Acknowledgement: Adapted from evaluation surveys of EESLR-NGOM and GOMA project workshops in partnership with Apalachicola, Grand Bay, and Weeks Bay NERRs; Louisiana Sea Grant workshops; and the "Best Practices for Interviews" training evaluation survey at the 2016 Social Coast Forum.

APPENDIX C: WORKSHOP PRESENTATIONS

Dynamic sea level rise assessments of the ability of natural and nature-based features to mitigate surge and nuisance flooding

Scott C. Hagen
Director, LSU Center for Coastal Resiliency (shagen@lsu.edu)
Professor, Civil & Environmental Engineering / Center for Computation & Technology



Co-PIs & Science Collaborators

MTAG PI: Renee Collini, Dauphin Island Sea Lab / NGOM SSC

Co-PIs: Denise E. DeLorme, Louisiana State University

Stephen C. Medeiros, University of Central Florida

James T. Morris, University of South Carolina

David Yoskowitz, TAMU-CC Harte Research Institute

Science Collaborators: Karim Alizad, LSU

Len Balthis, NOAA

Matthew Bilskie, LSU

Christine Buckel, NOAA

Diana Del Angel, TAMU-CC Harte Research Institute

Davina Passeri, USGS

Defining the acronym

- 2010 – 2017 :

  EESLR-NGOM:

  Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico

- 2017+ : **EESLR-NGOM ⟹ NGOM+**

  Natural and **N**ature-Based Features ⟹ **N2**

  Economic Impact Analysis / **E**cosystem Services Valuation ⟹ **E2**

  ⟹ **NGOM+N2E2**

NGOM+N2E2 Objectives

The objectives for this transdisciplinary project are to:

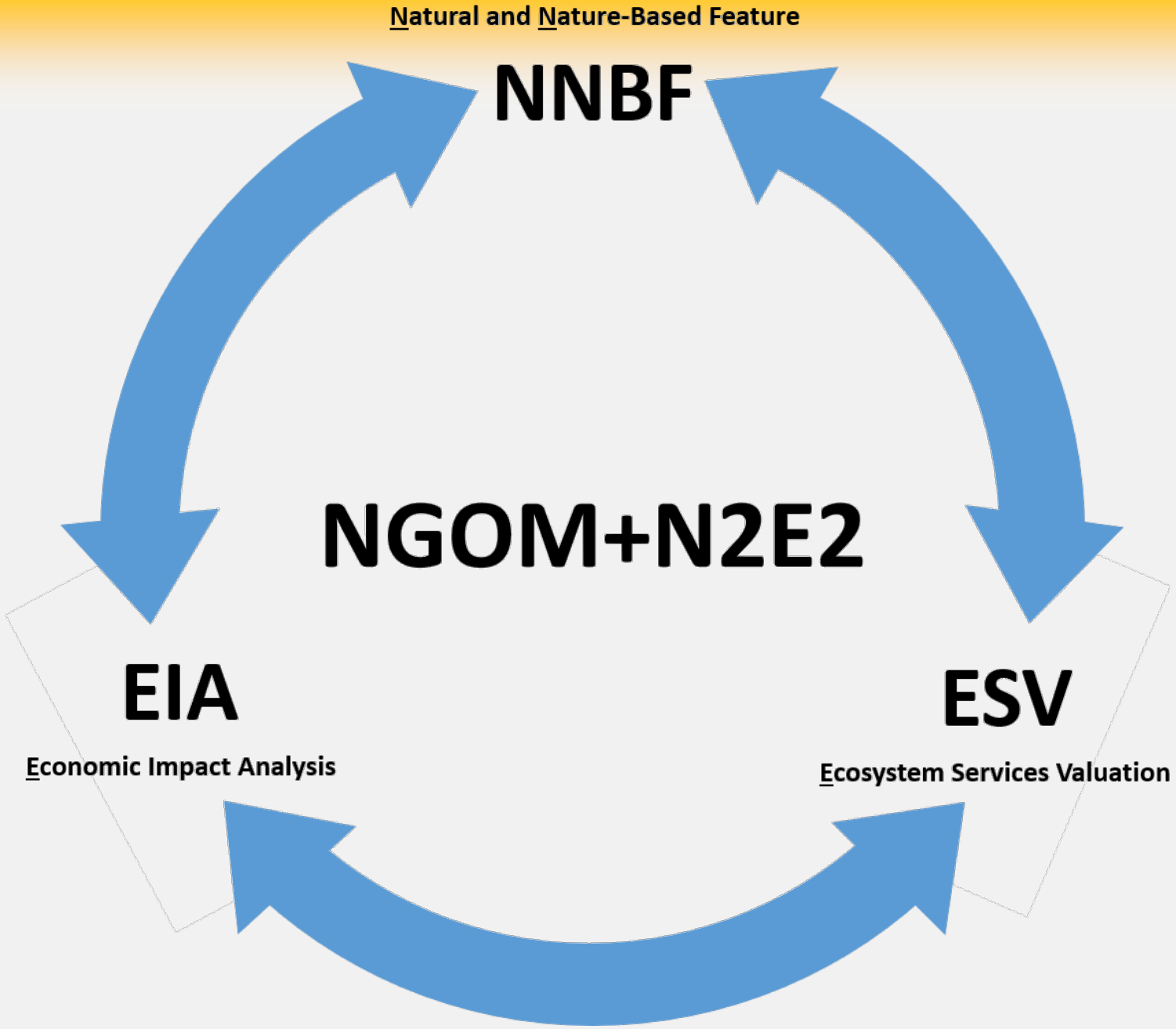
1) Refine, enhance, and extend the coupled dynamic, bio-geo-physical models of coastal morphology, tide, marsh, and surge;

2) Advance the paradigm shift for sea level rise assessments by linking economic impact analysis and ecosystem services valuation directly to these coastal dynamics of SLR;

3) Establish and engage a Management Transition Advisory Group (MTAG) throughout the entire project process;

4) Deliver our results via a flexible, multi-platform mechanism that allows for region-wide or place-based assessment of NNBFs.

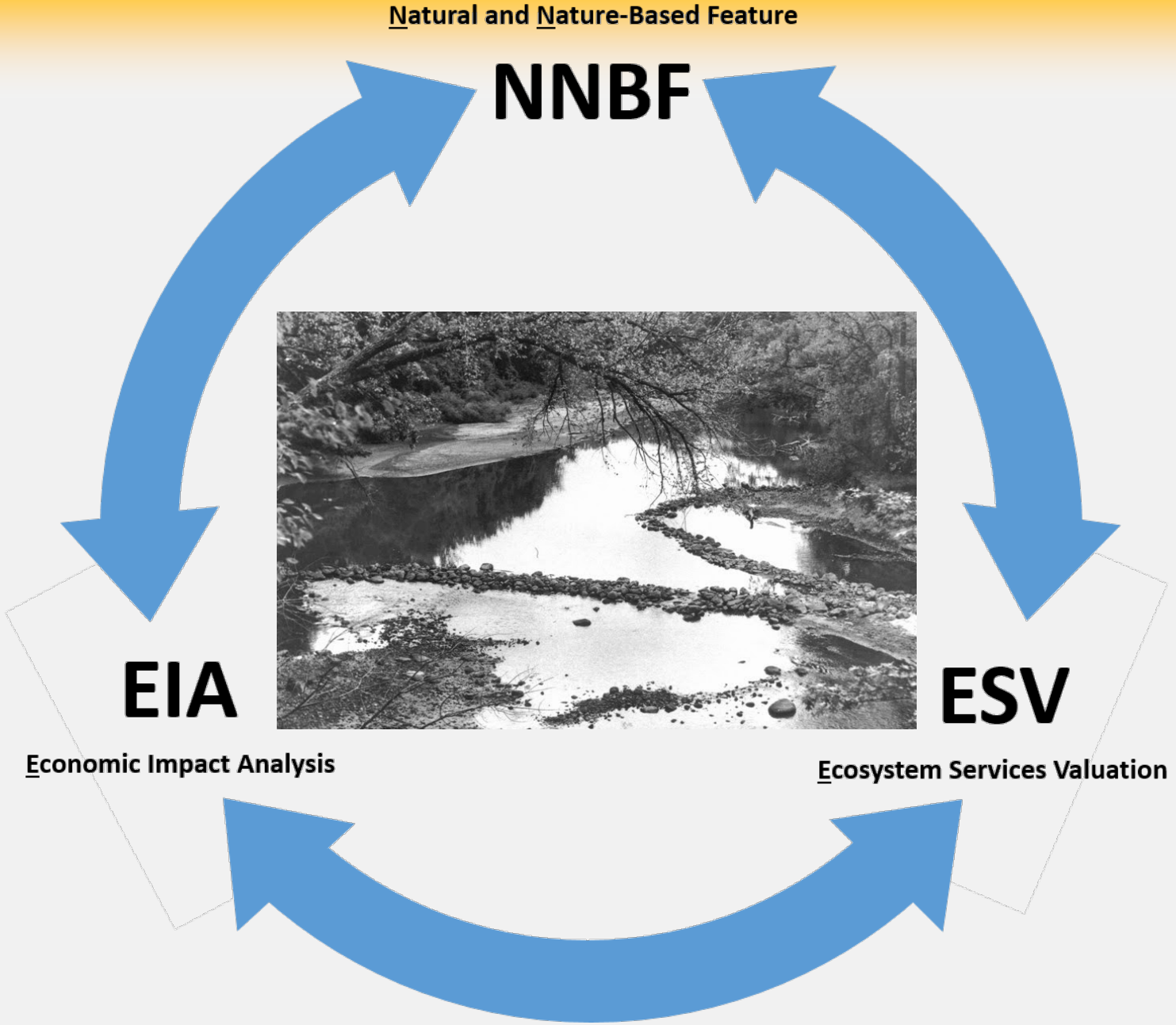
Evaluate the tradeoffs



American Indian Dam on the Iowa River

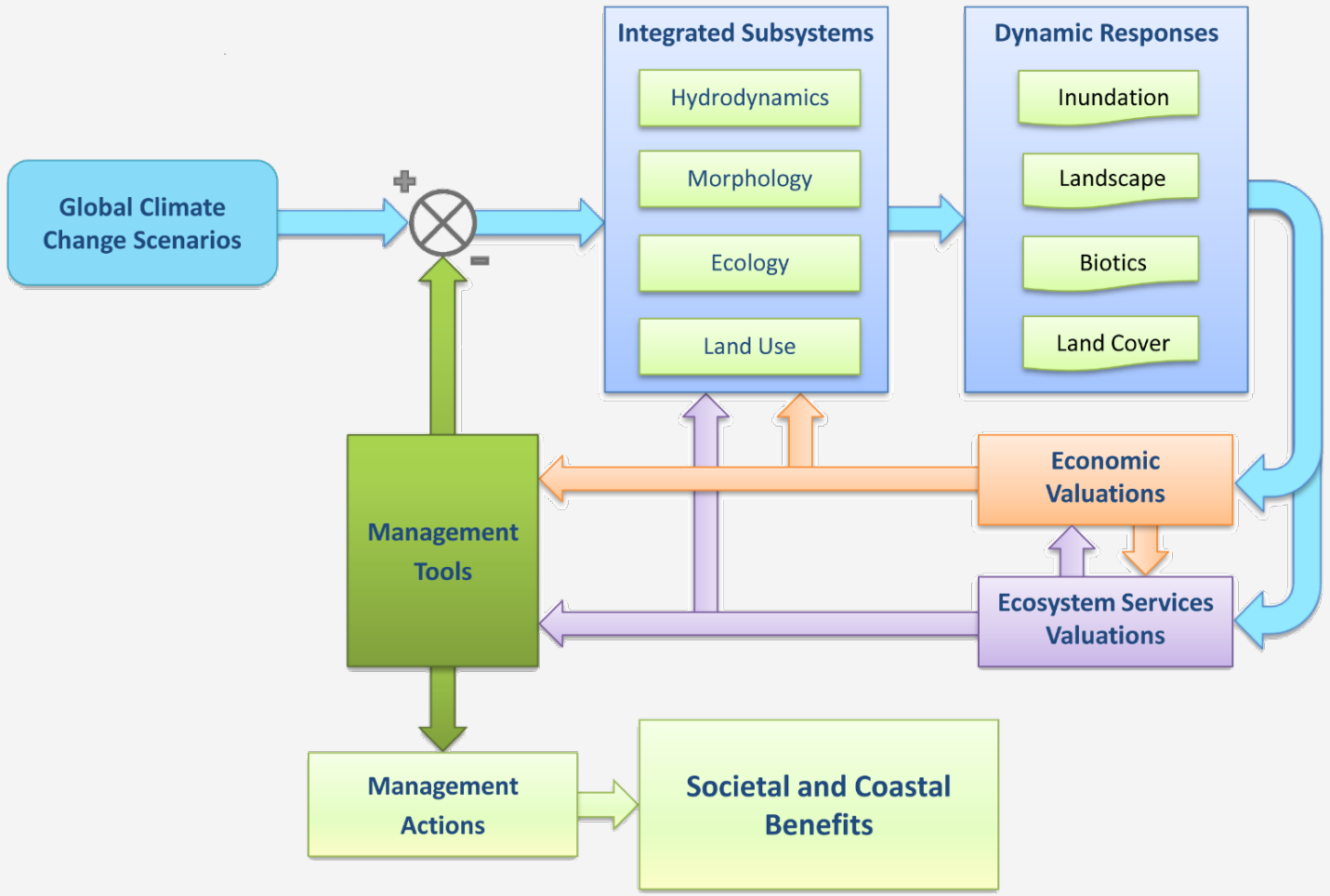
(http://renatesimages.blogspot.com/2014/04/indian-dam_25.html)

Evaluate the tradeoffs



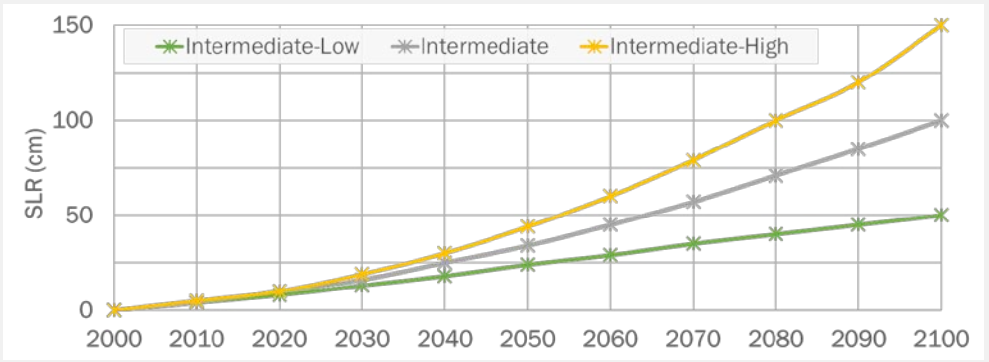
A Process Diagram for the NGOM+N2E2 System

We will continue to shift the paradigm of how climate change in general and sea level rise in particular is assessed at the coastal land margin. With our system of systems approach we can evaluate more aspects of the coastal dynamics of sea level rise.

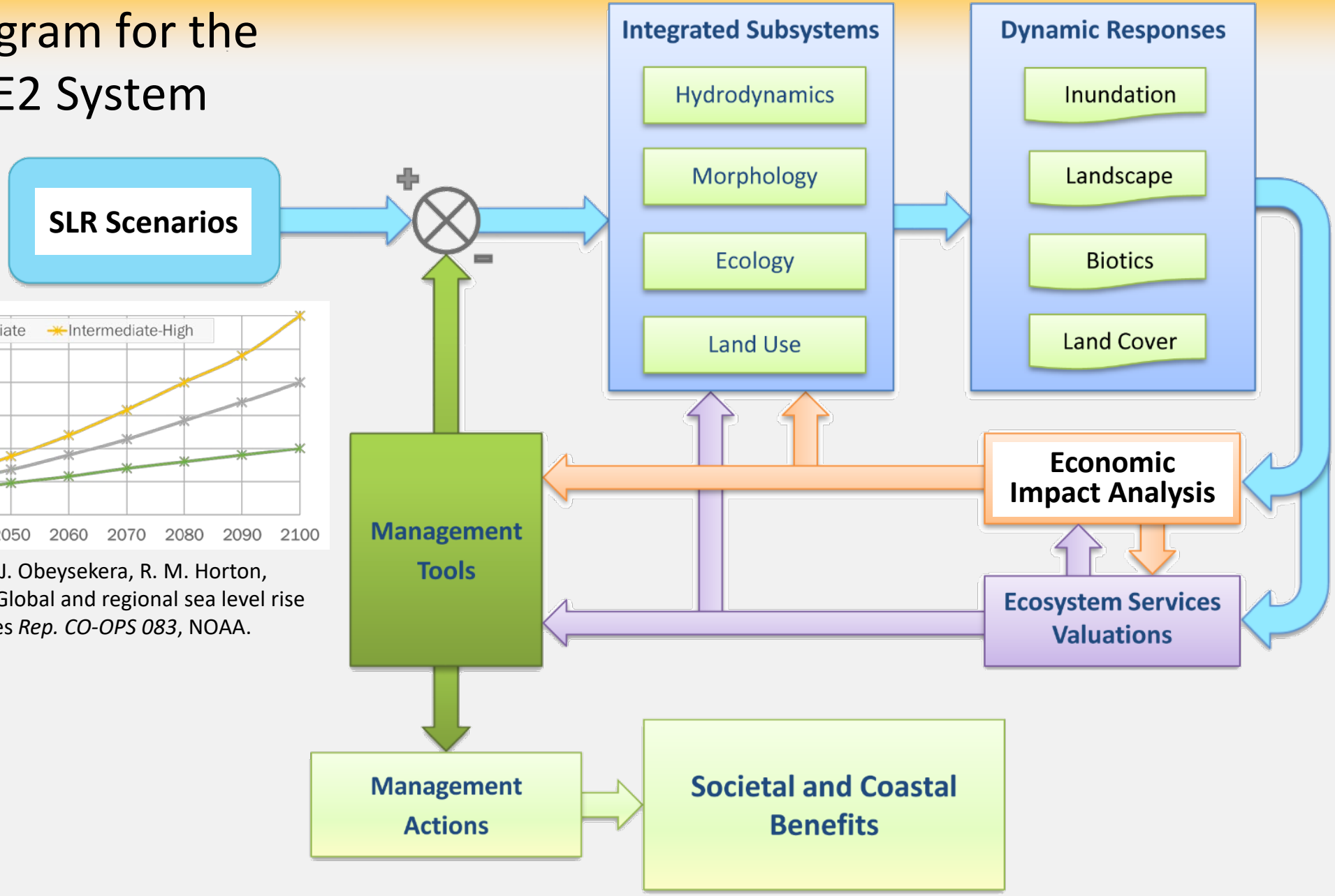


"*Systems Approaches for Coastal Hazard Assessment and Resilience*."
in S. Cutter (Ed): Oxford Research Encyclopedia: Natural Hazard Science.
http://naturalhazardscience.oxfordre.com/browse?t0=ORE_NHS:REFNHS063

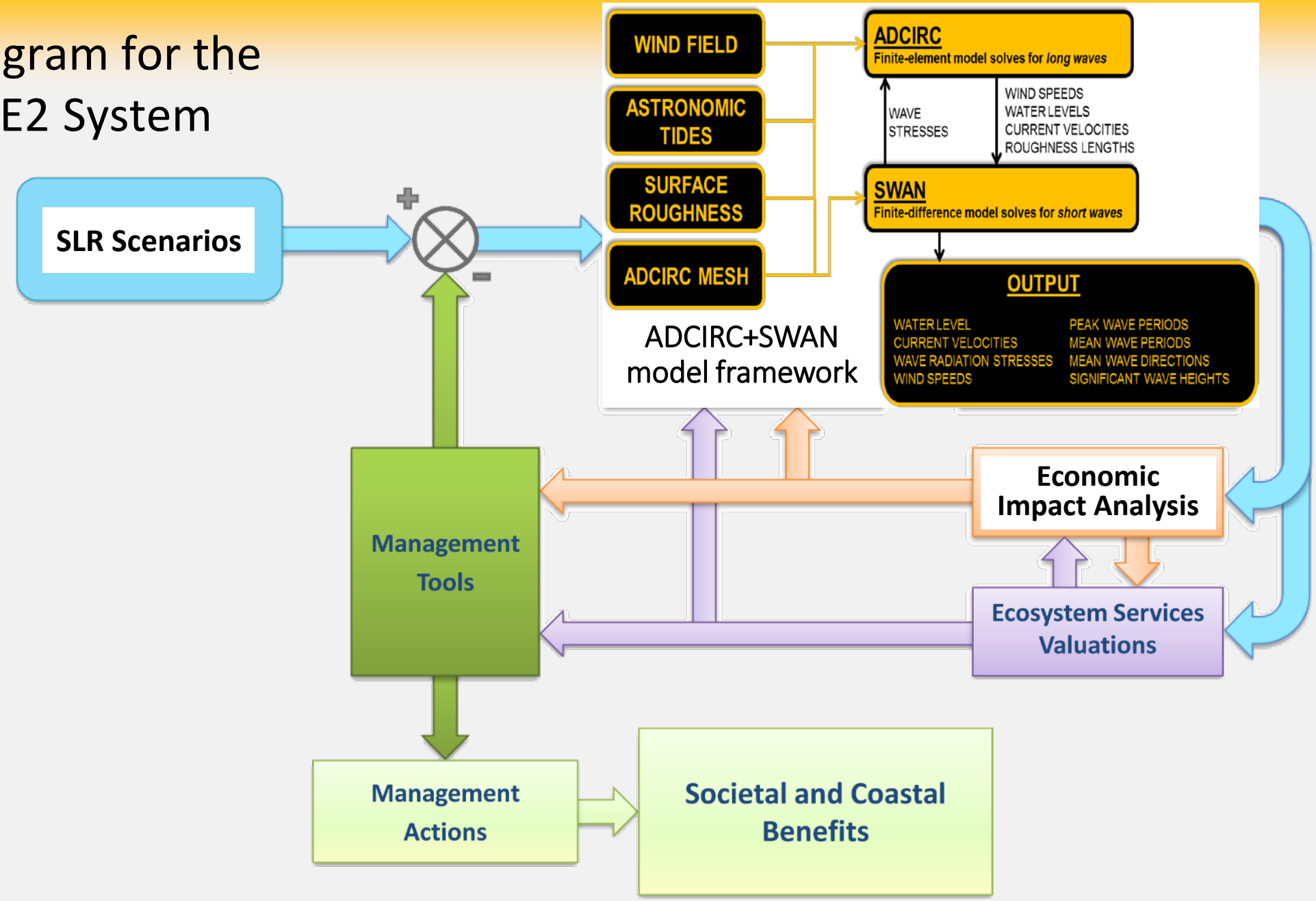
A Process Diagram for the NGOM+N2E2 System



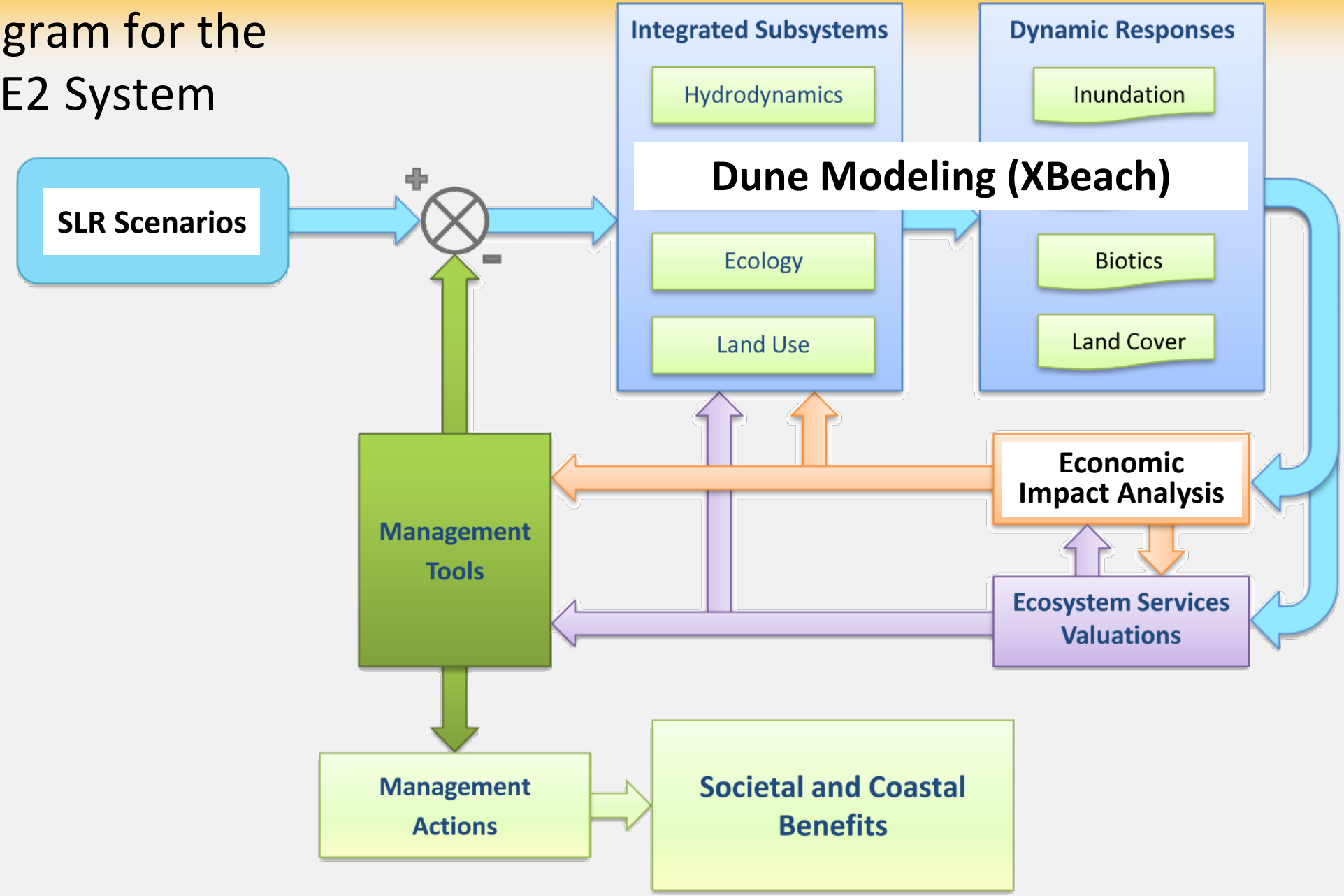
Sweet, W., R. Kopp, C. Weaver, J. Obeysekera, R. M. Horton, E. R. Thieler, and C. Zervas (2017), Global and regional sea level rise scenarios for the United States *Rep. CO-OPS 083*, NOAA.



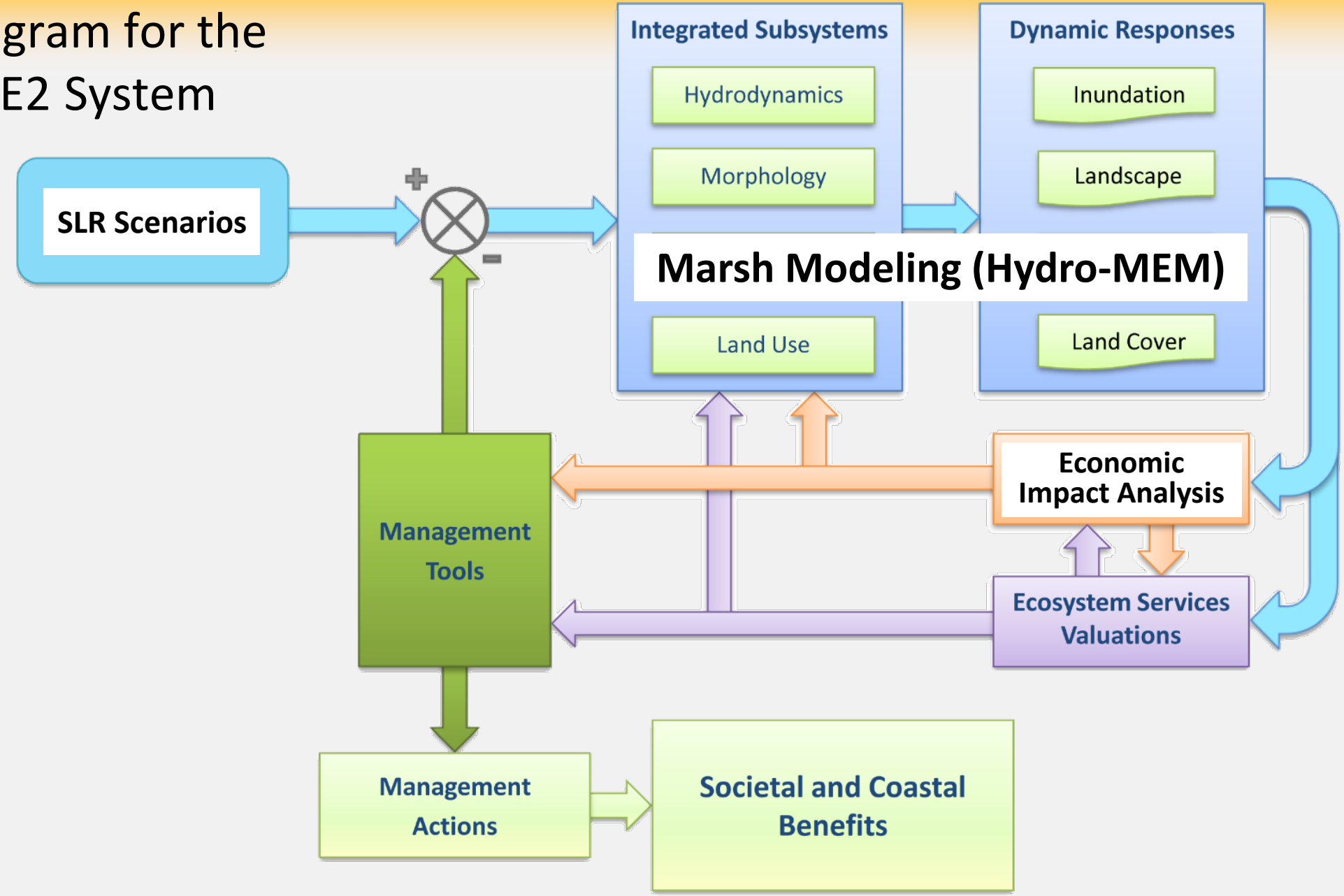
A Process Diagram for the NGOM+N2E2 System



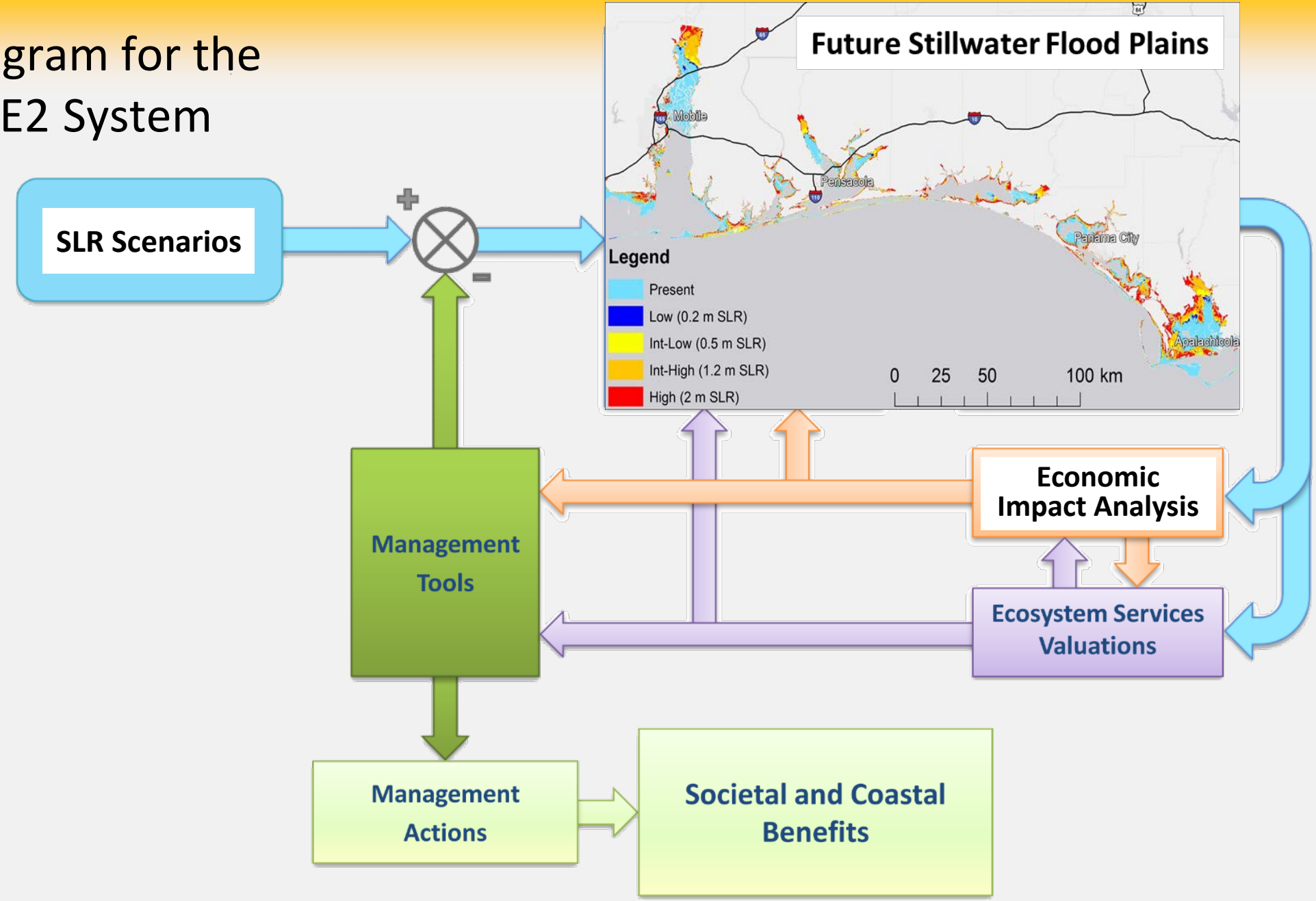
A Process Diagram for the NGOM+N2E2 System



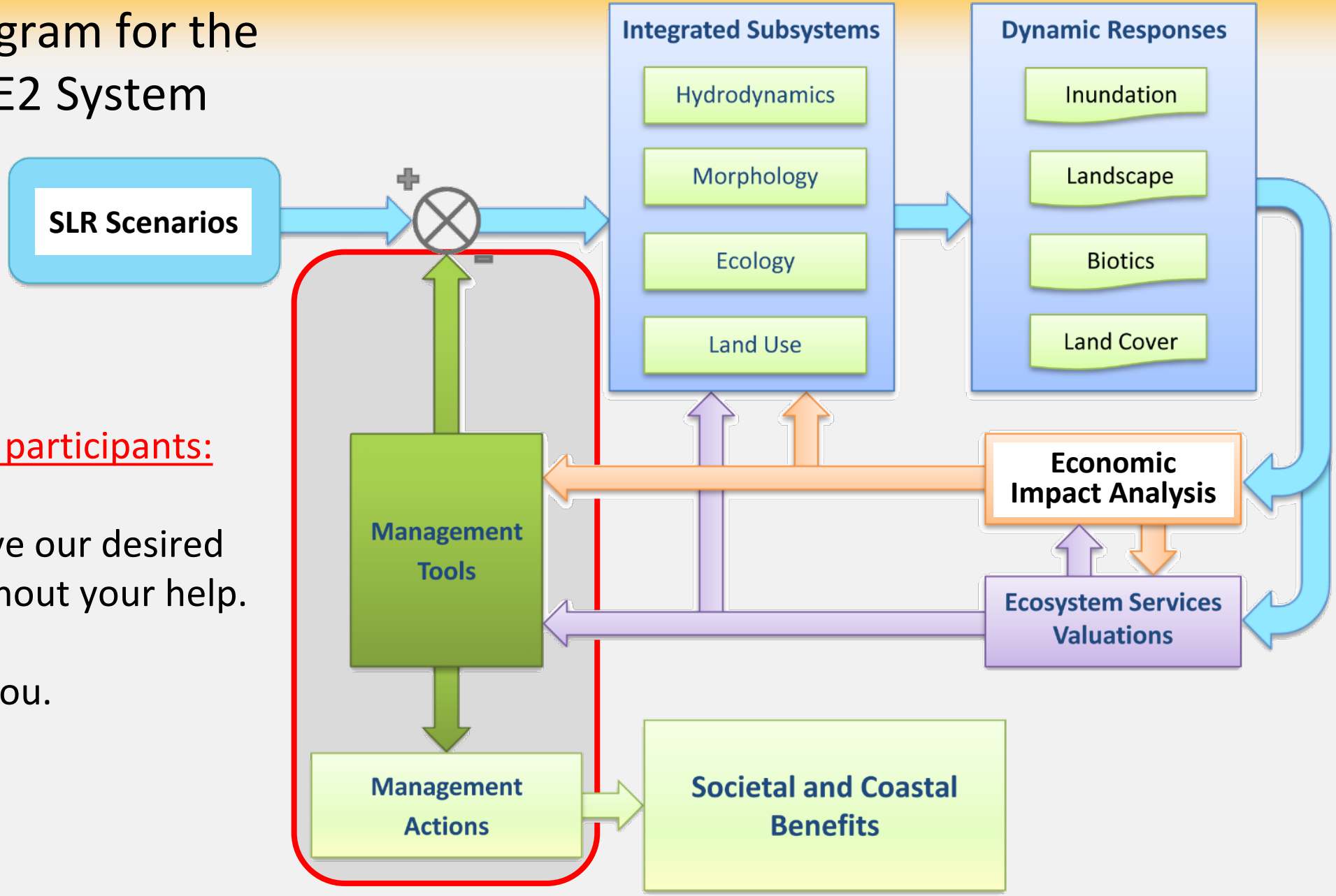
A Process Diagram for the NGOM+N2E2 System



A Process Diagram for the NGOM+N2E2 System



A Process Diagram for the NGOM+N2E2 System

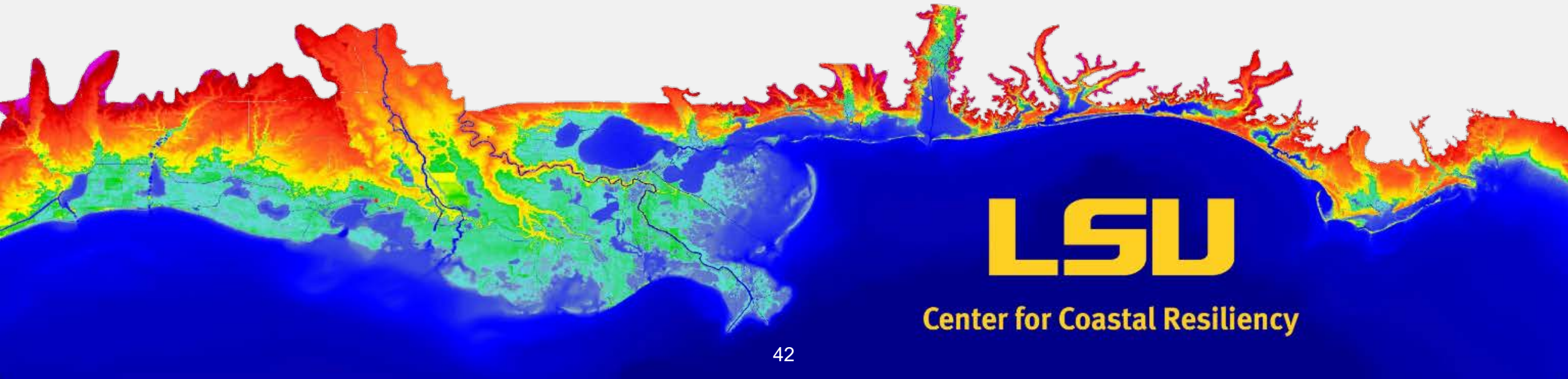


MTAG Workshop participants:

We cannot achieve our desired level of success without your help.

Thank you.

Questions



NGOM+N2E2 MTAG:
How have you made a difference?

NGOM+N2E2 Workshop

July 12, 2018

Grand Bay NERR

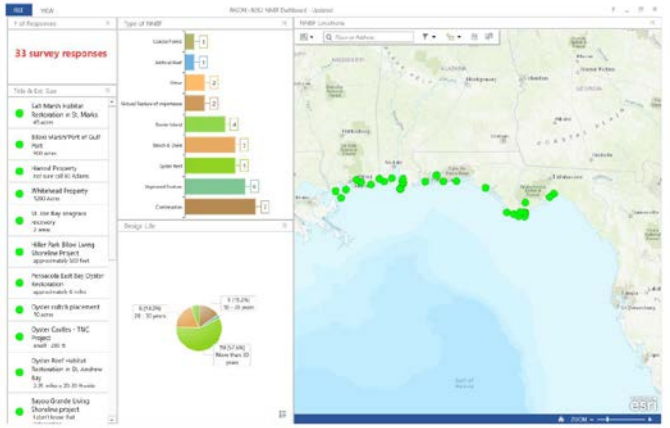
The big picture

1. Narrow options for analysis
2. Improve data access and awareness
3. Shape data products

Useable Science

Activities

- Virtual Meetings
  - Q/A
  - Discussion
  - Surveys
- Workshops
  - Discussions
  - Focus Groups
  - Worksheets
  - Digital Platforms
  - Mapping Exercises



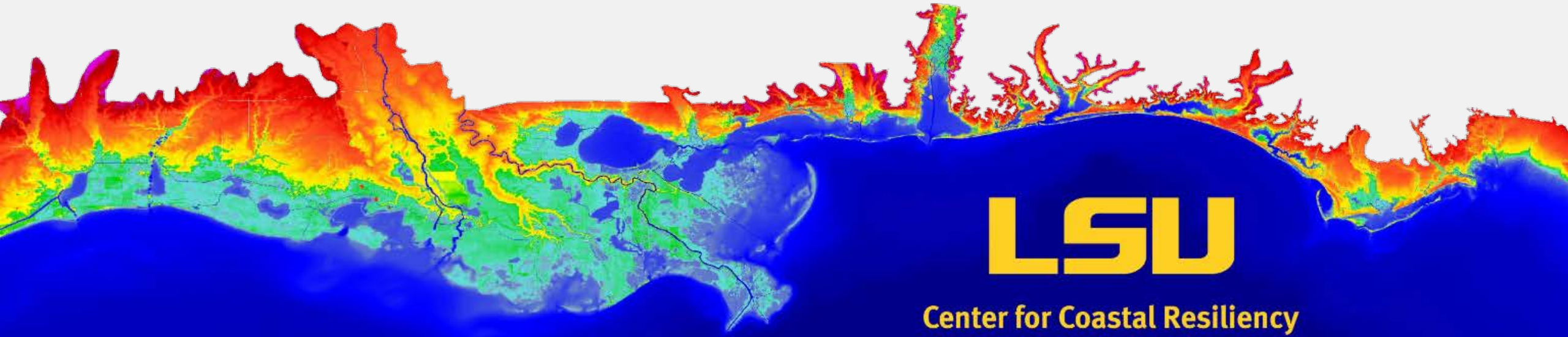
Impact on Project

- Enhanced marsh fieldwork
- Improved marsh validation
- Scoped SLR scenarios and timesteps
- Provided over 35 NNBFs in the region
- Facilitated nuisance flooding research
- Shaped analyses:
  - Flooding scenarios(surge and nuisance flooding)
  - Economic impact analysis
  - Ecosystem service valuation


A BIG
THANK YOU

Apalachicola Wetland Response to Sea Level Rise

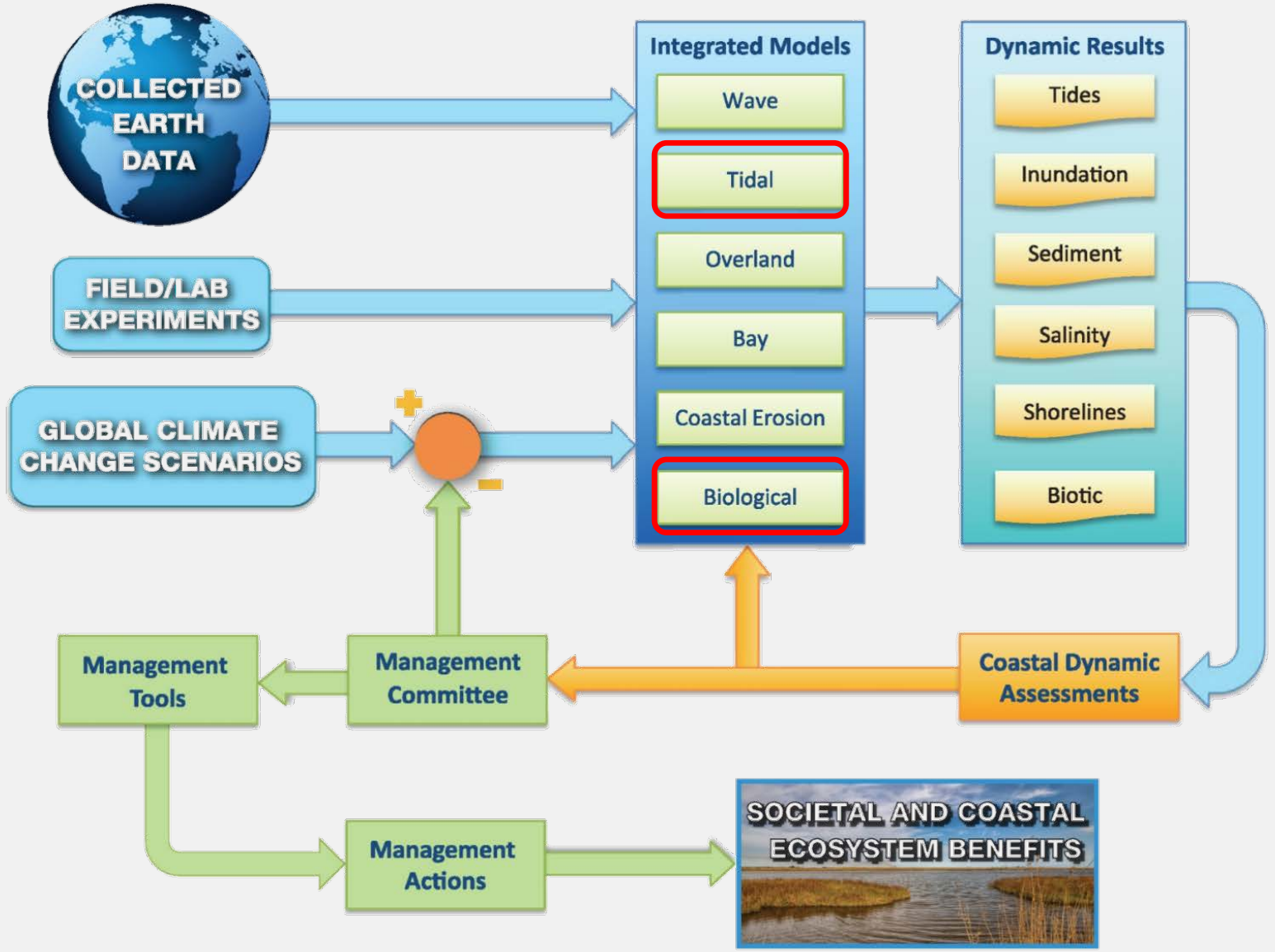
Karim Alizad, Scott C. Hagen, Stephen C. Medeiros, James T. Morris



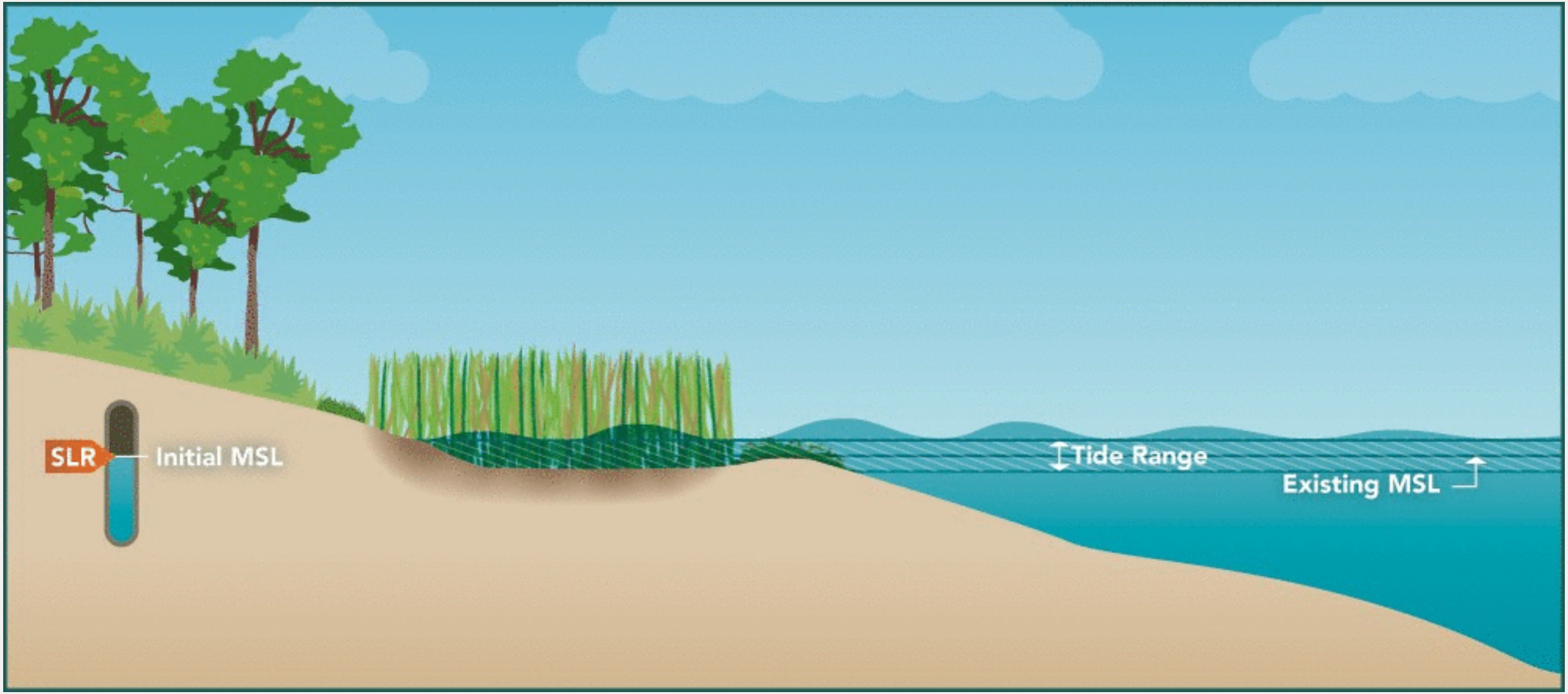
Outline

- Overview
- Methodology
- Hydro-MEM Improvements
- Findings and Future Work

Ecological Effects of SLR in the NGOM

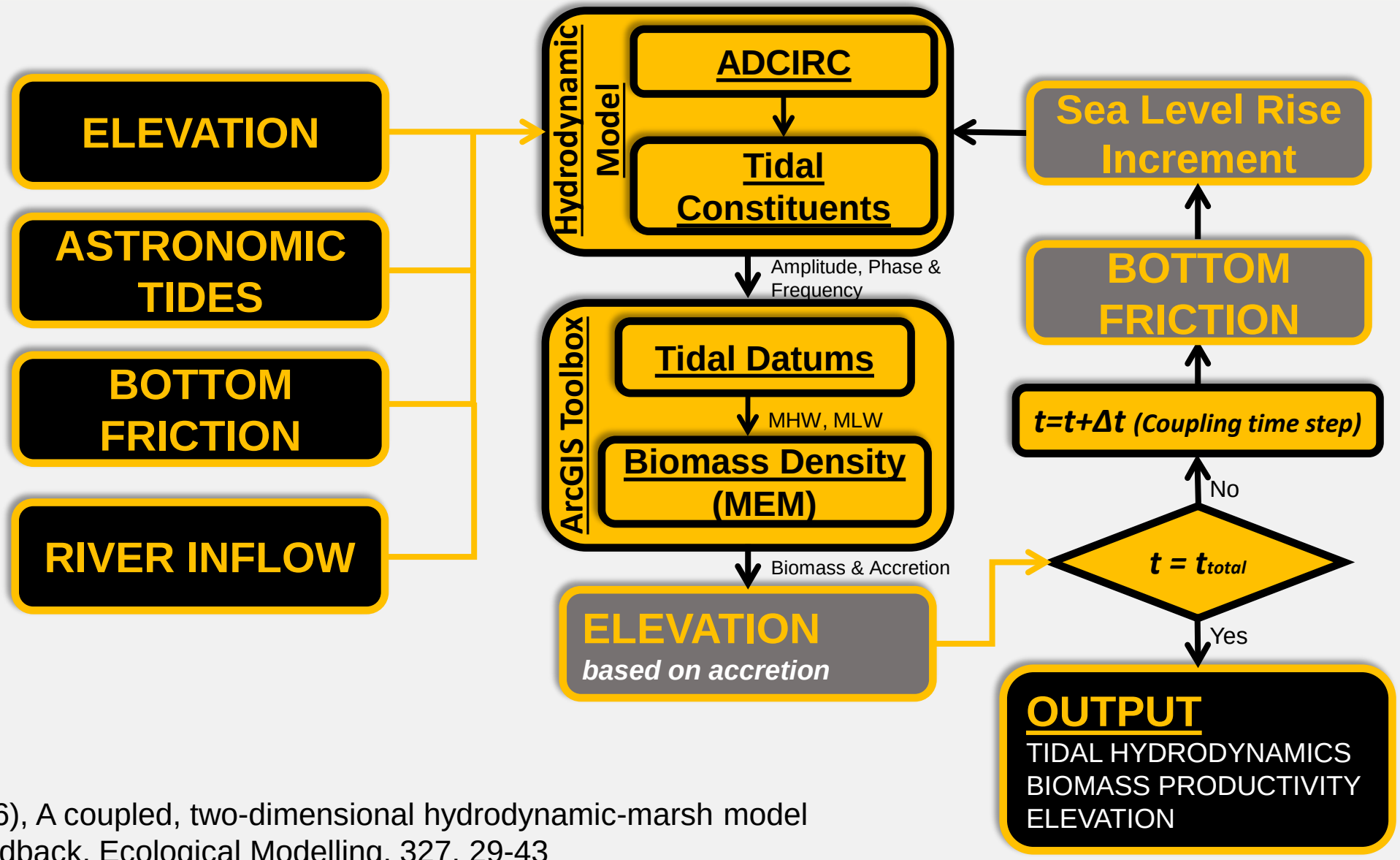


Dynamics of Sea Level Rise in Marsh Model



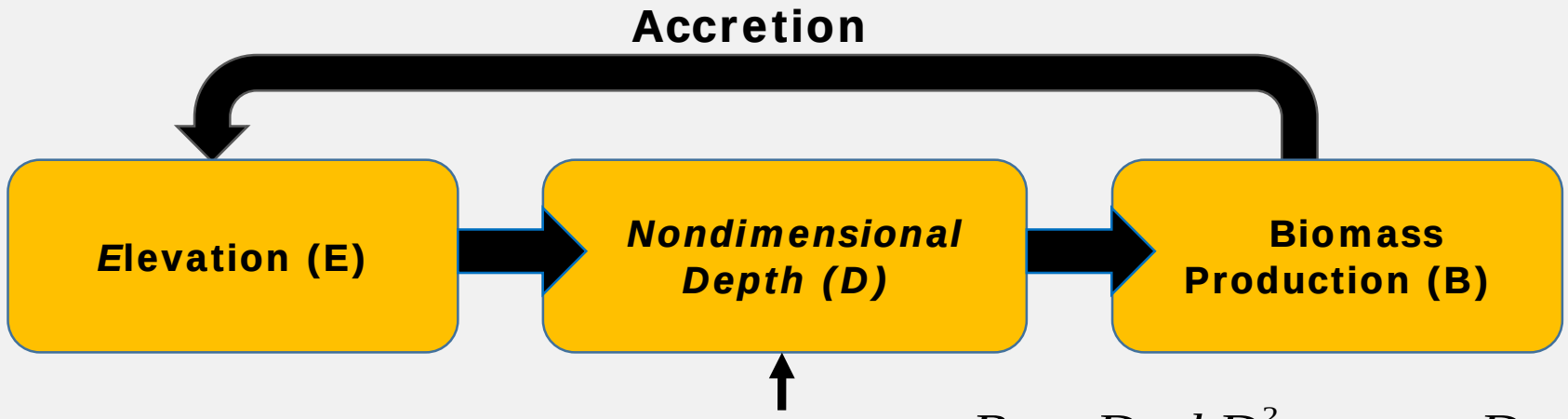
Passeri, D. L., S. C. Hagen, S. C. Medeiros, M. V. Bilskie, **K. Alizad**, and D. Wang (2015), The dynamic effects of sea level rise on low-gradient coastal landscapes: A review, *Earth's Future*, *3*(6), 159-181

Hydro-MEM Process Diagram

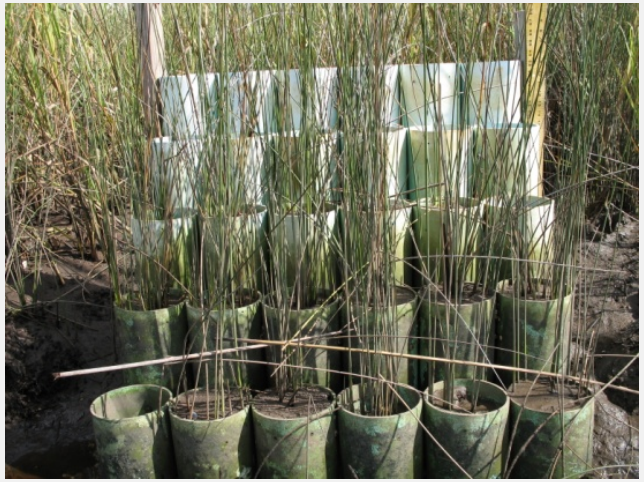


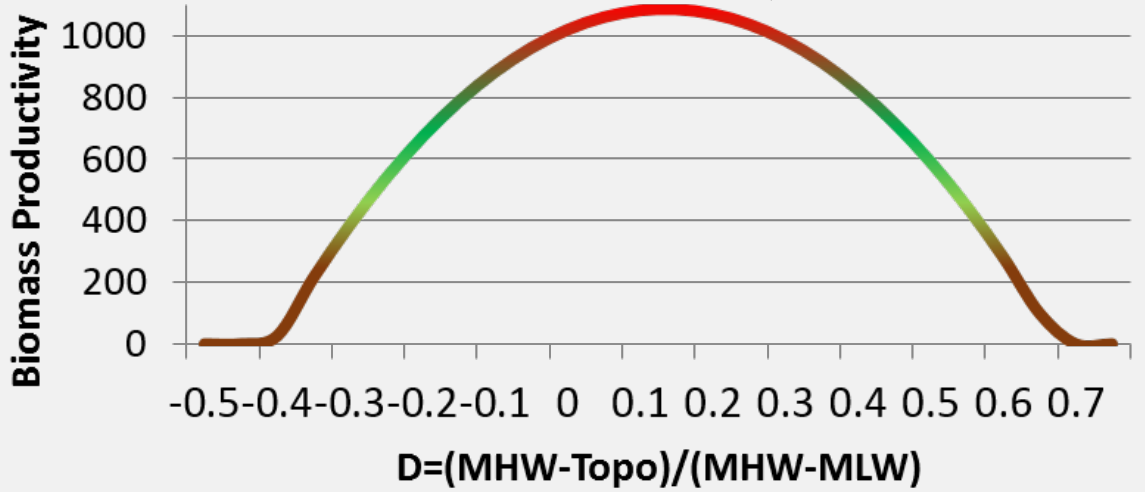
Alizad et al. (2016), A coupled, two-dimensional hydrodynamic-marsh model with biological feedback, Ecological Modelling, 327, 29-43

Parametric Marsh Model (MEM)



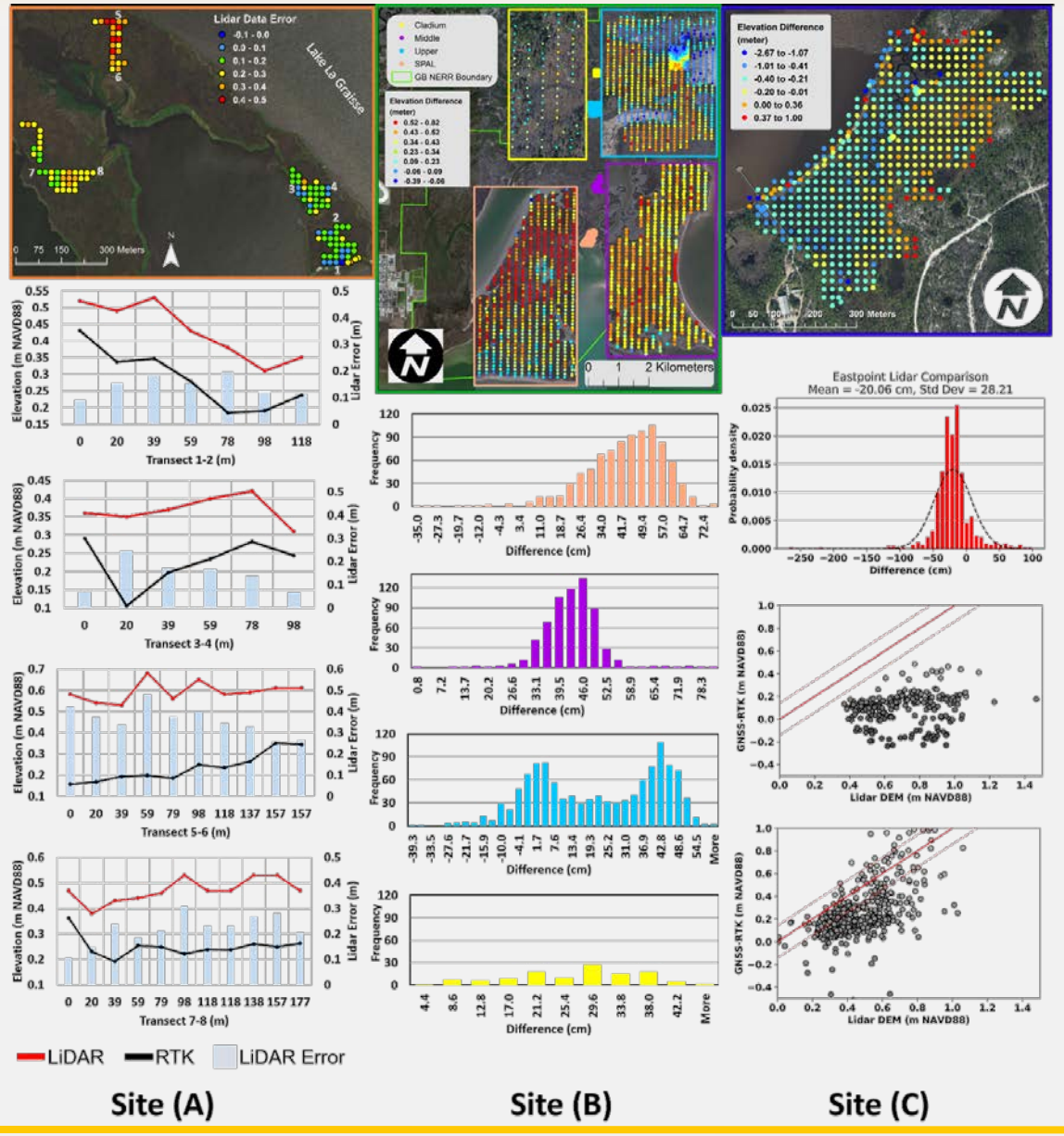
$$B = aD + bD^2 + c \quad ; \quad D = \frac{(\mathrm{MHW} - E)}{(\mathrm{MHW} - \mathrm{MLW})}$$





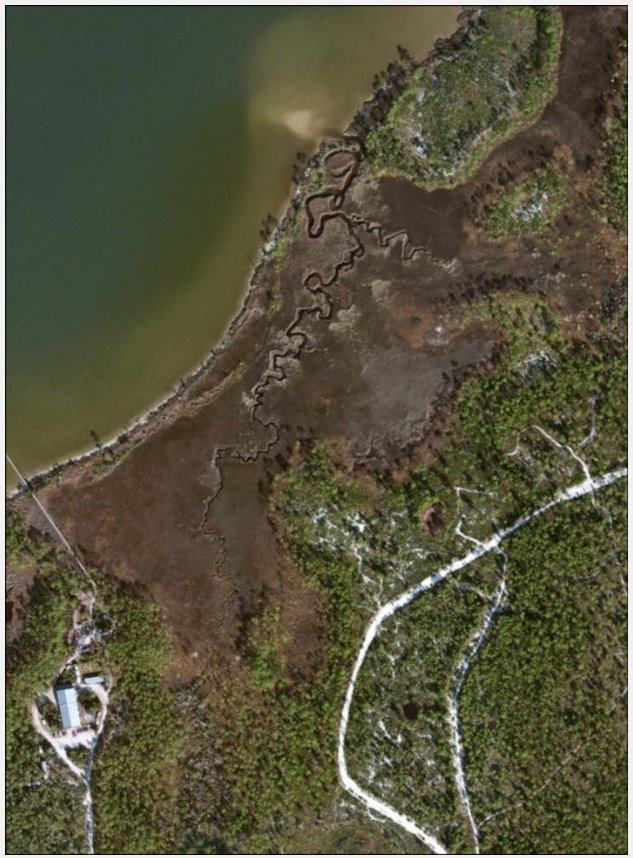
Morris et al. (2002). "Responses of coastal wetlands to rising sea level." Ecology 83(10): 2869-2877

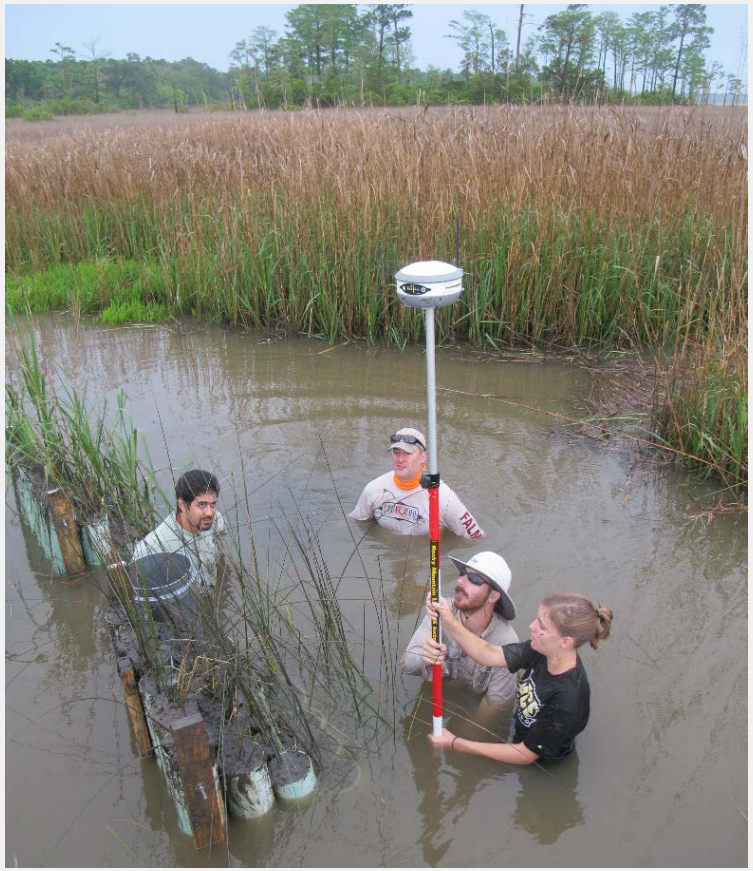
Topographic Uncertainty



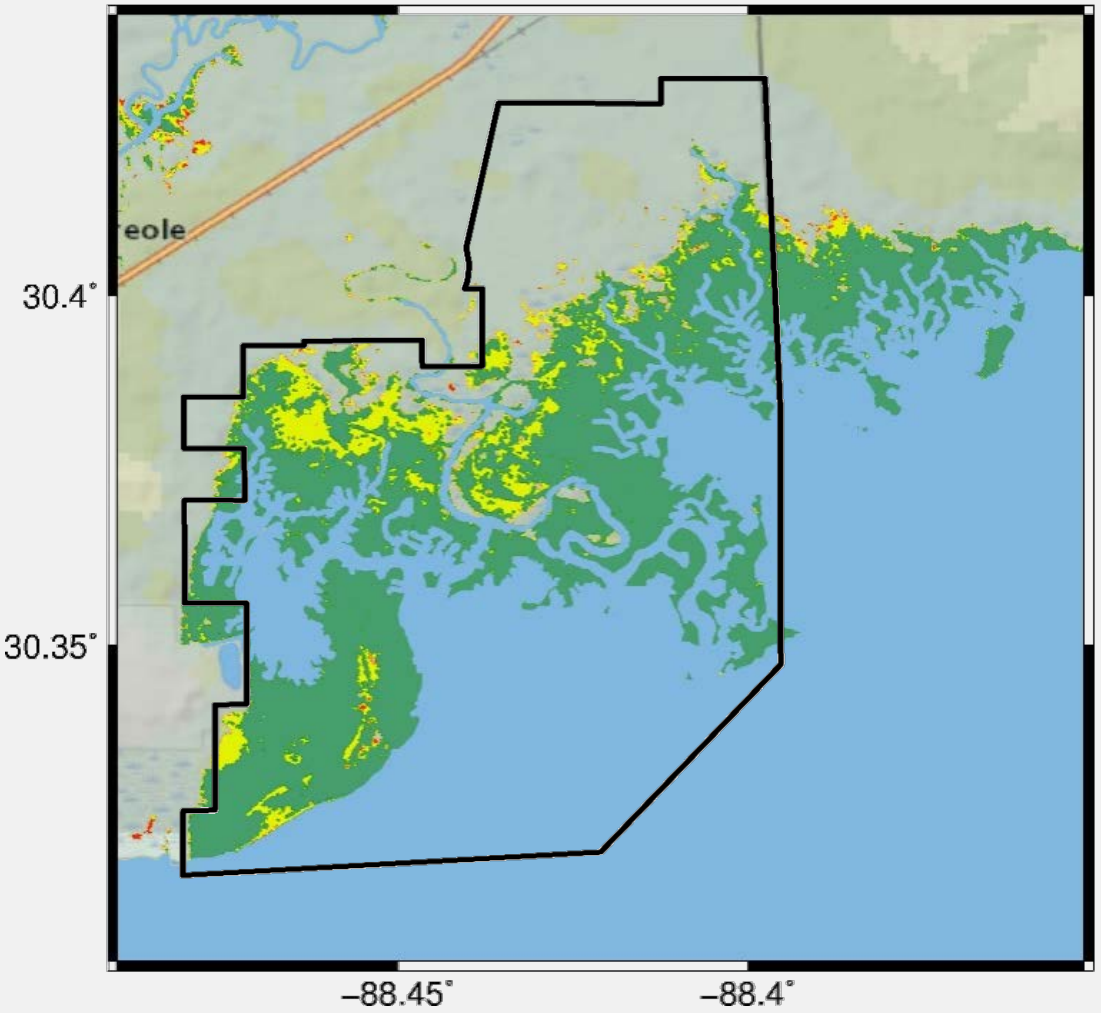
Alizad, K., Medeiros, S.C., Lauve, W.R., Hagen, S.C. (2018), Topographic uncertainty in the dynamic modeling of coastal salt marshes, Geophysical Research Letters, under preparation

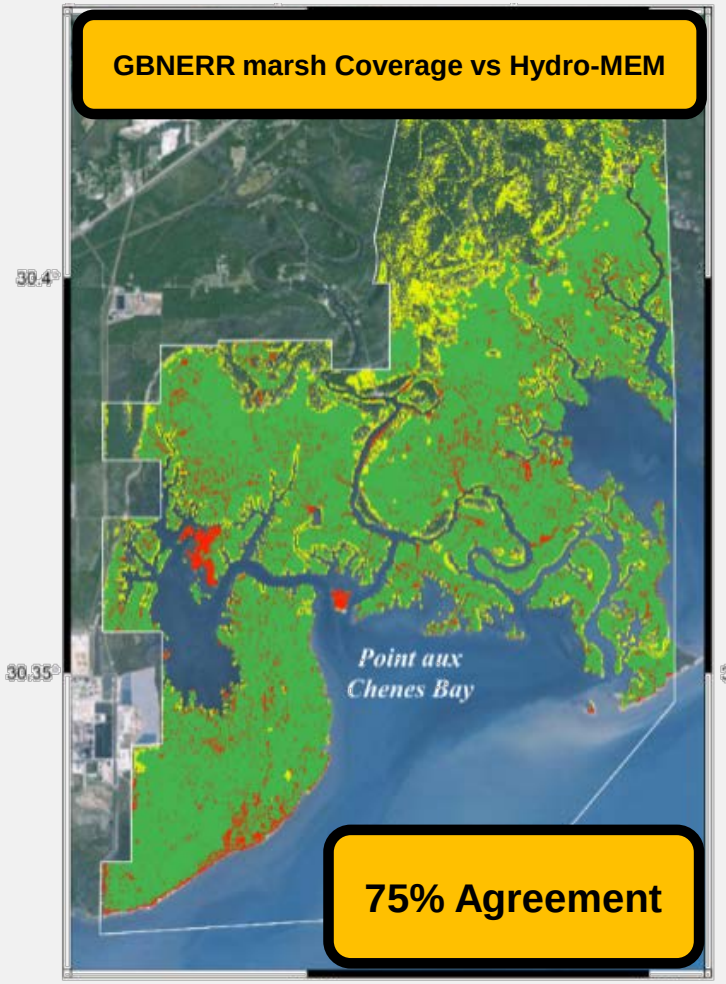
Field Measurements

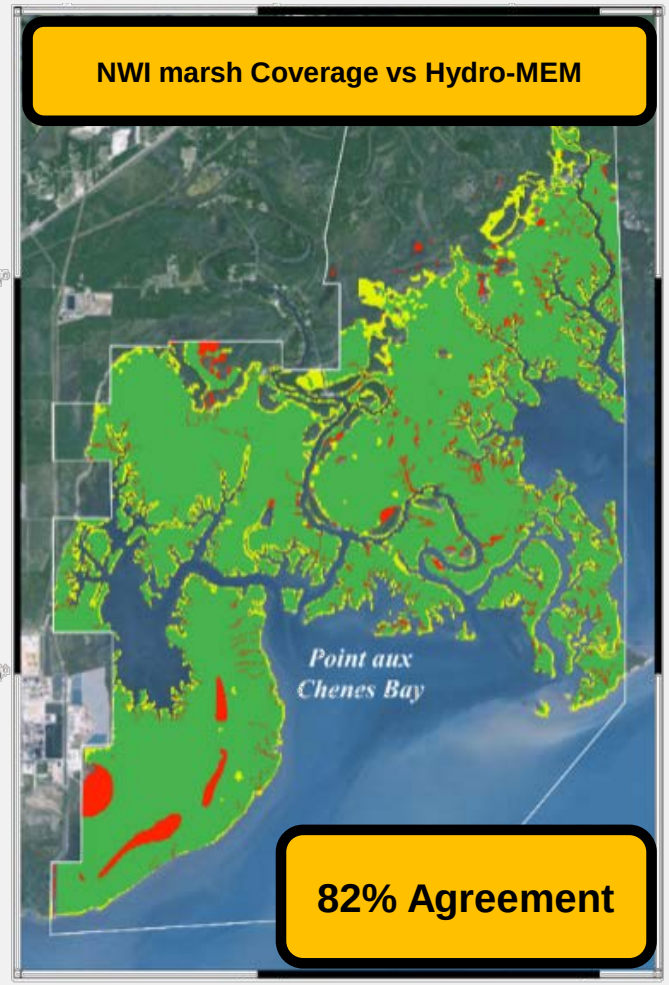




Marsh Projection Validation



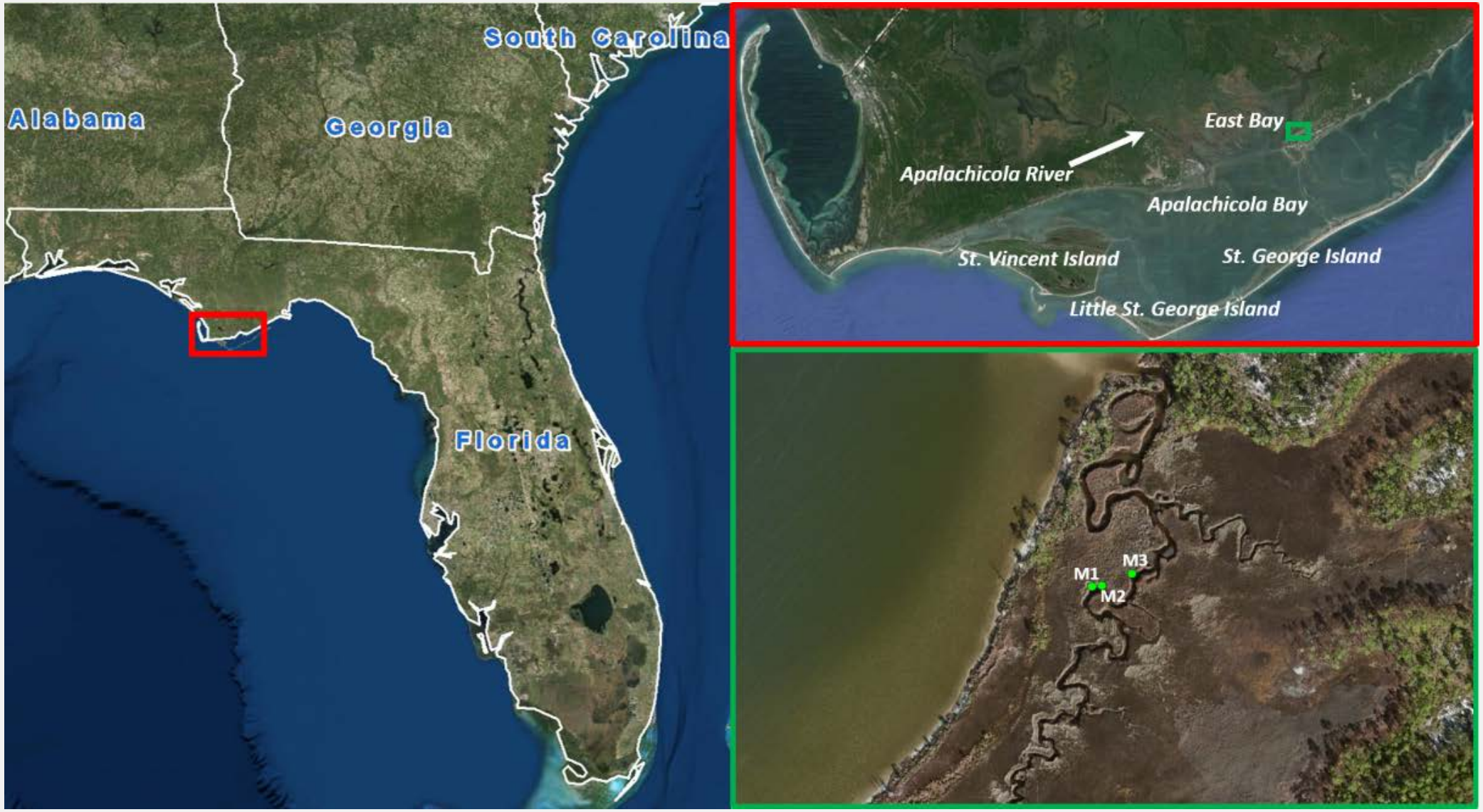




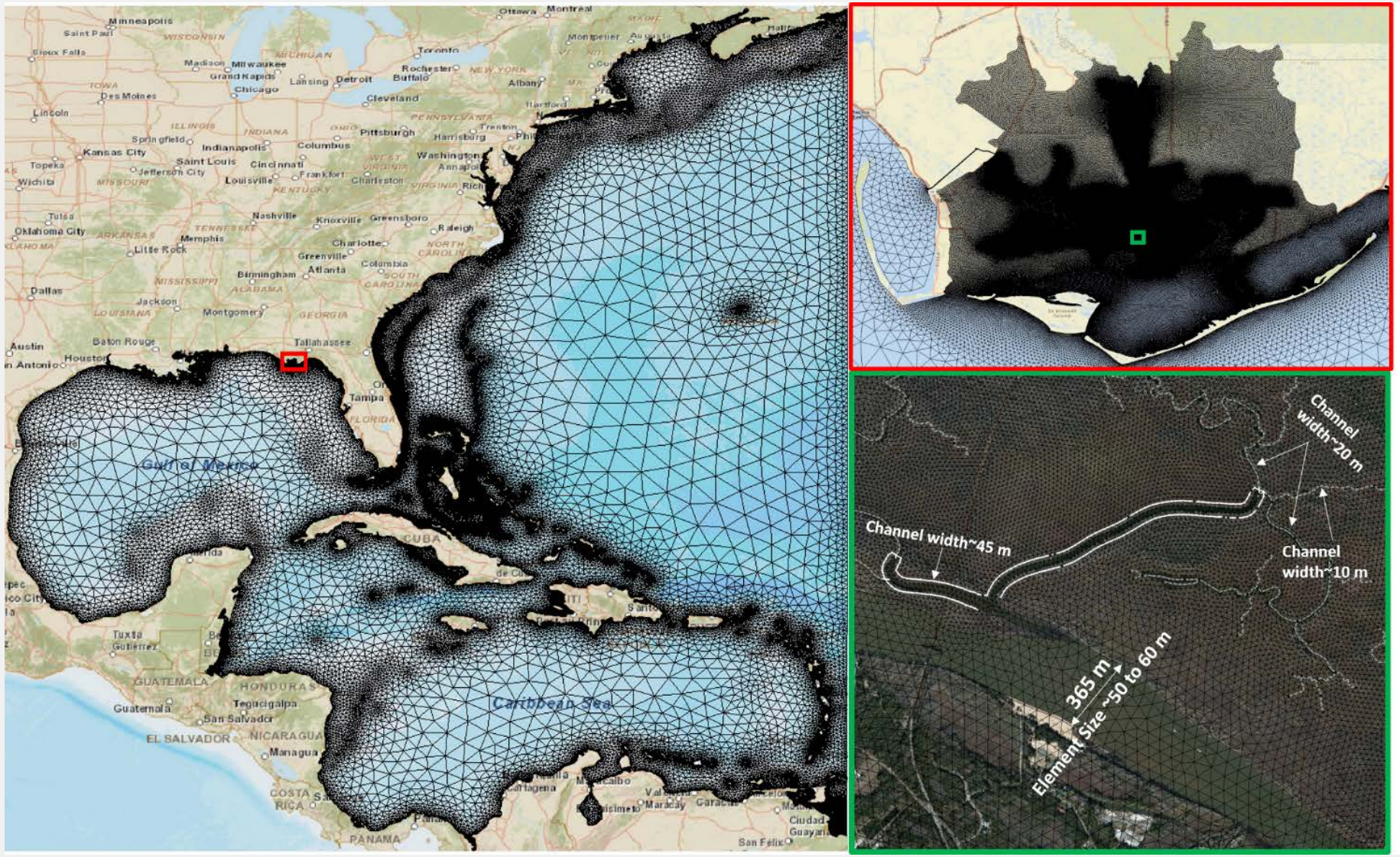
Agree (Marsh) | HM (Not marsh) LC (Marsh) | HM (Marsh) LC (Not marsh)

Alizad, K., Hagen, S.C., Medeiros, S.C., Bilskie, M.V., Morris, J.T., Balthis, L., Buckel, C.A. (2018), Dynamic responses and implications to coastal wetlands and the surrounding regions under sea level rise, PLOS ONE, under review

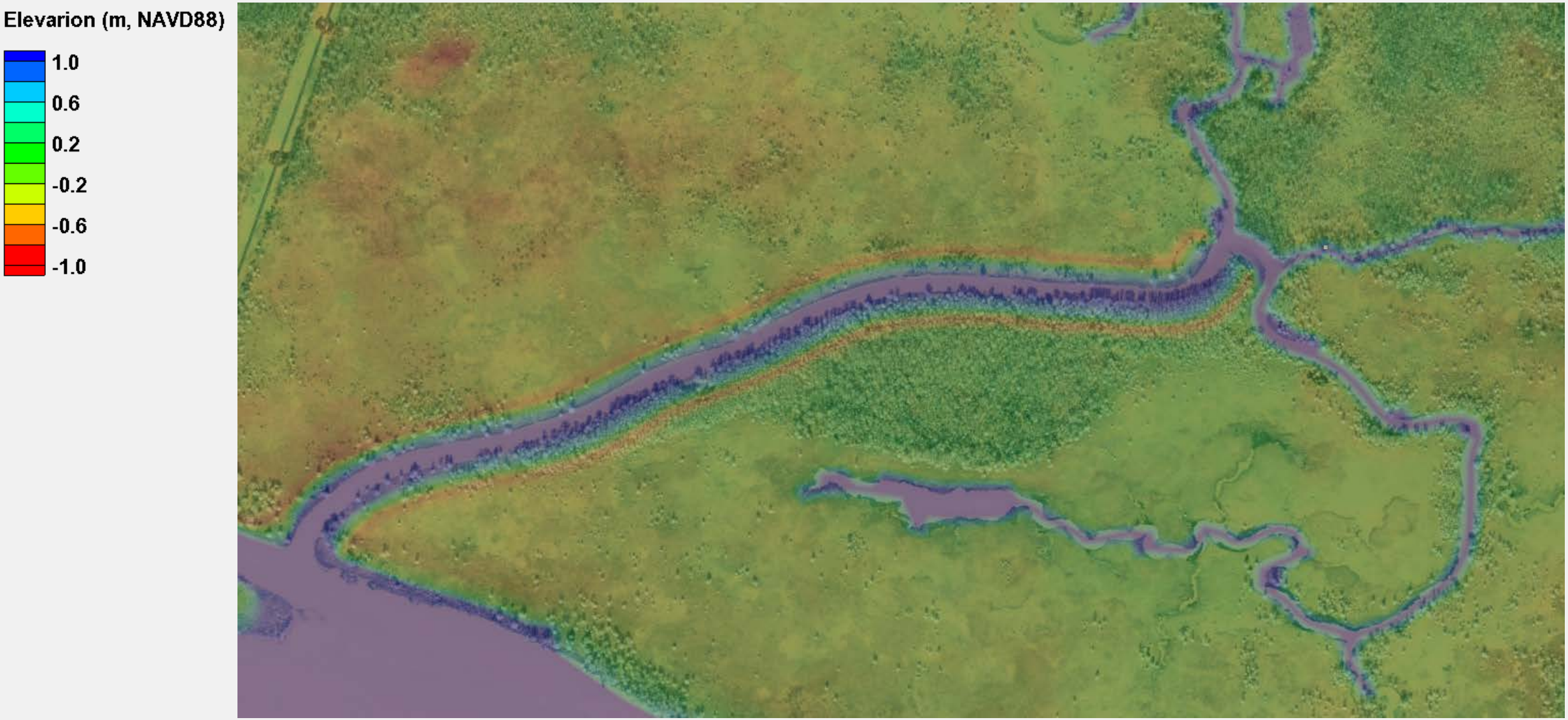
Model Application in Apalachicola, FL



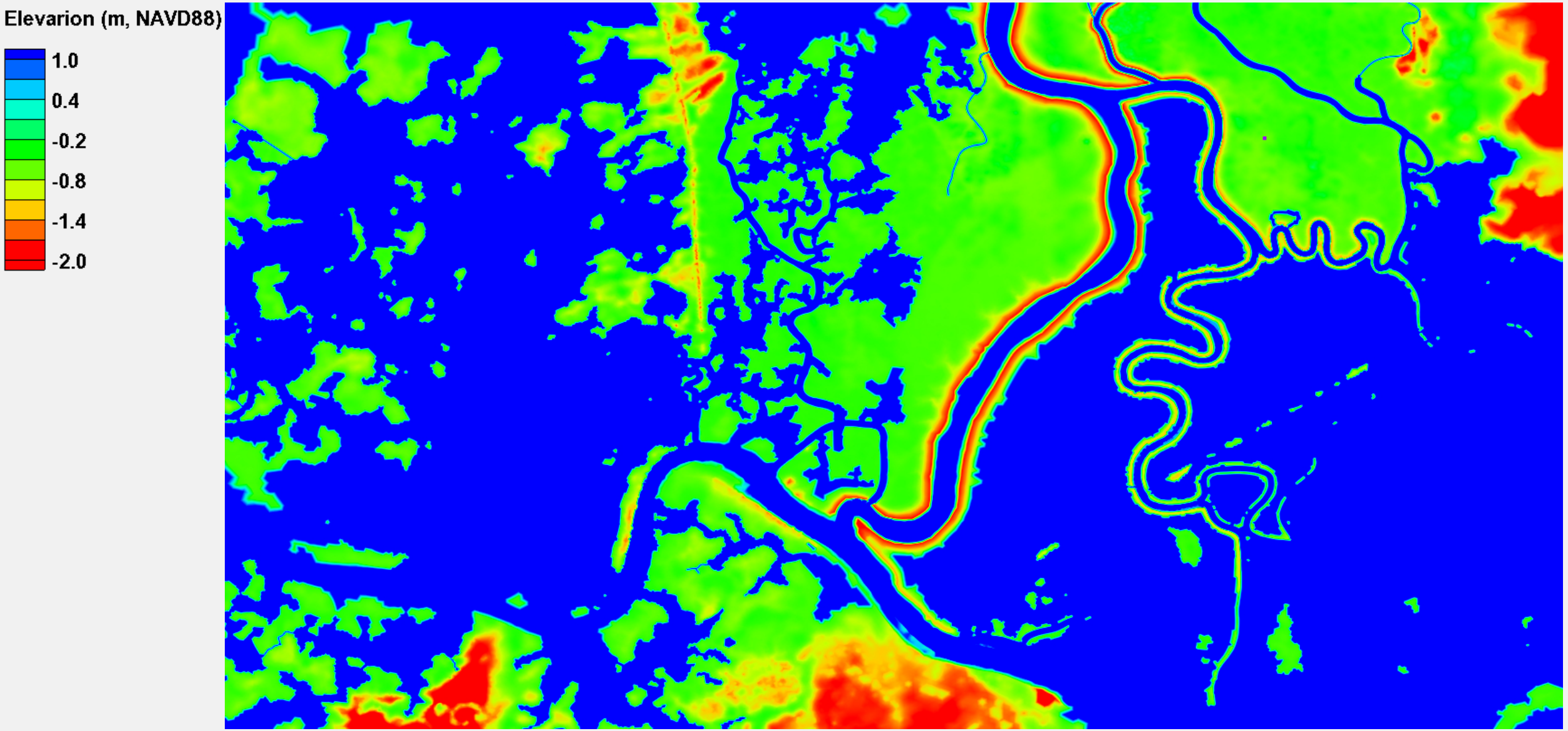
Finite Element Mesh



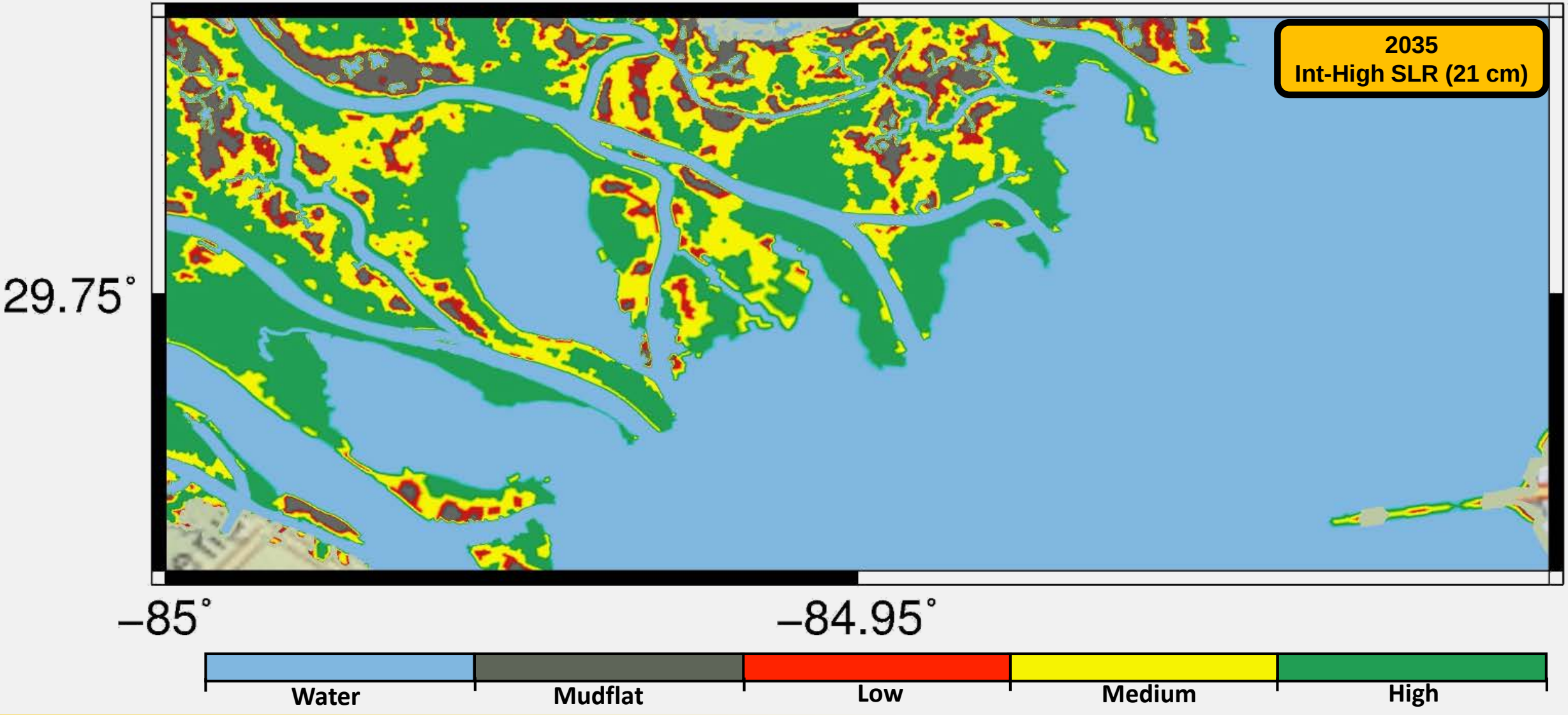
Creeks and Ponding



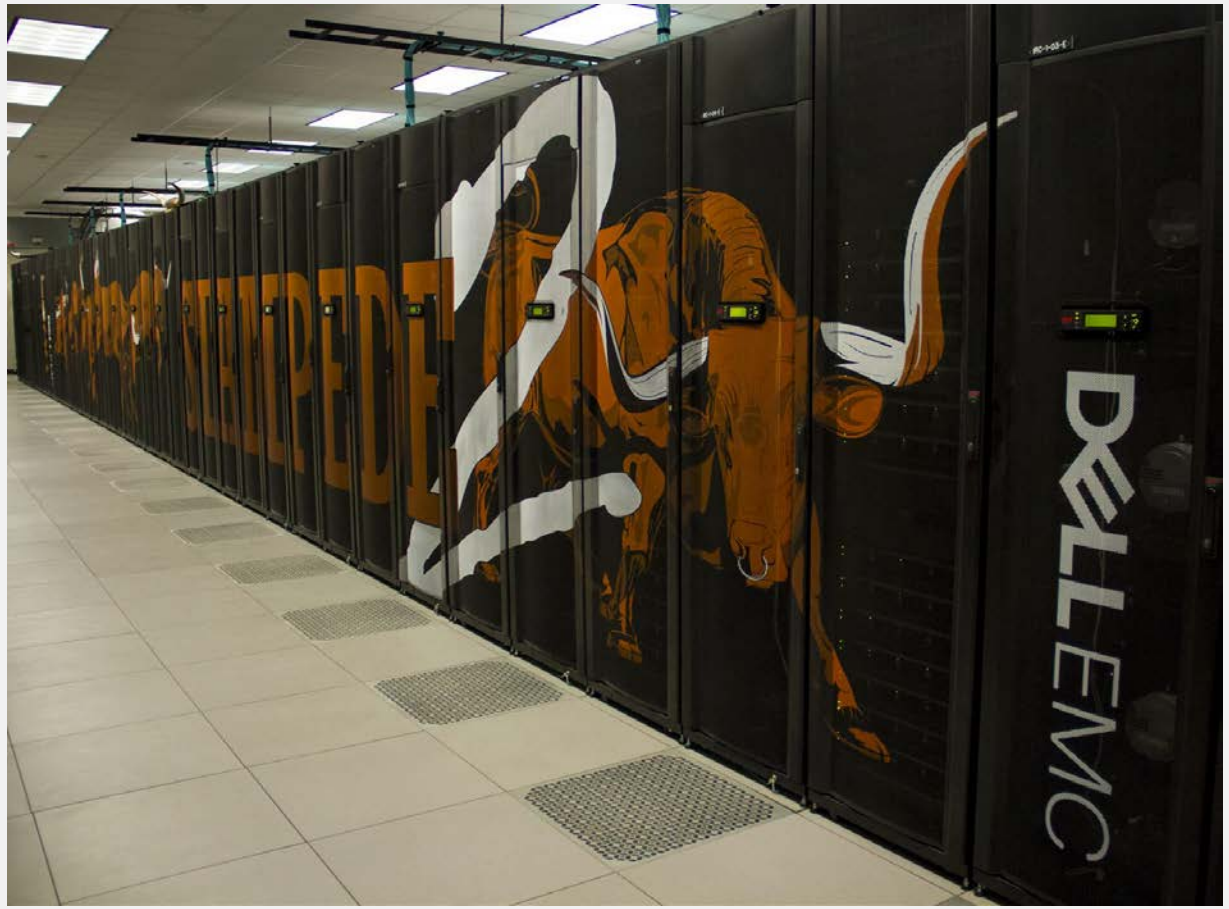
Bay Expansion and New Creeks Creation



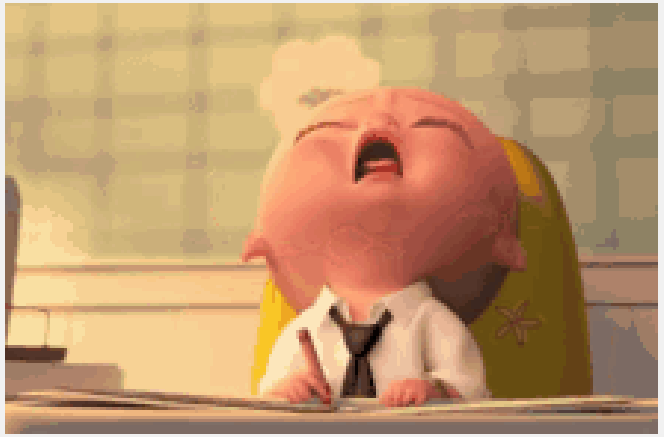
Adding Mudflat to Marsh Productivity Results



Hydro-MEM Simulations

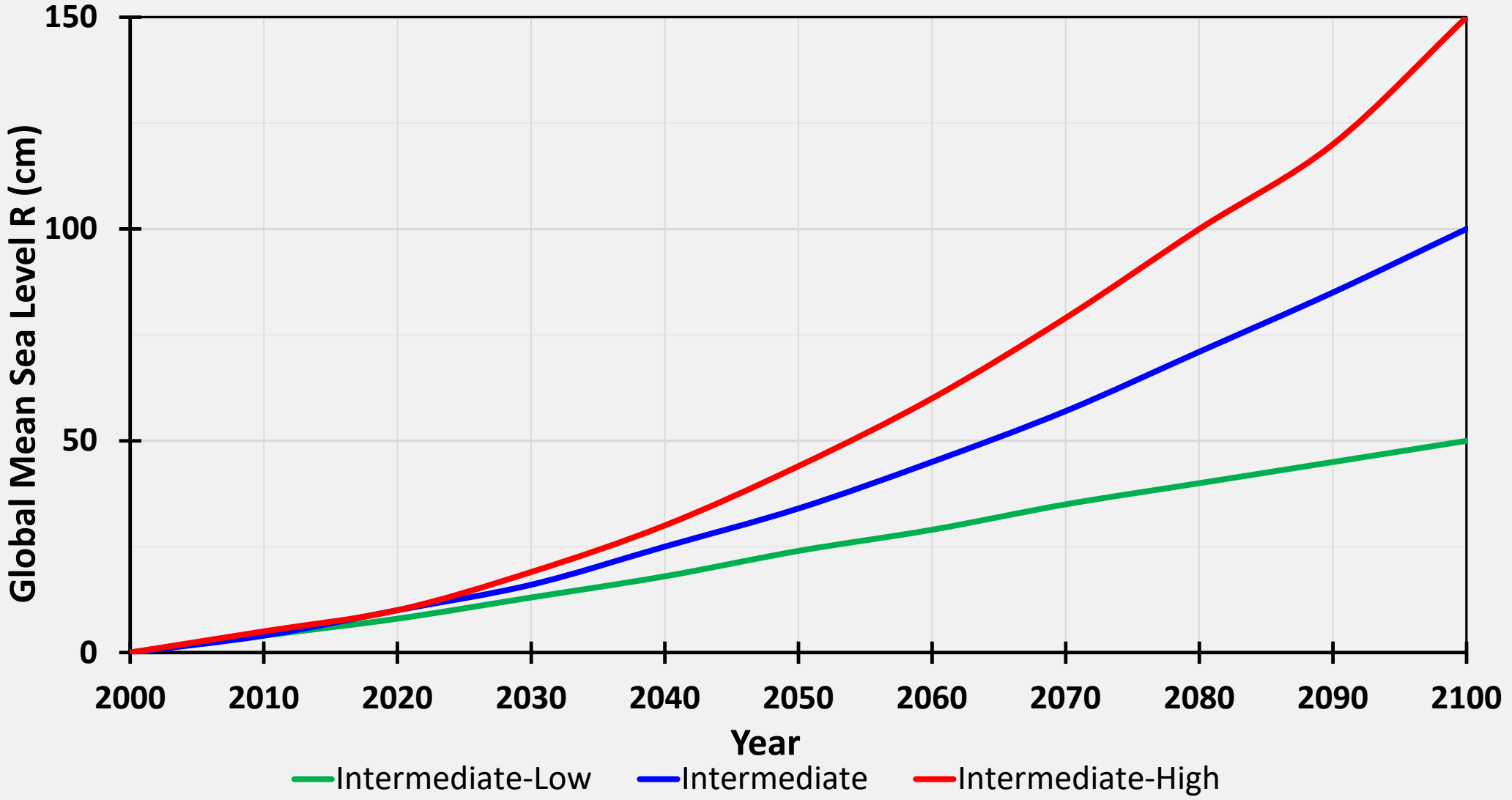


- Each hydrodynamic run takes 5 hour using 960 cpu core nodes
- Waiting time in Stampede2 supercomputer queue: More than a day
- Hydro-MEM and input file processing time: 5 hour
- Each time step takes 2 days.



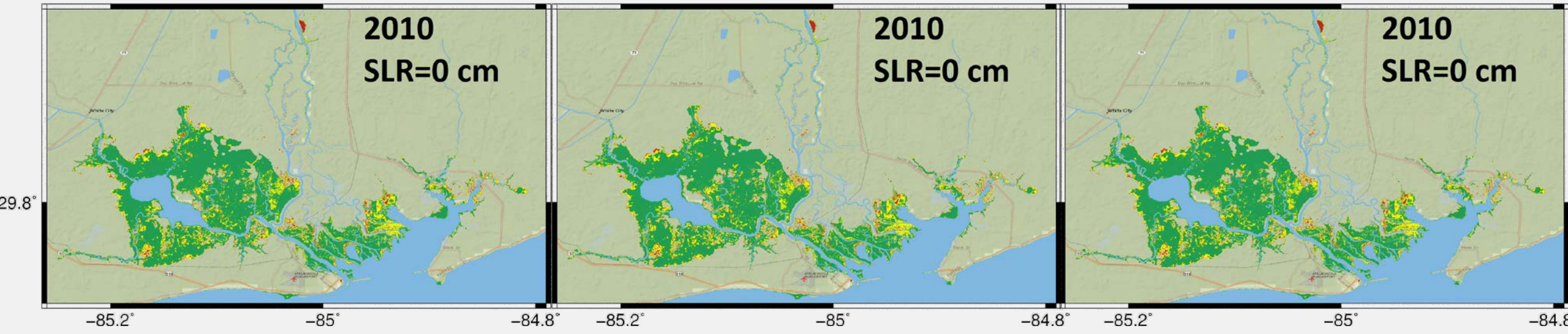
www.tenor.com

SLR Scenario

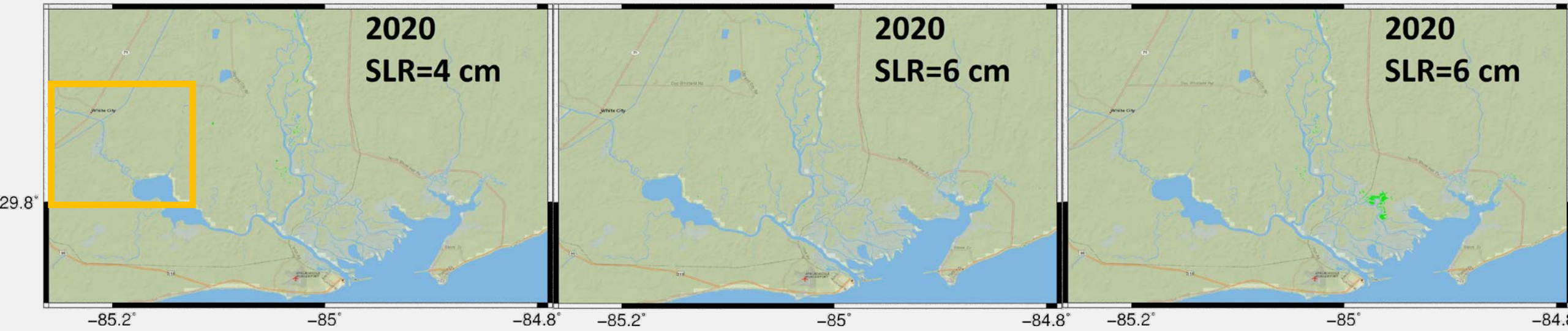


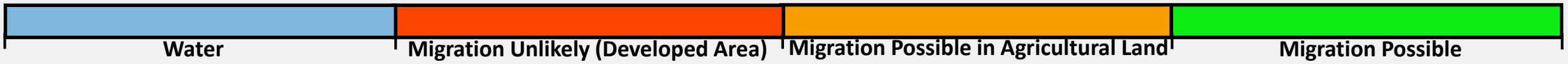
Sweet et al. (2017), Global and regional sea level rise scenarios for the United States Rep. CO-OPS 083, NOAA.

Marsh Productivity

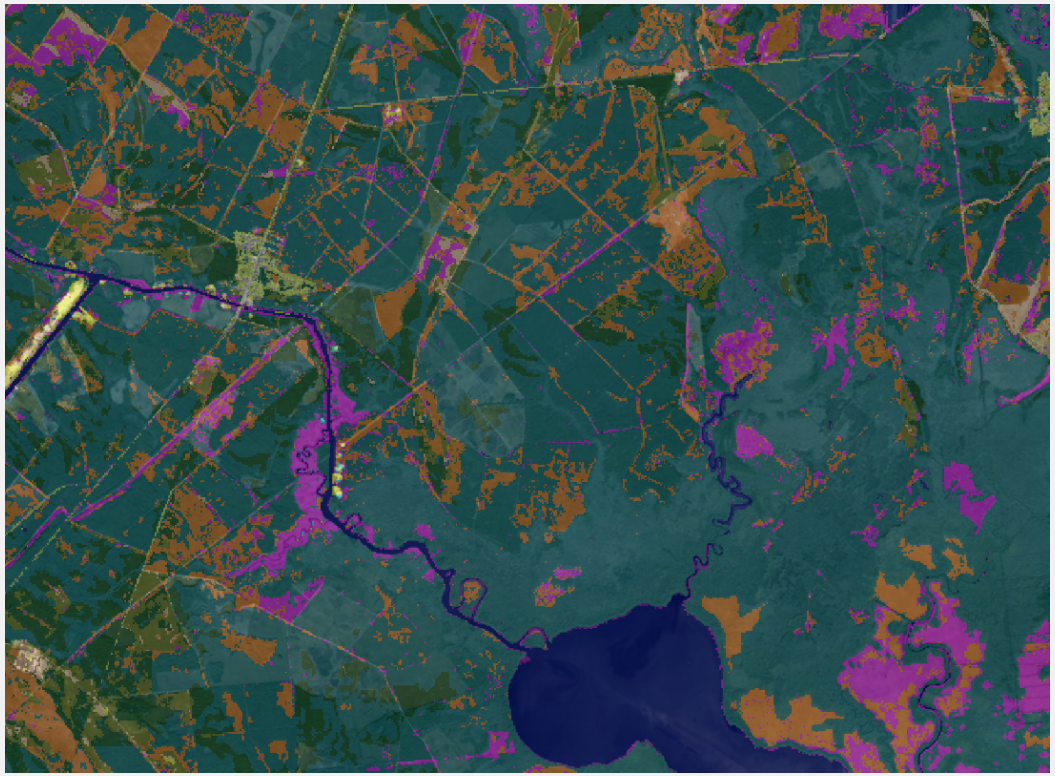


Marsh Migration Possibility





Land Cover




Background
Unclassified
Developed, High Intensity
Developed, Medium Intensity
Developed, Low Intensity
Developed, Open Space
Cultivated Crops
Pasture/Hay
Grassland/Herbaceous
Deciduous Forest
Evergreen Forest
Mixed Forest
Scrub/Shrub
Palustrine Forested Wetland
Palustrine Scrub/Shrub Wetland
Palustrine Emergent Wetland
Estuarine Forested Wetland
Estuarine Scrub/Shrub Wetland
Estuarine Emergent Wetland
Unconsolidated Shore
Bare Land
Open Water
Palustrine Aquatic Bed
Estuarine Aquatic Bed

Conclusion

- The Hydro-MEM model was employed in several sites in the NGOM and East Coast and the results were validated.
- Salt marsh productivity is projected to decrease under the intermediate-low SLR scenario and ponds in the marsh system were created.
- Marsh systems were projected to become inundated while some could possibly migrate to higher lands under intermediate and intermediate-high SLR scenarios.

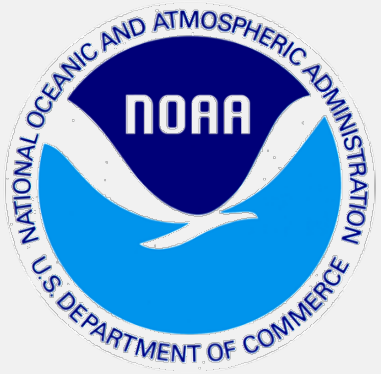
Future Work

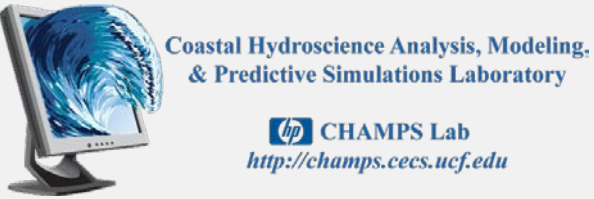
- Big Bend and Pascagoula region models

- Hydro-MEM:
  - Dynamic MEM curve
  - High and low marsh
  - Adding more Geomorphology

Acknowledgment

- Dr. Scott C. Hagen
- Dr. Stephen C. Medeiros
- CCR Colleagues






@kaliz001
/Karim_Alizad
/kalizad
Thanks!
https://www.karimalizad.com/
karimalizad@lsu.edu

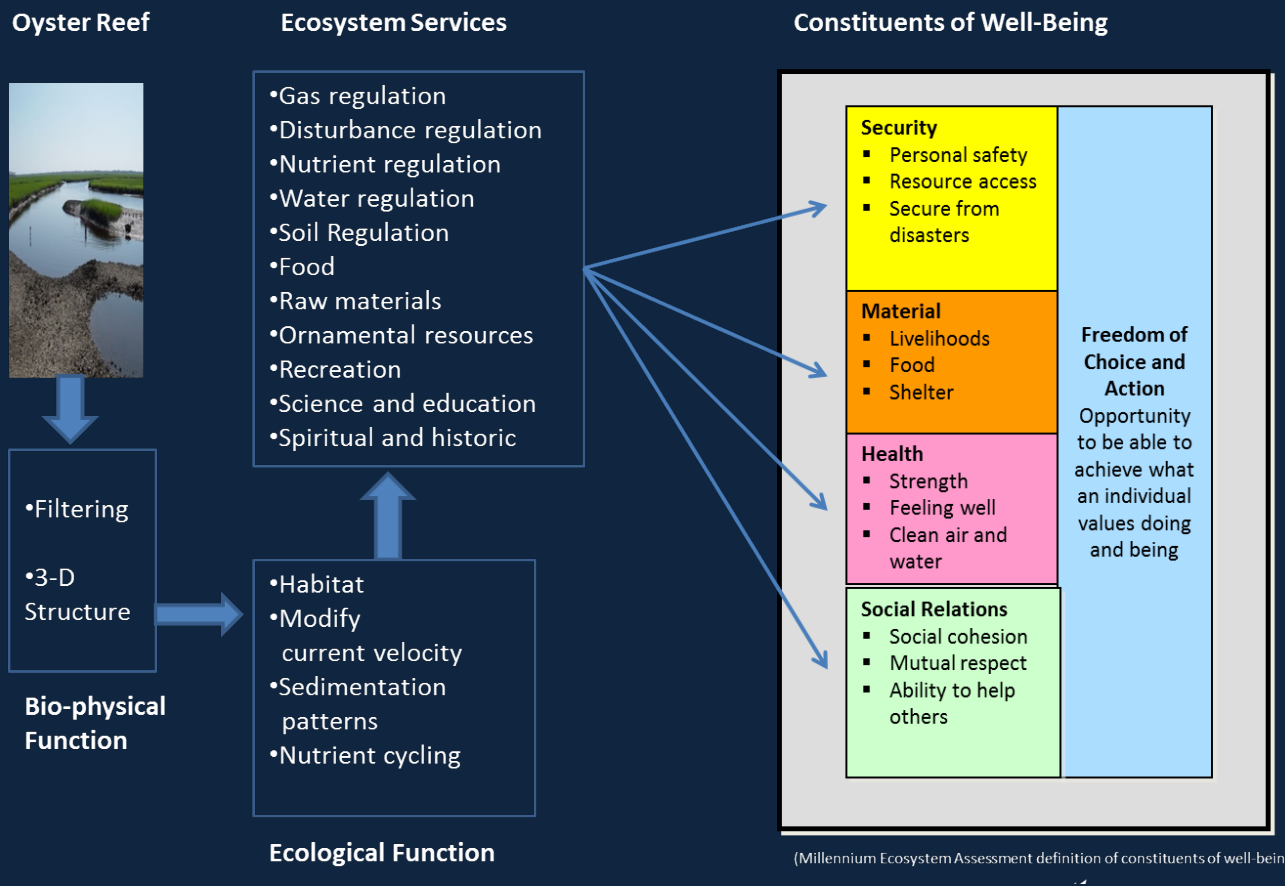
Evaluating Ecosystem Services for Natural and Nature Based Features

David Yoskowitz and Diana DelAngel

TEXAS A&M UNIVERSITY CORPUS CHRISTI | HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES

Ecosystem Services Assessment / Valuation

- Assessments may include valuations or not.
- Valuations might be monetary or non-monetary.



Ecosystem Services

"Ecosystem Services (ES) are the direct or indirect contributions from ecosystems that help *support*, *sustain*, and *enrich* human life" (Yoskowitz, et al. 2010).

DIRECT-USE VALUES

- Cultural Services
- Provisioning Services
- Regulating Services
- Supportive Services

PASSIVE-USE VALUES

- Existence
- Bequest
- Option

ECOSYSTEM SERVICES

USE VALUES	
Supportive Services	**Regulating Services**
Nutrient Cycling	Gas Regulation
Net Primary Production	Climate Regulation
Pollination and Seed Dispersal	Disturbance Regulation
Habitat	Biological Control/Regulation
Hydrological Cycle	Water Regulation
	Erosion Control/Soil Retention
	Waste Regulation
	Nutrient Regulation
Provisioning Services	**Cultural Services**
Water Supply	Recreation
Food	Aesthetics
Raw Materials	Science and Education
Genetic Resources	Cultural, Spiritual and Historic
Medicinal Resources	
Ornamental Resources	
PASSIVE-USE VALUES	
Bequest, Existence, Option	

Source: Farber et al., 2006

Priorities in ES Assessment from previous polling of the MTAG

- Nutrient Cycling
- Food
- Aesthetic/Existence Value
- Water Regulation
- Gas Regulation

Priorities in ES Assessment from previous polling of the MTAG

- Nutrient ~~Cycling~~ removal/scrubbing/uptake
- Food (crabs, shrimp, fish,...)
- Aesthetic/Existence
- Water ~~Regulation~~ movement
- ~~Gas Regulation~~ Carbon sequestration

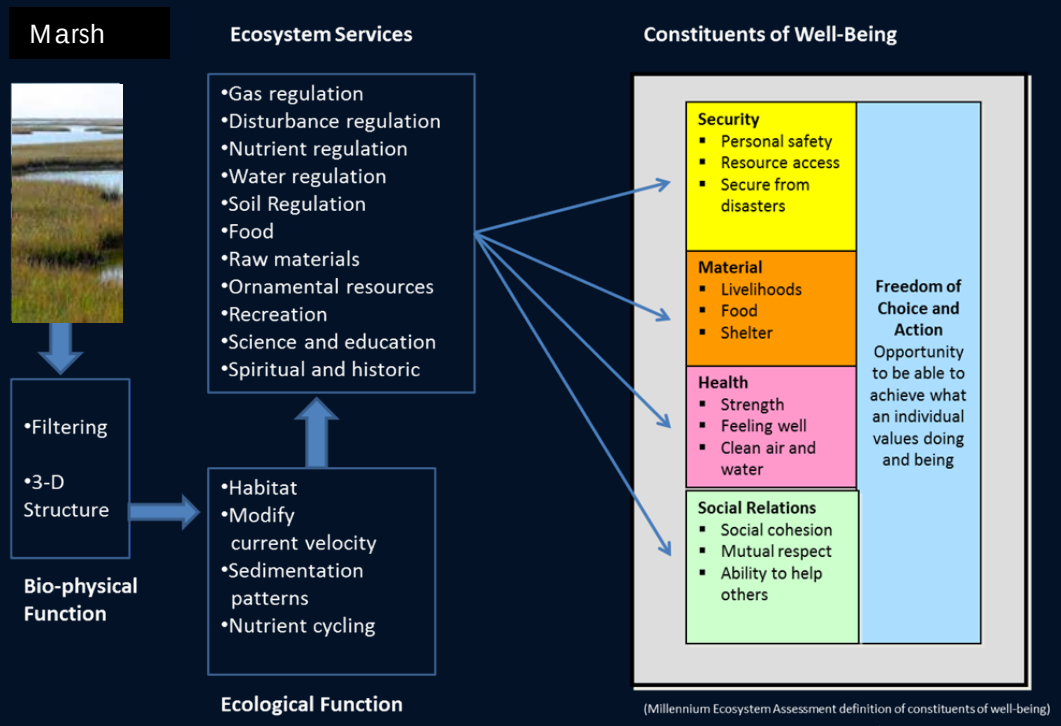
Protection Value of NBBF's

- Attenuates and/or dissipates waves and buffers wind. Provides sediment stabilization

This will be valued in the economic impact analysis

At the end of the day what is the benefit that we are interested in?

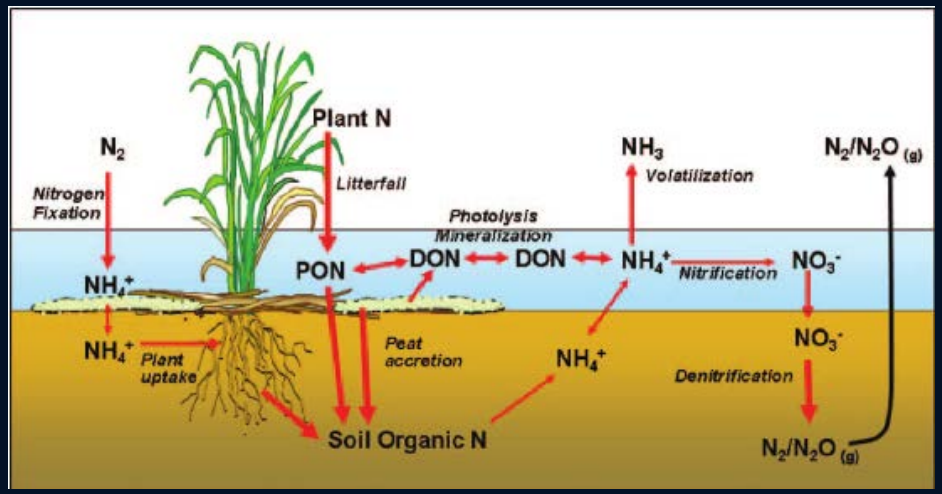
The benefits that humans receive!



Connected back to ecosystem structure, function and processes.

Nutrient scrubbing/removal/uptake

- Provides nutrient and pollution uptake and retention. Particle deposition



Schematic diagram of nitrogen cycle processes in wetland systems. From Reddy and DeLaune (2008).

Potential indicators & proxies

- Net primary production
- N & P Mineralization
- Cover of N-fixing plants

Food

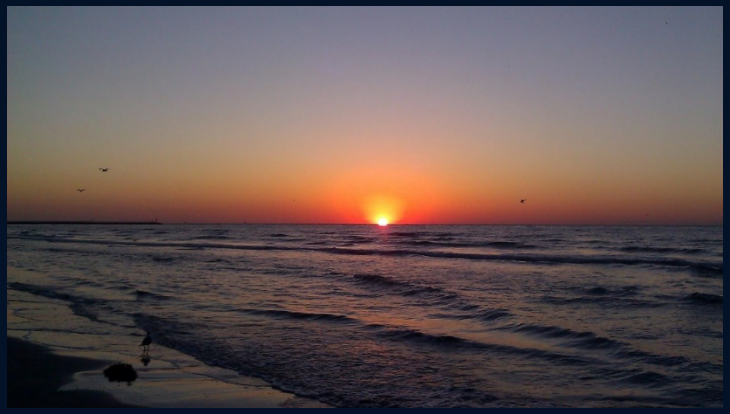
- General biological productivity for human consumption

Potential indicators & proxies

- Yield of crops
- Livestock biomass
- Harvest of species
- Stock of species
- Gross profit of fisheries

Aesthetics and Existence Value

- Provides a unique and aesthetic landscape for cultural, historic, or spiritual value



Potential indicators & proxies

- Visitor opinions
- Number of areas of importance or protection status

Water movement

- Water flow across the landscape that affects bio-geo-physical structure function and processes.

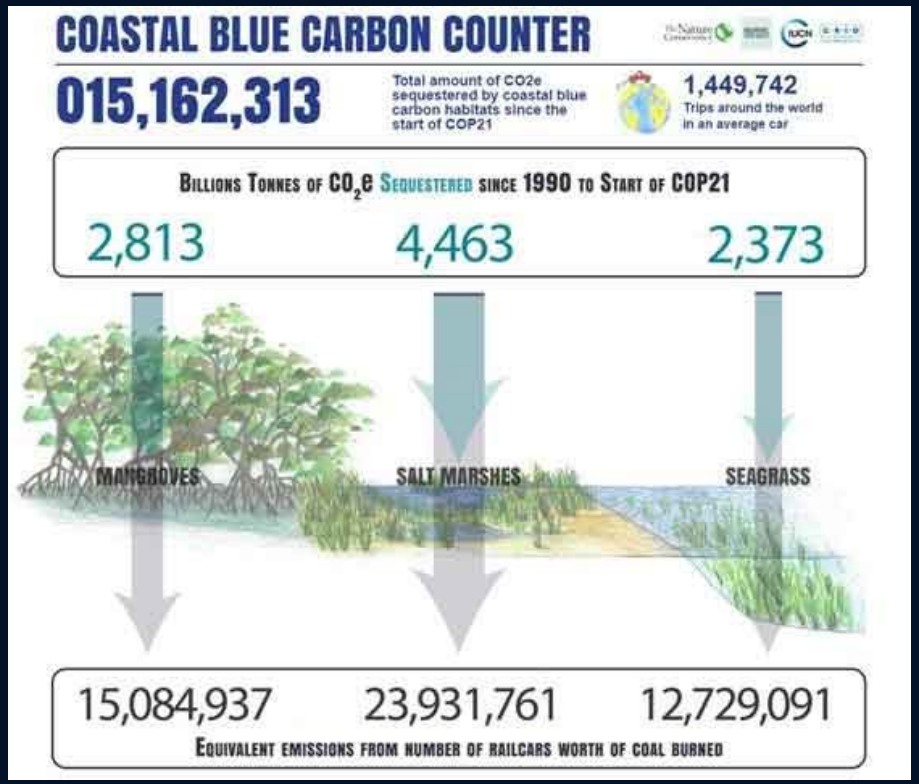
Annie Lockhart

Potential indicators & proxies

- Degree of hydrologic connectivity
- % cover of fragmented marsh
- Salinity

Carbon Sequestration

- Ecosystem structure and function that generates biogeochemical activity.



Grid-Arendal blue carbon counter

Potential indicators & proxies

- Tons of carbon stored
- Social cost of carbon

Recreation

- Provides a opportunity for recreational activities

Potential indicators & proxies

- Recreational opportunities
- Tourism sector profit
- Number of visitors or visits
- Number of recreational areas/ amenities

Thank you!

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seg-hri@tamucc.edu

ES valuation vs ES assessment

- Goal: Quantify change in ES due to SLR induced habitat change and use of NNBF's.
- Measures of Value

Ecosystem services

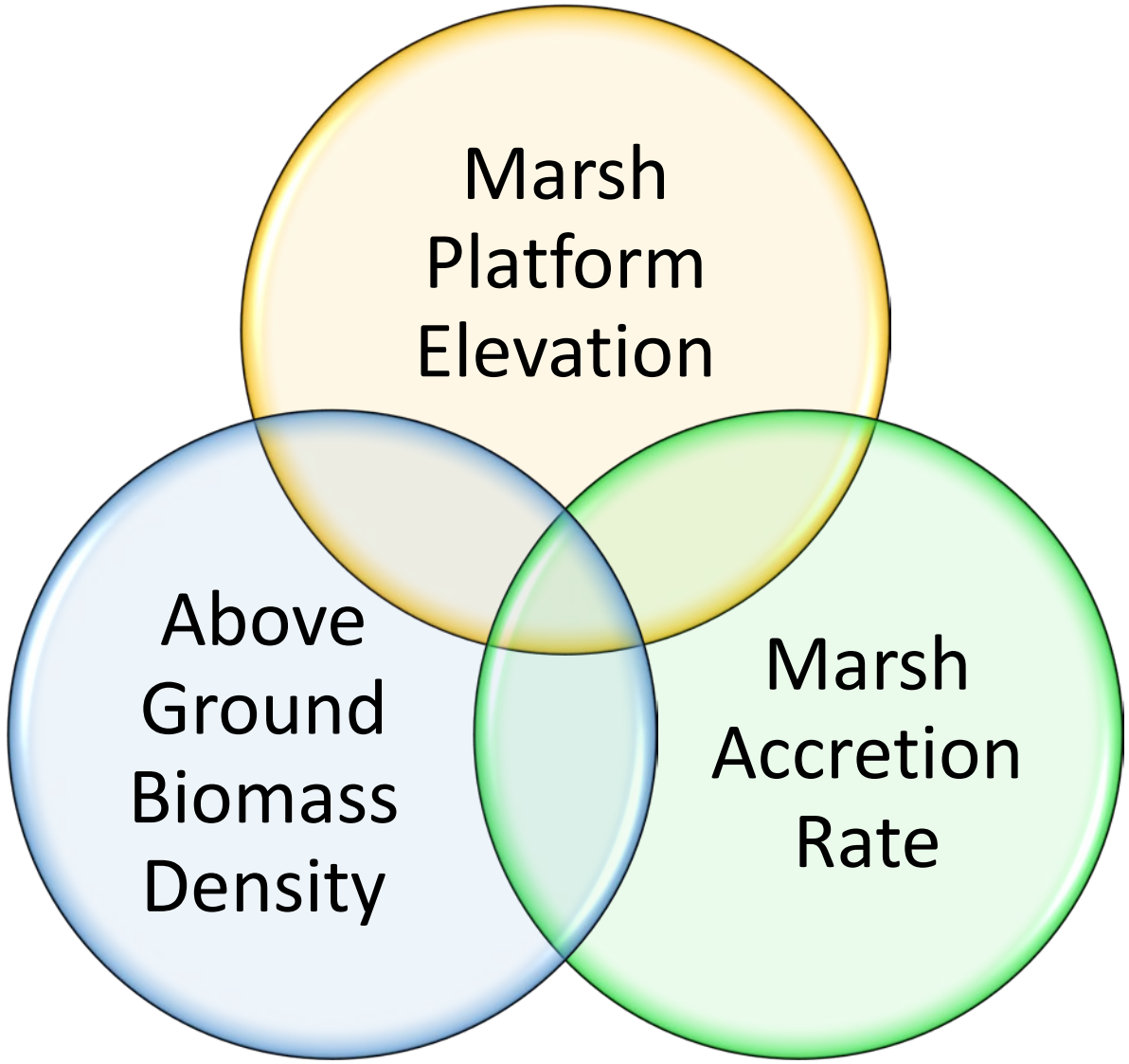
UCF | College of Engineering and Computer Science

Data Collection in Support of NGOM-N2E2 Modeling

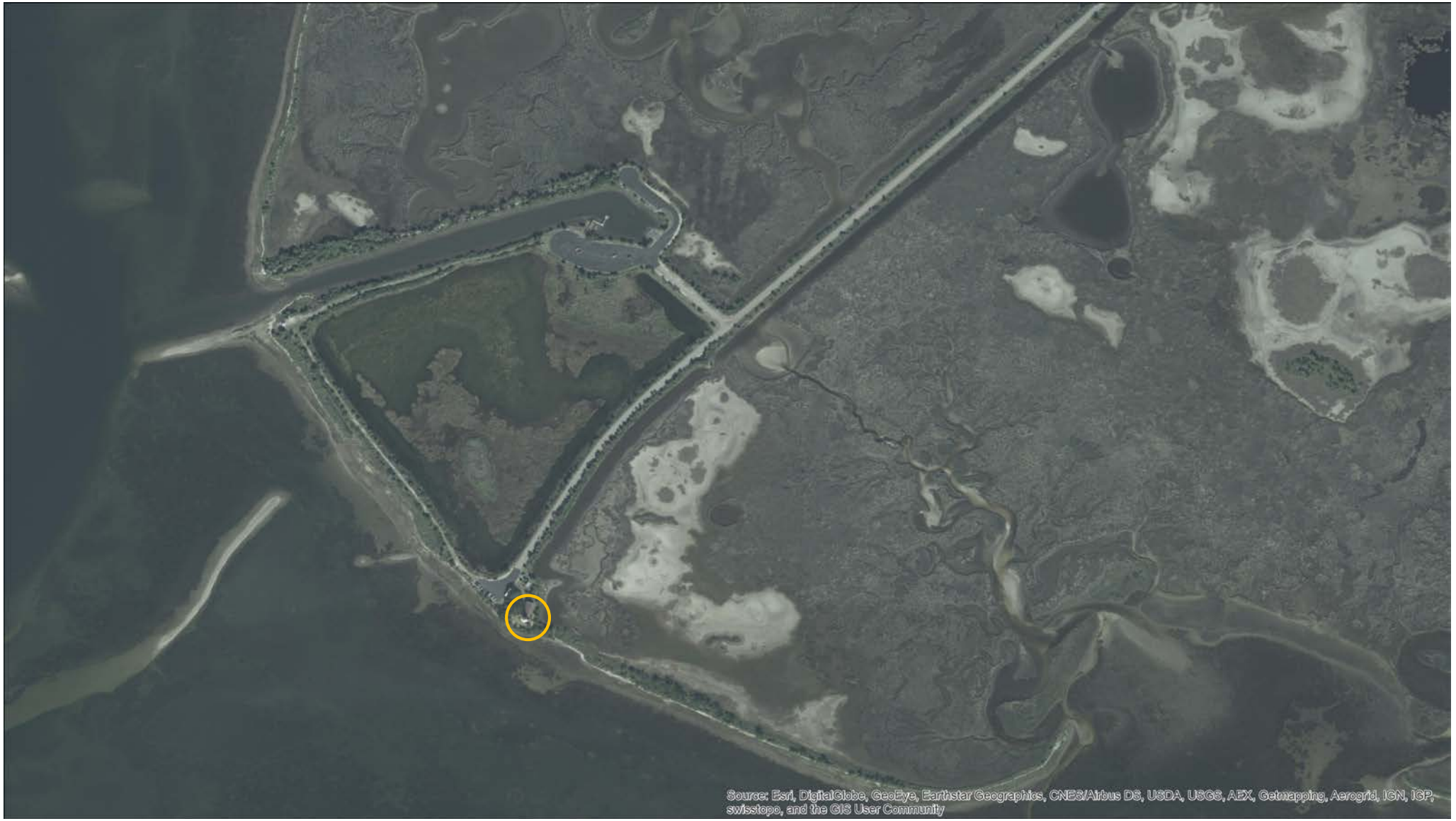
Apalachee Bay, FL & Pascagoula, MS

Stephen C. Medeiros & Khalid Abdelwahab
University of Central Florida
Civil, Environmental & Construction Engineering
Stephen.Medeiros@ucf.edu

Data Collection Objectives



Data Collection – Apalachee Bay



RTK GNSS Topographic Elevations

AGBM 25 cm Quadrat





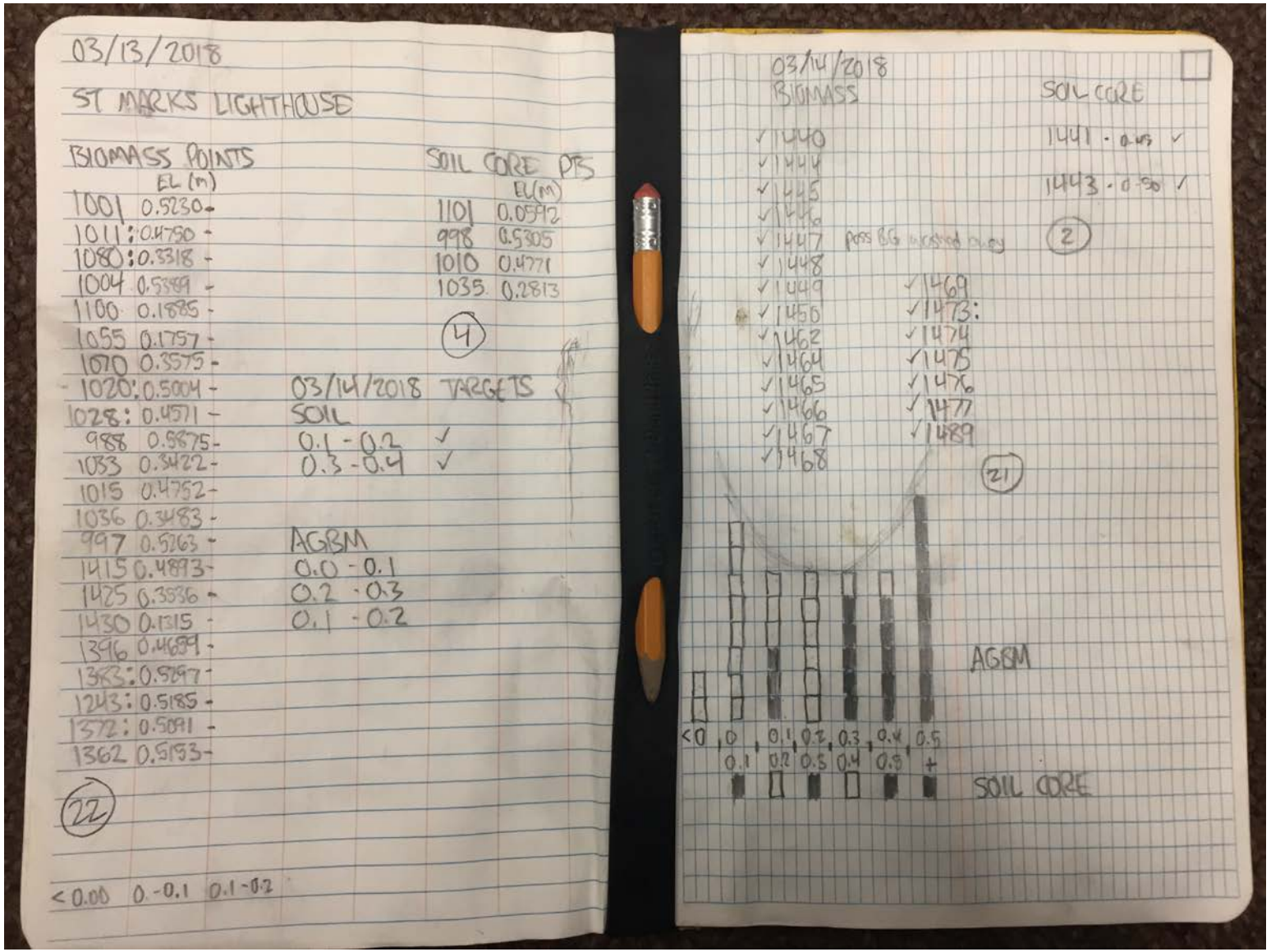

50 cm x 4 in Soil Core



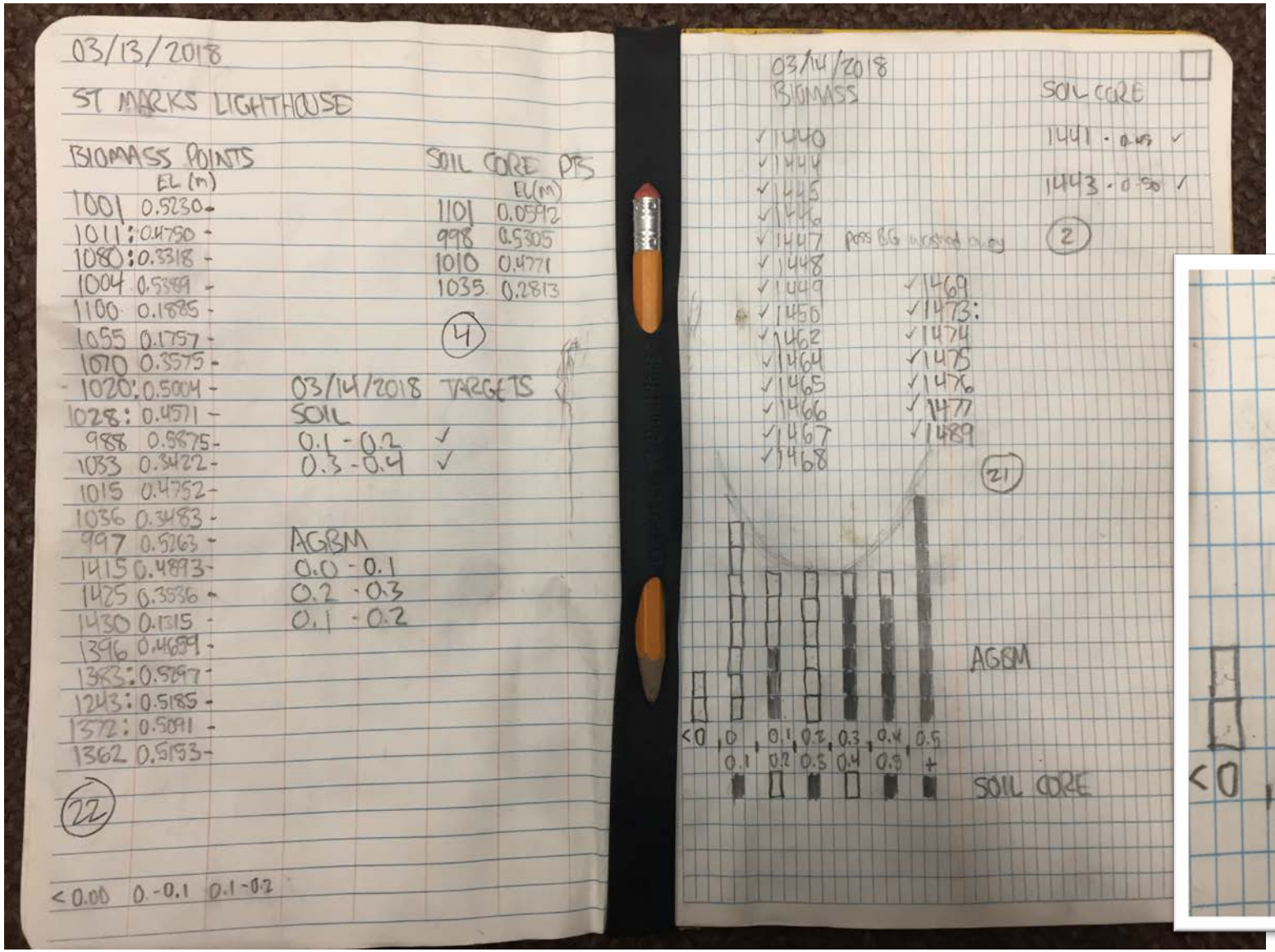


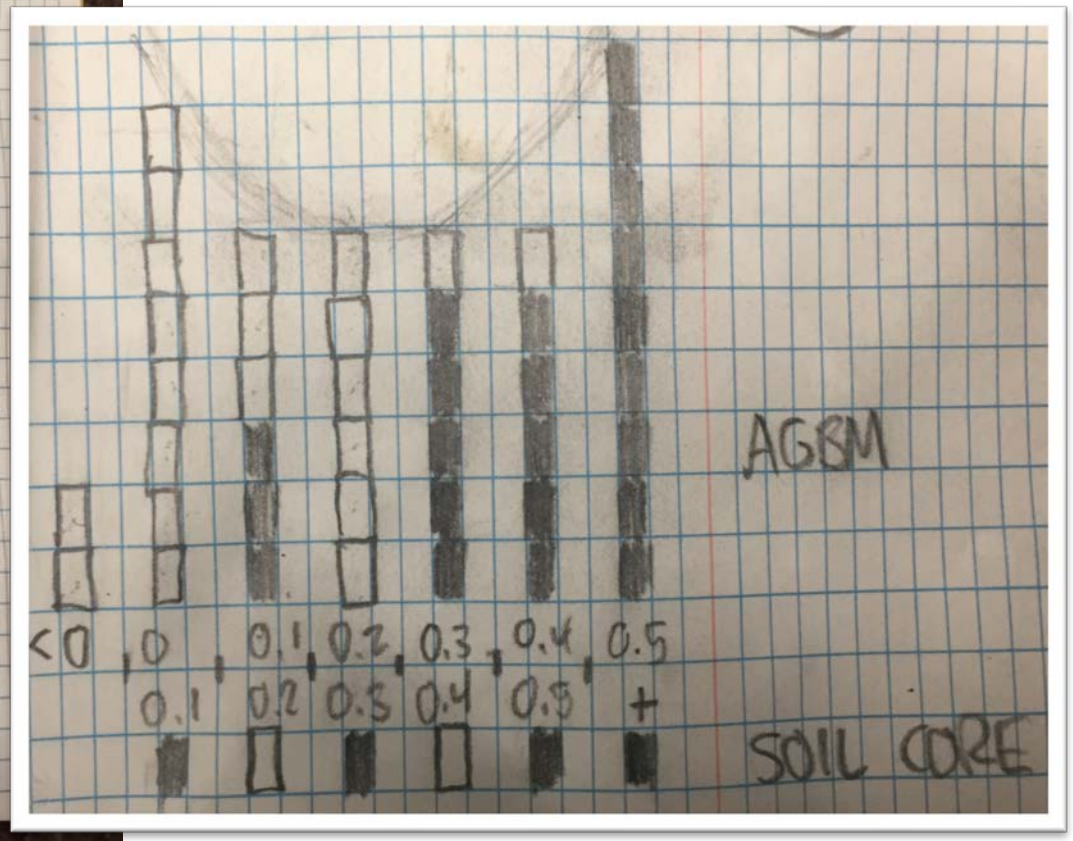

Preliminary Results – Apalachee Bay

Preliminary Results - Apalachee Bay

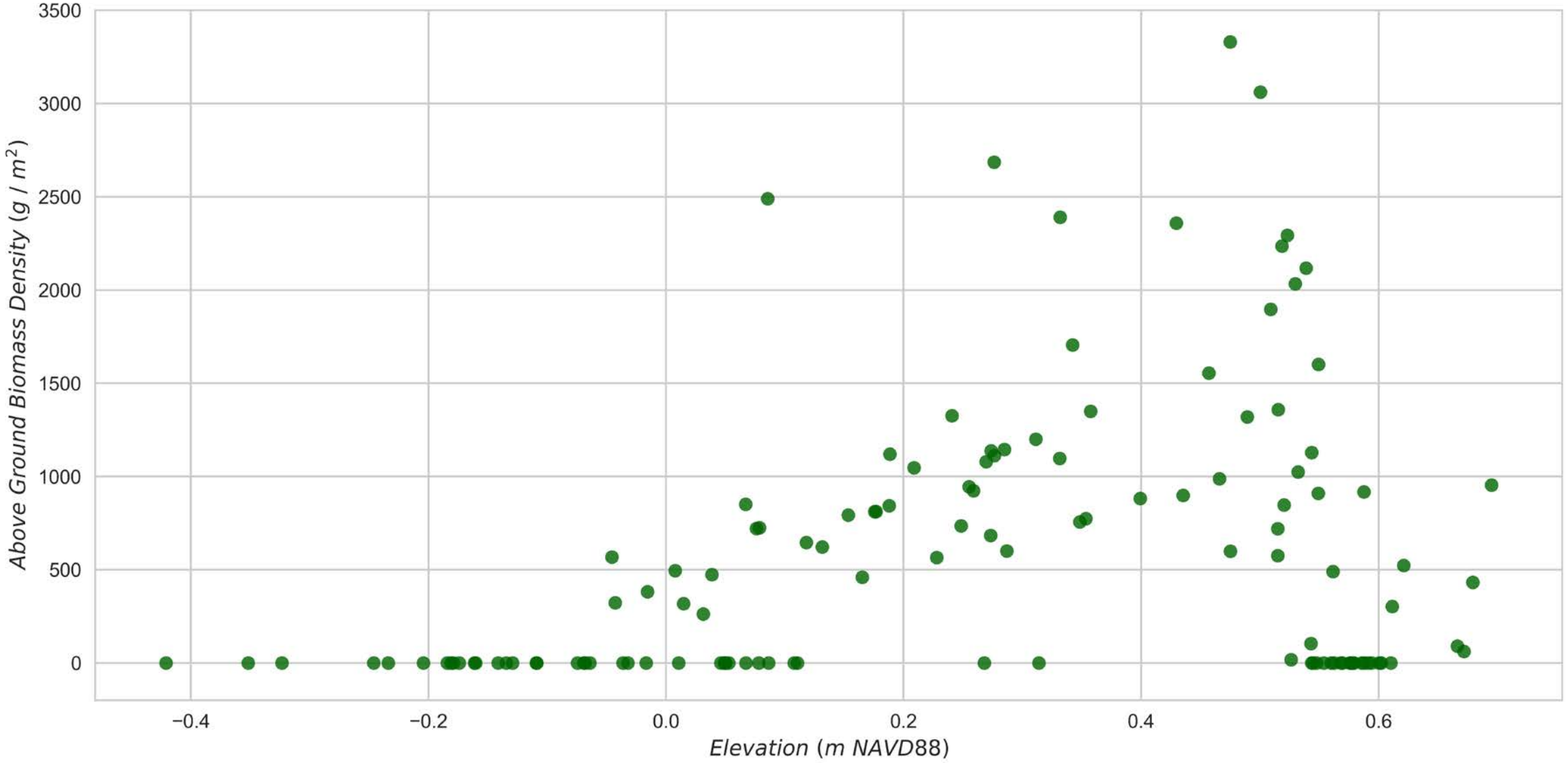


Preliminary Results - Apalachee Bay





Preliminary Results - Apalachee Bay



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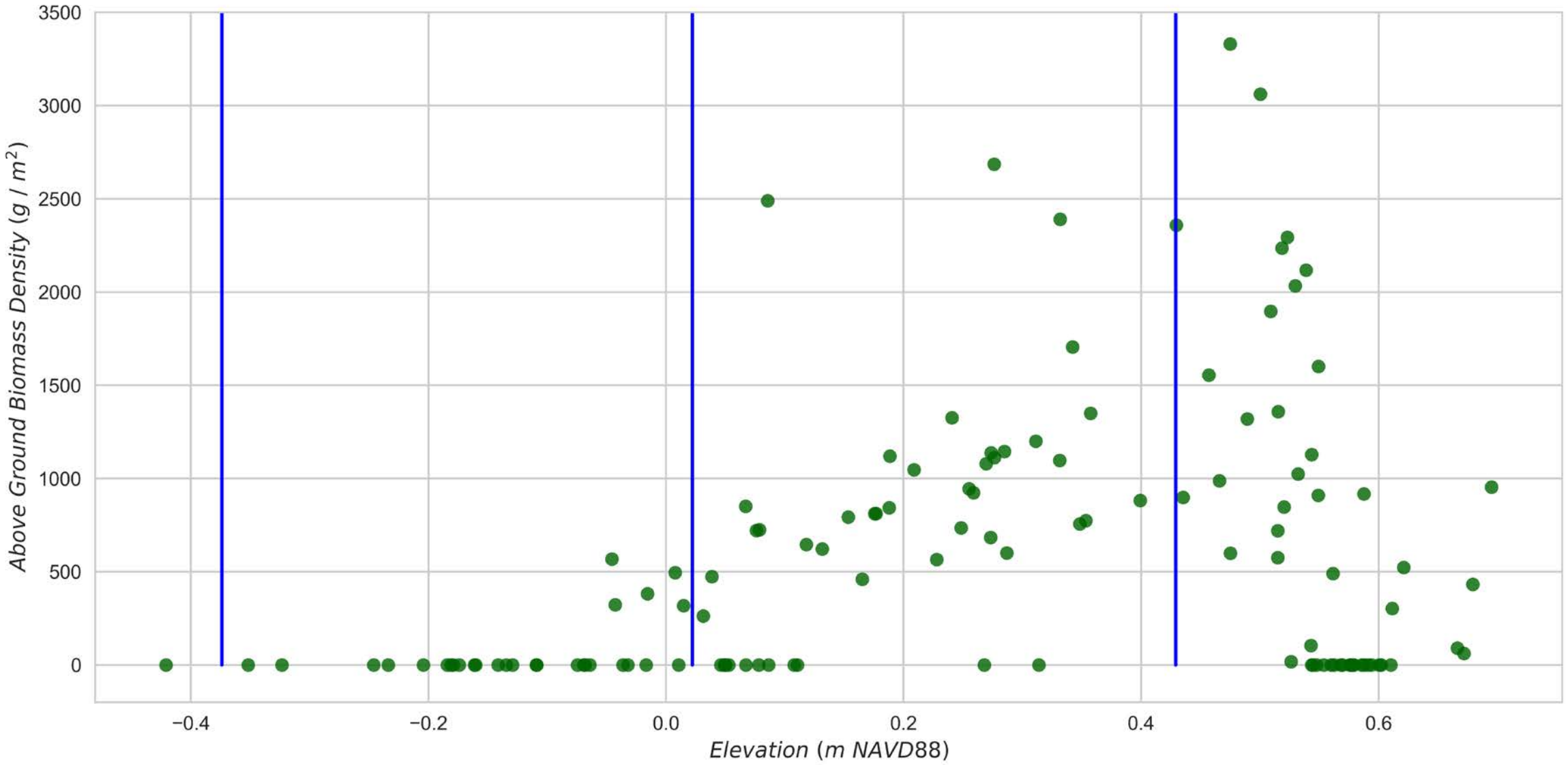
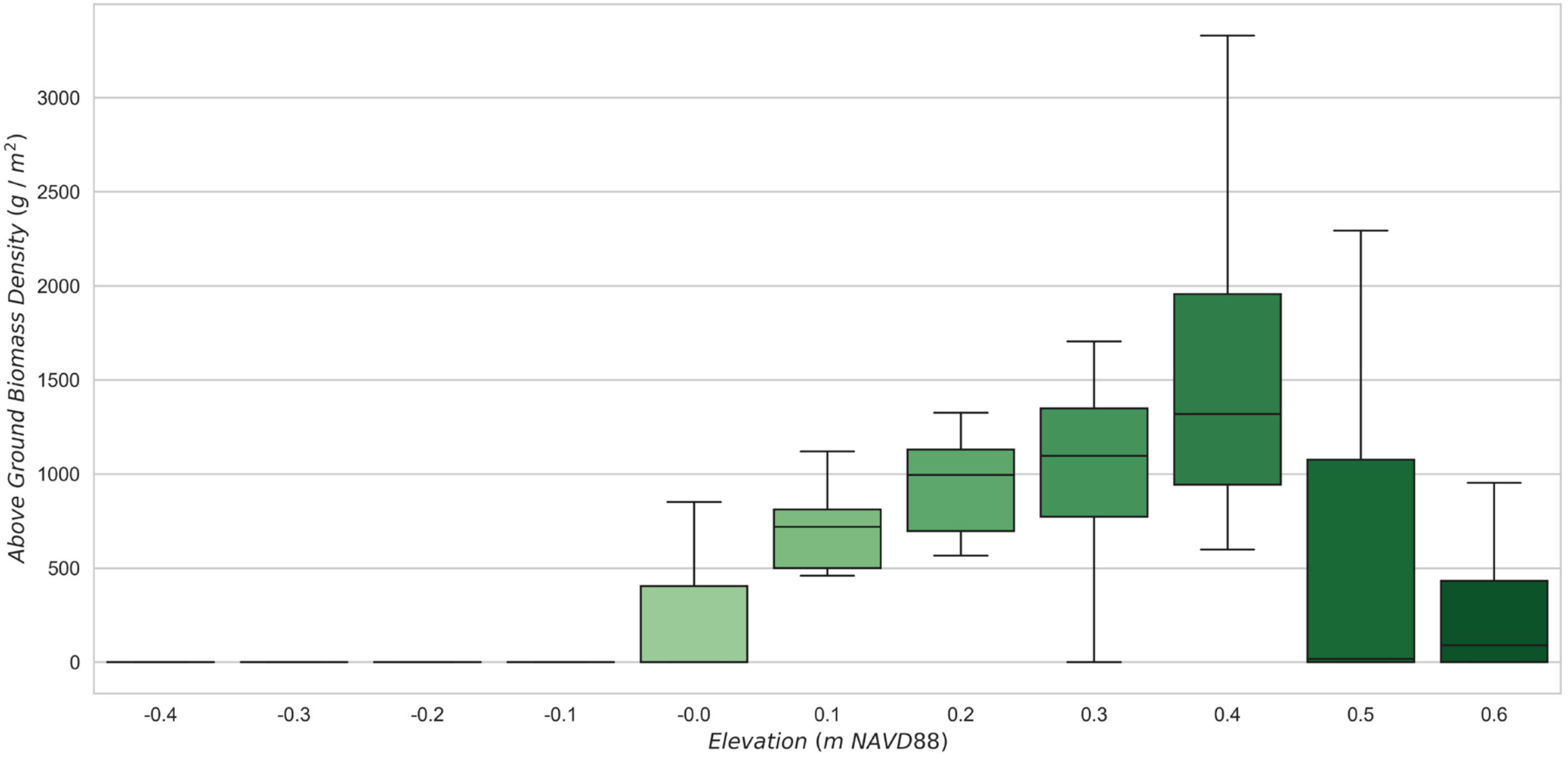
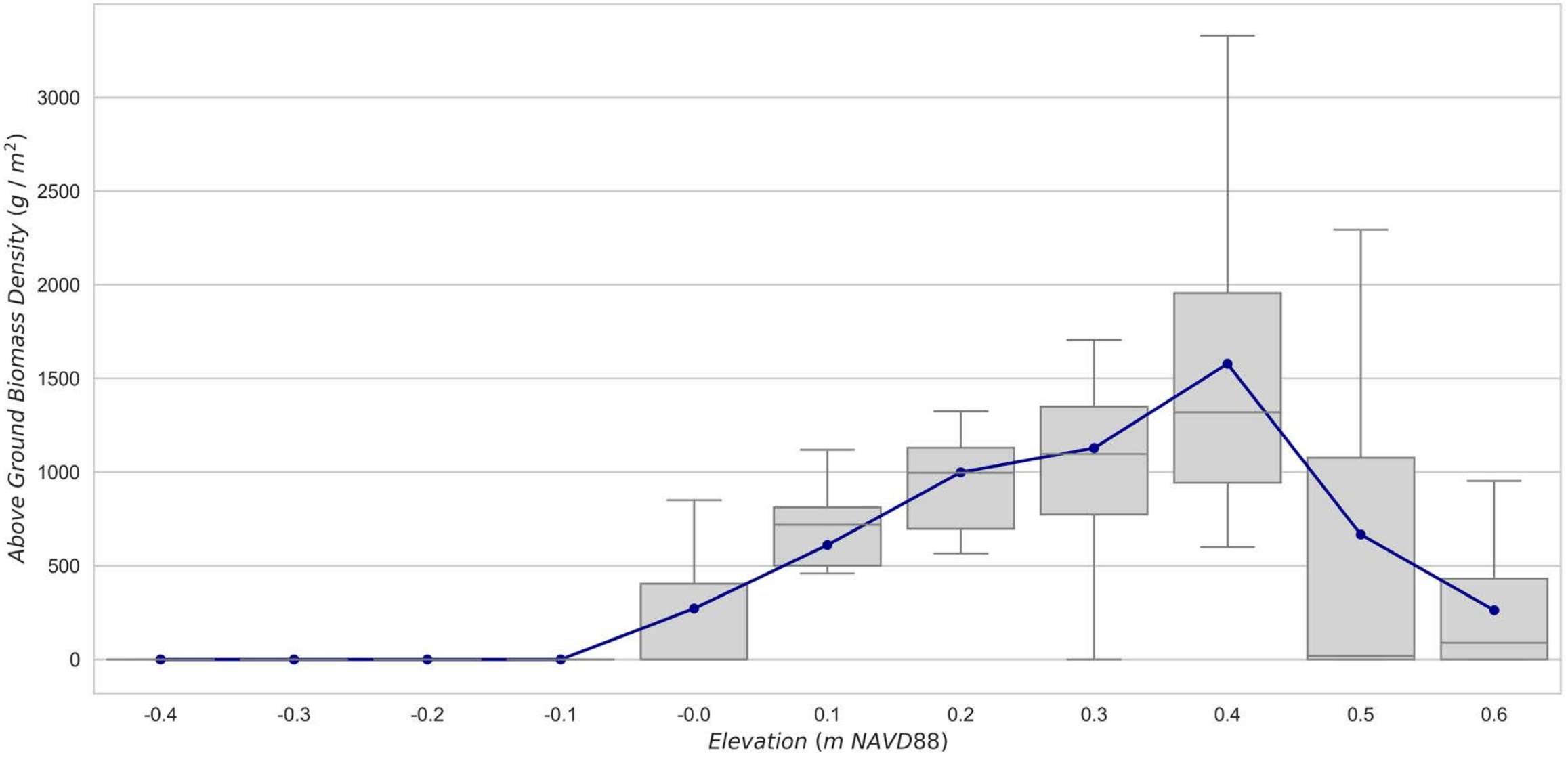


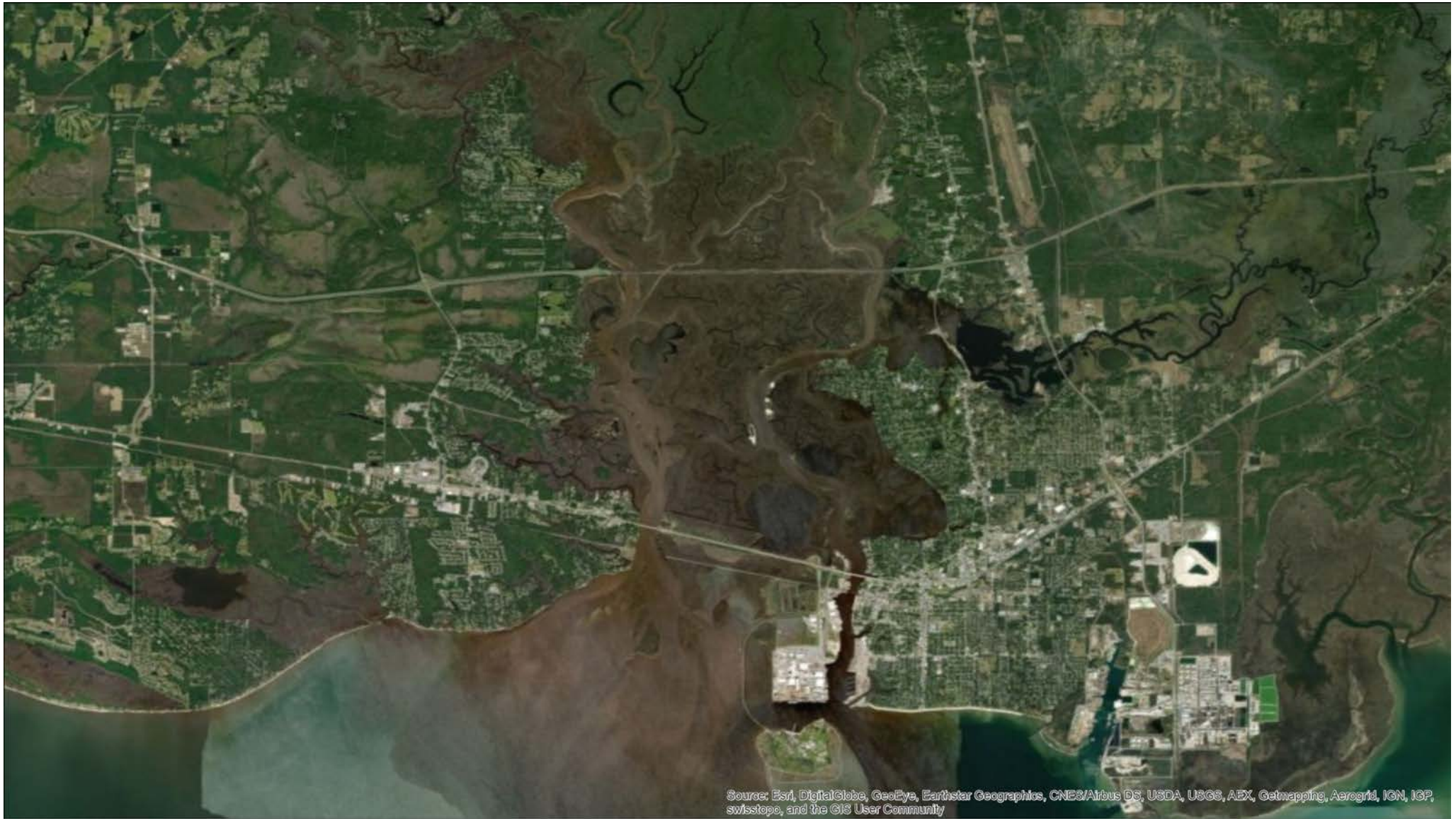
Preliminary Results - Apalachee Bay



Preliminary Results - Apalachee Bay



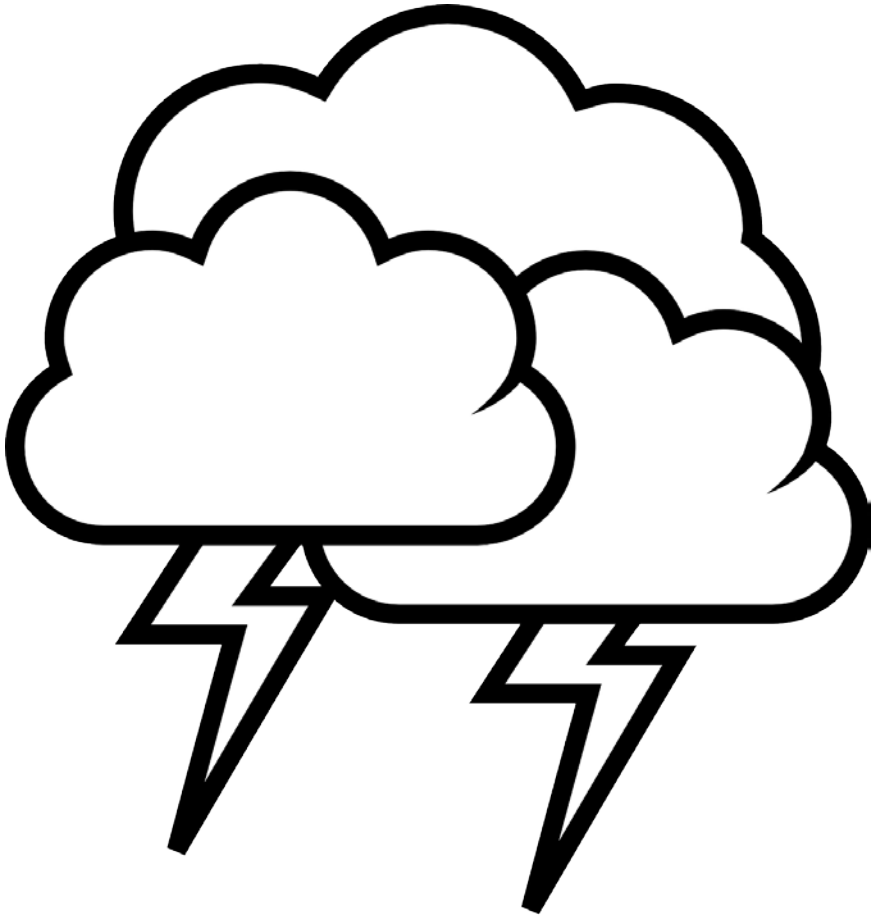
Preliminary Plan - Pascagoula, MS



Preliminary Plan - Pascagoula, MS

Preliminary Plan - Pascagoula, MS

Acknowledgements



Acknowledgements

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Crawfordville, FL 32327
(850) 926-2995
http://www.ams-florida.com/

Acknowledgements

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Jim Morris, USC
Terry Peacock, USFWS - St. Marks NWR
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David Newcomer, FL NGS Rep (Retired)
Karim Alizad, LSU
Maddie Martinez, LSU
Ryan Lauve, LSU
Katherine Renken, USC
Gwen Miller, USC

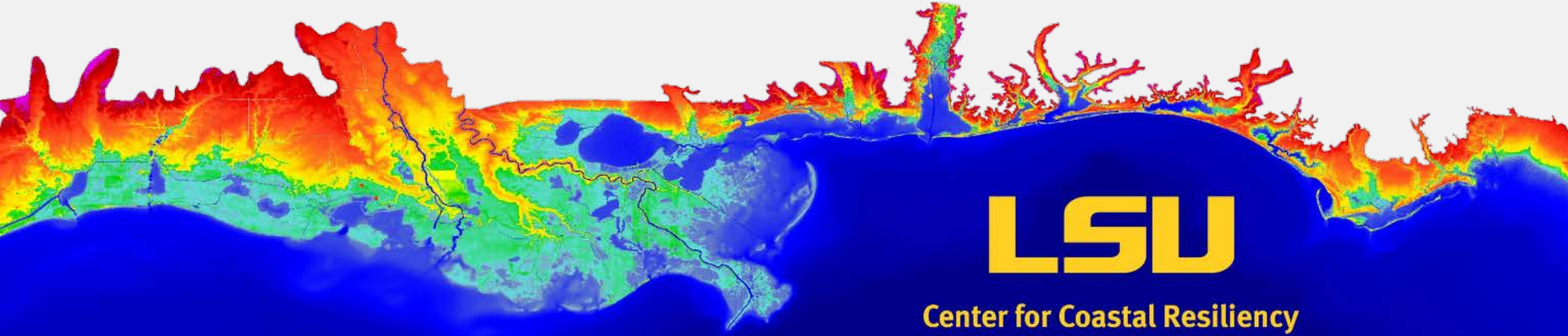
Nuisance Flooding in the northern Gulf Of Mexico

- Mobile Bay -

Matthew V. Bilskie

Center for Coastal Resiliency, Louisiana State University

NGOM+N2E2 - June 2018 MTAG Workshop – Grand Bay, MS



Introduction

- Sweet et al. flooding thresholds and sea level rise scenarios (SLR)
- Apply the Coastal Dynamics of Sea Level Rise (CDSLR) for nuisance flooding
- Examine Mobile Bay as case study (May 2017)
- Summary and Future Work

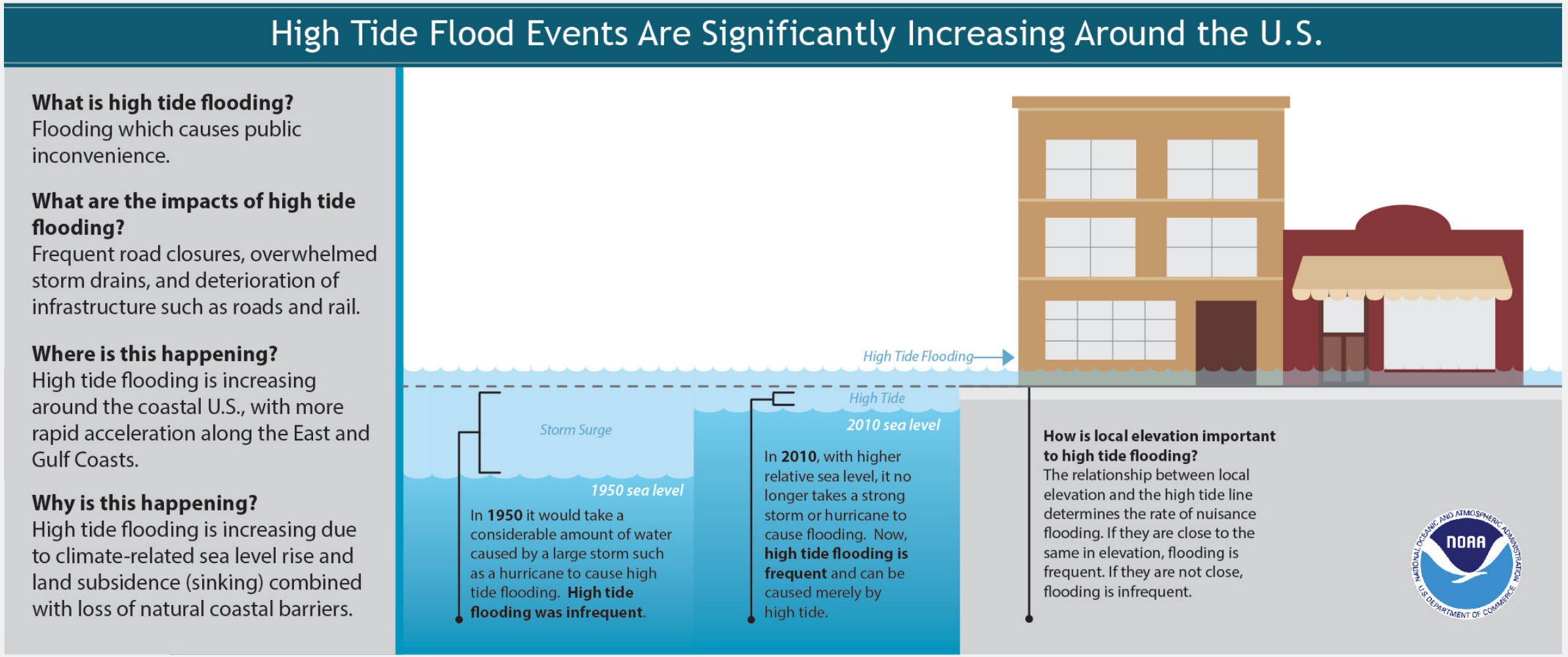
Sweet, W. V., R. E. Kopp, C. P. Weaver, J. Obeysekera, R. M. Horton, E. R. Thieler, and C. Zervas (2017), Global and Regional Sea Level Rise Scenarios for the United States, NOAA, Silver Spring, MD.

Sweet, W. V., G. Dusek, J. Obeysekera, and J. J. Marra (2018), Patterns and Projections of High Tide Flooding Along the US Coastline Using a Common Impact Threshold., NOAA, Silver Spring, MD.

Cartoon by Emily Greenhalgh
https://www.climate.gov

Nuisance ("Sunny Day") Flooding

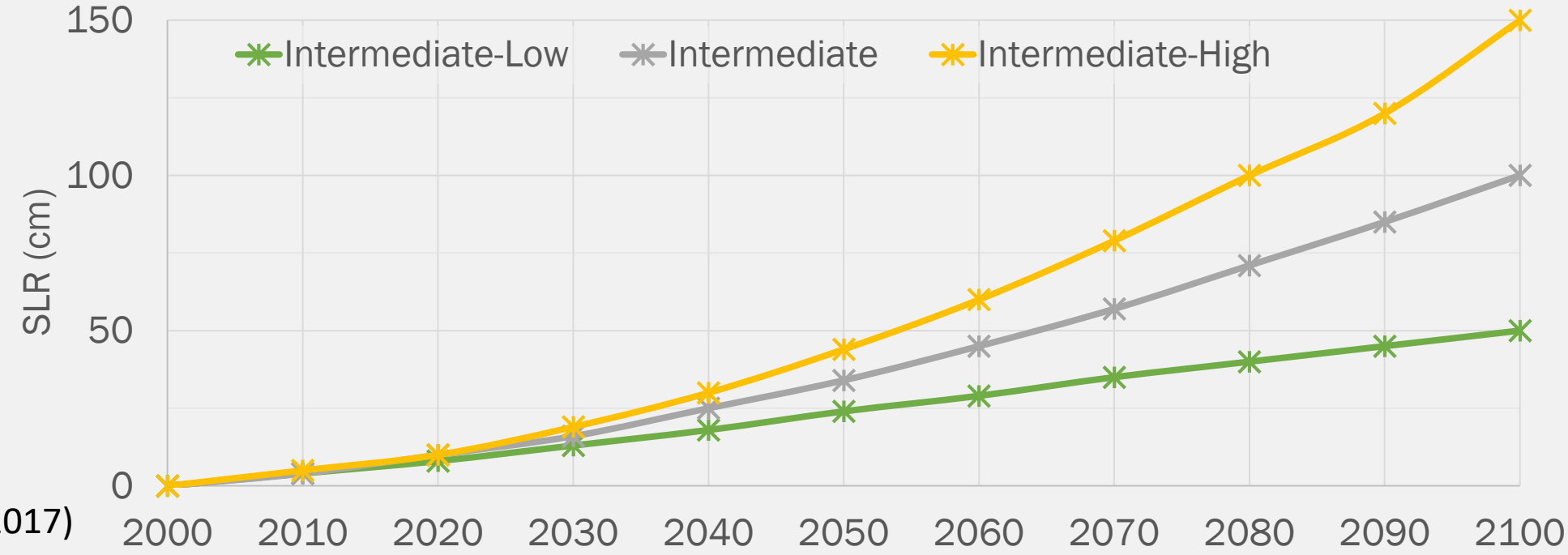
"Flooding that leads to public inconveniences such as road closures."



https://oceanservice.noaa.gov/facts/nuisance-flooding.html

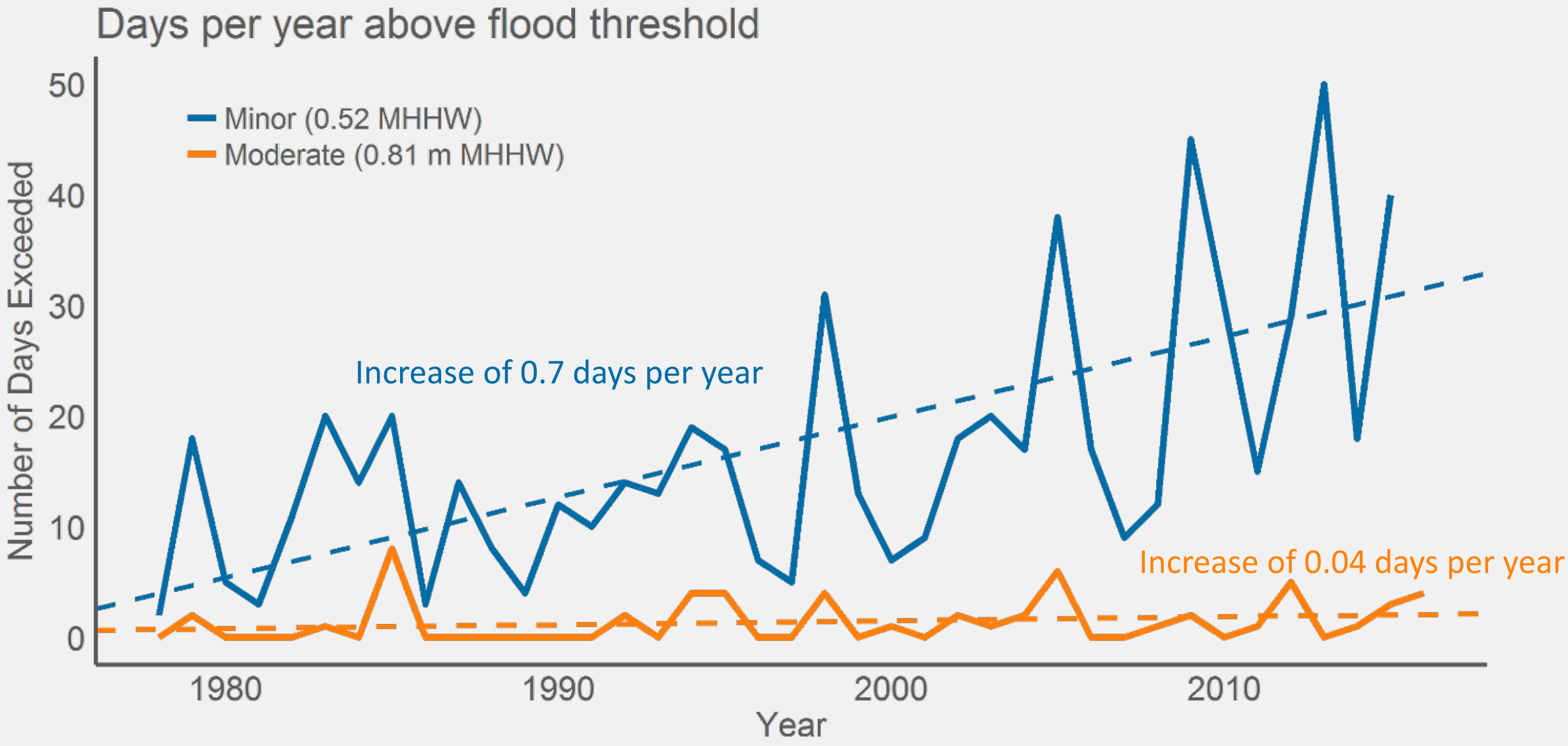
Sweet et al. (2018) Flood Threshold (m, MHHW)

Station Name	Minor	Moderate	Major
Apalachicola, FL	0.52	0.81	1.19
Panama City Beach, FL	0.52	0.81	1.19
Dauphin Island, AL	0.51	0.81	1.18

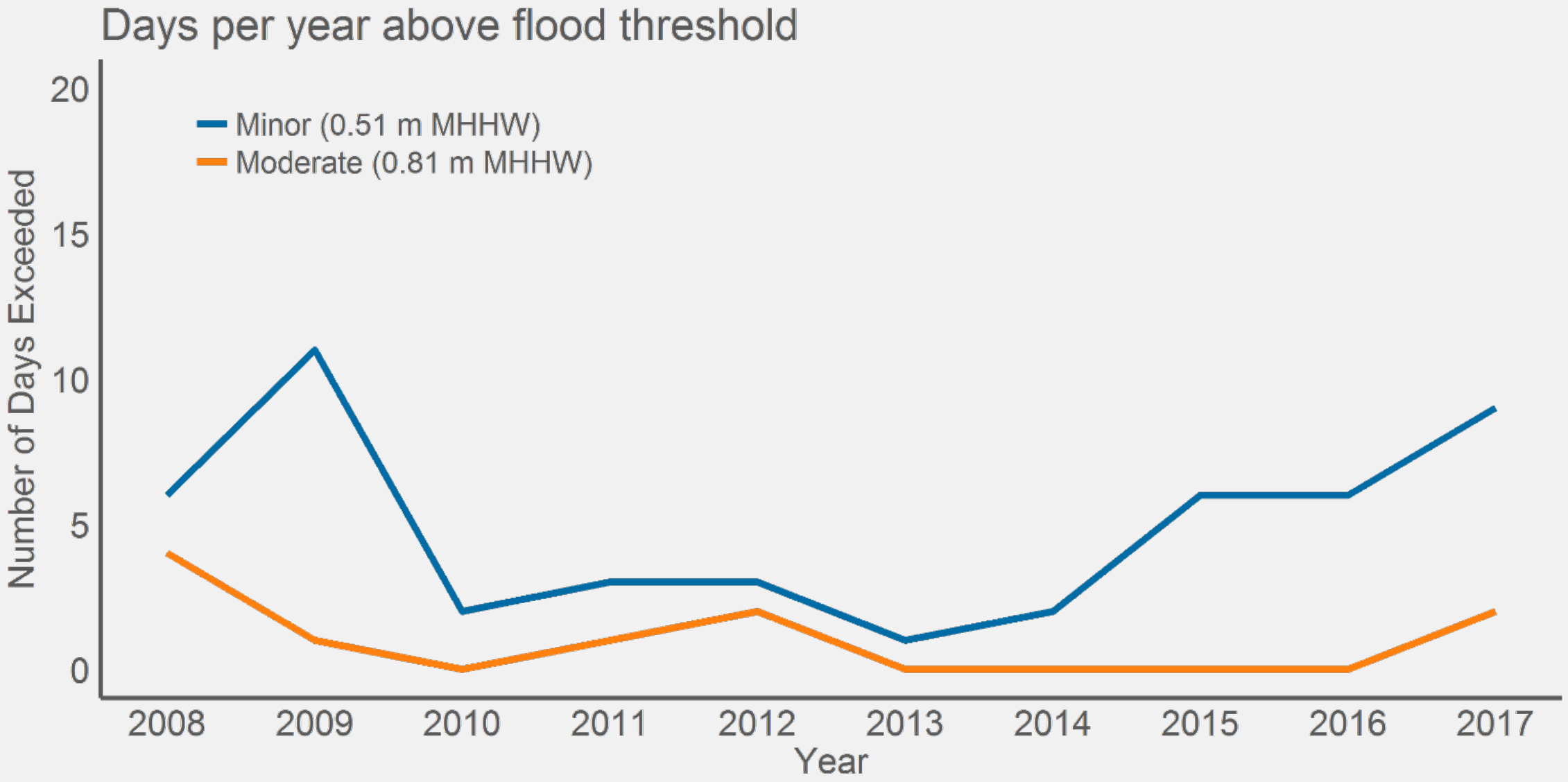


Sweet et al. (2017)

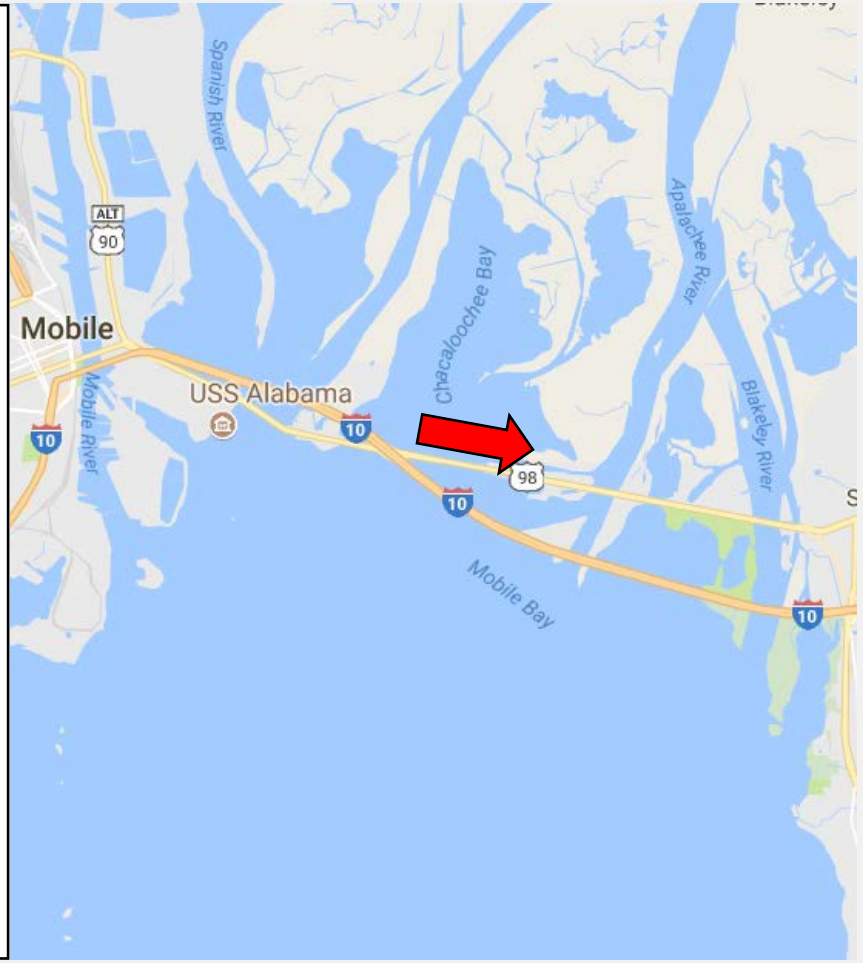
Nuisance Flooding – Apalachicola, FL



Nuisance Flooding – Mobile, AL

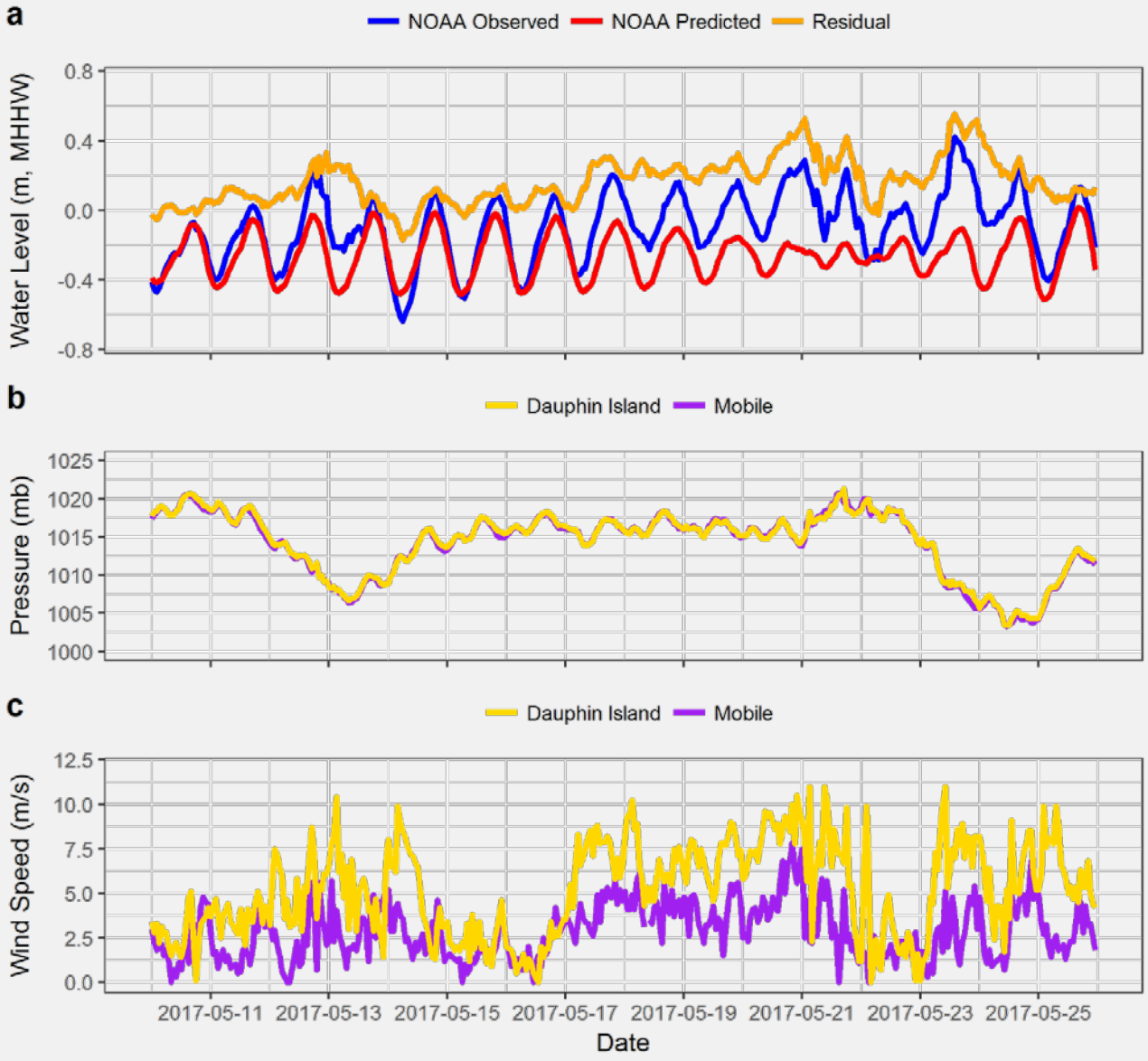


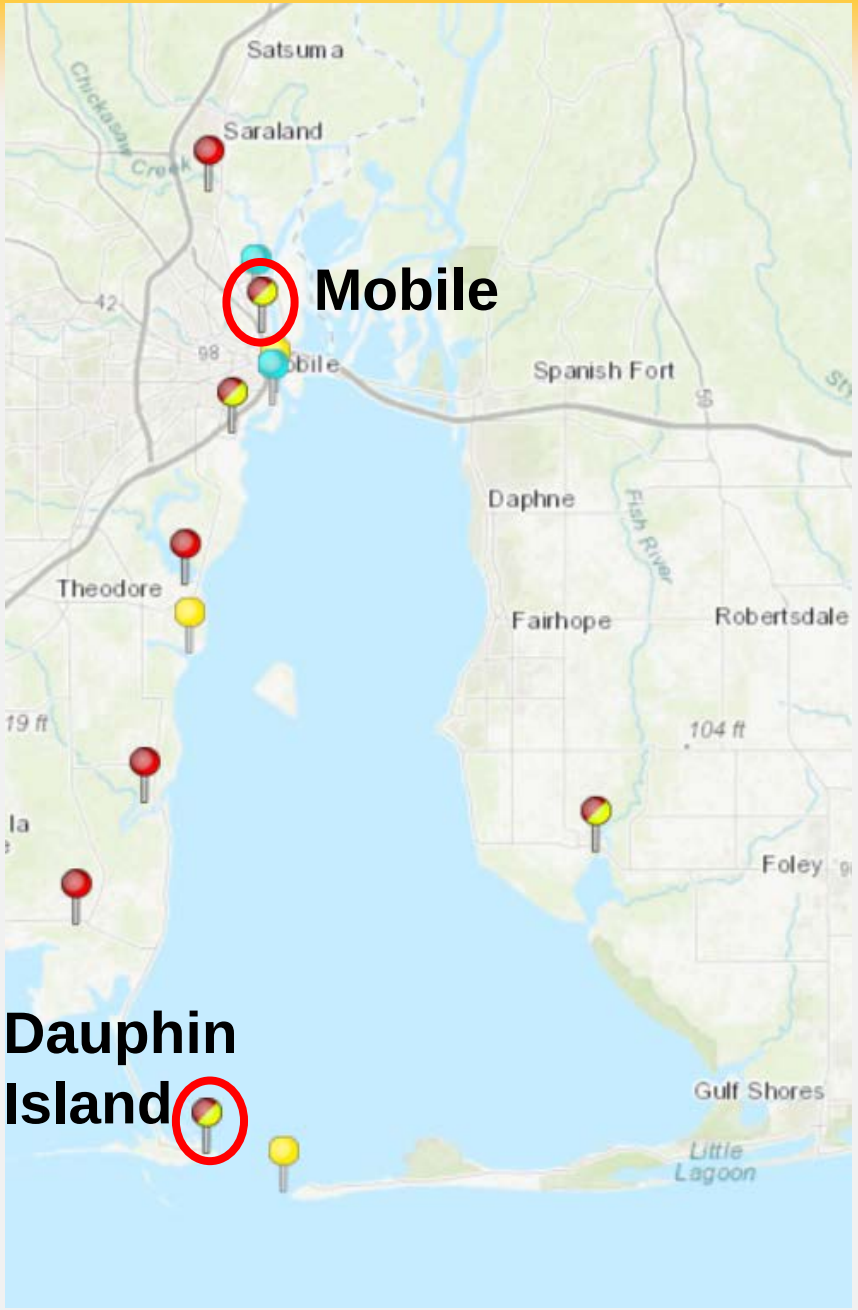
Nuisance Flooding - Mobile Bay on May 23



Video Courtesy of the Hank Hodde with Smart Home America.

Mobile Bay – Observed Data





ADCIRC Hydrodynamic Model

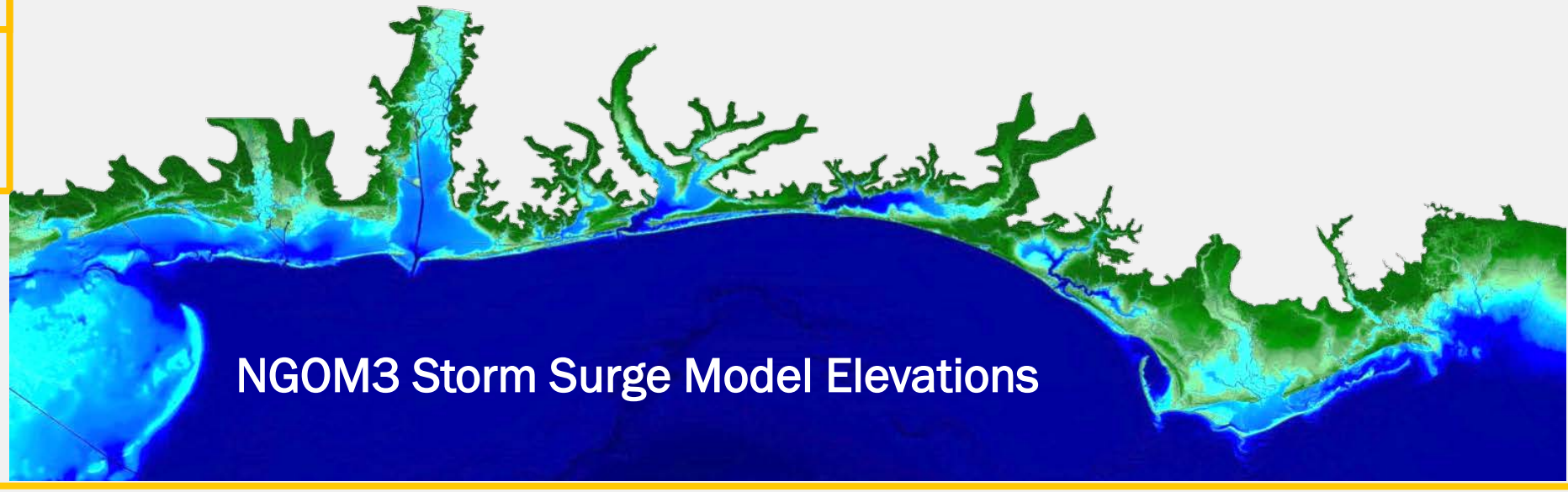
INPUTS

- ADCIRC MESH
- SURFACE ROUGHNESS
- TIDES
- WINDS

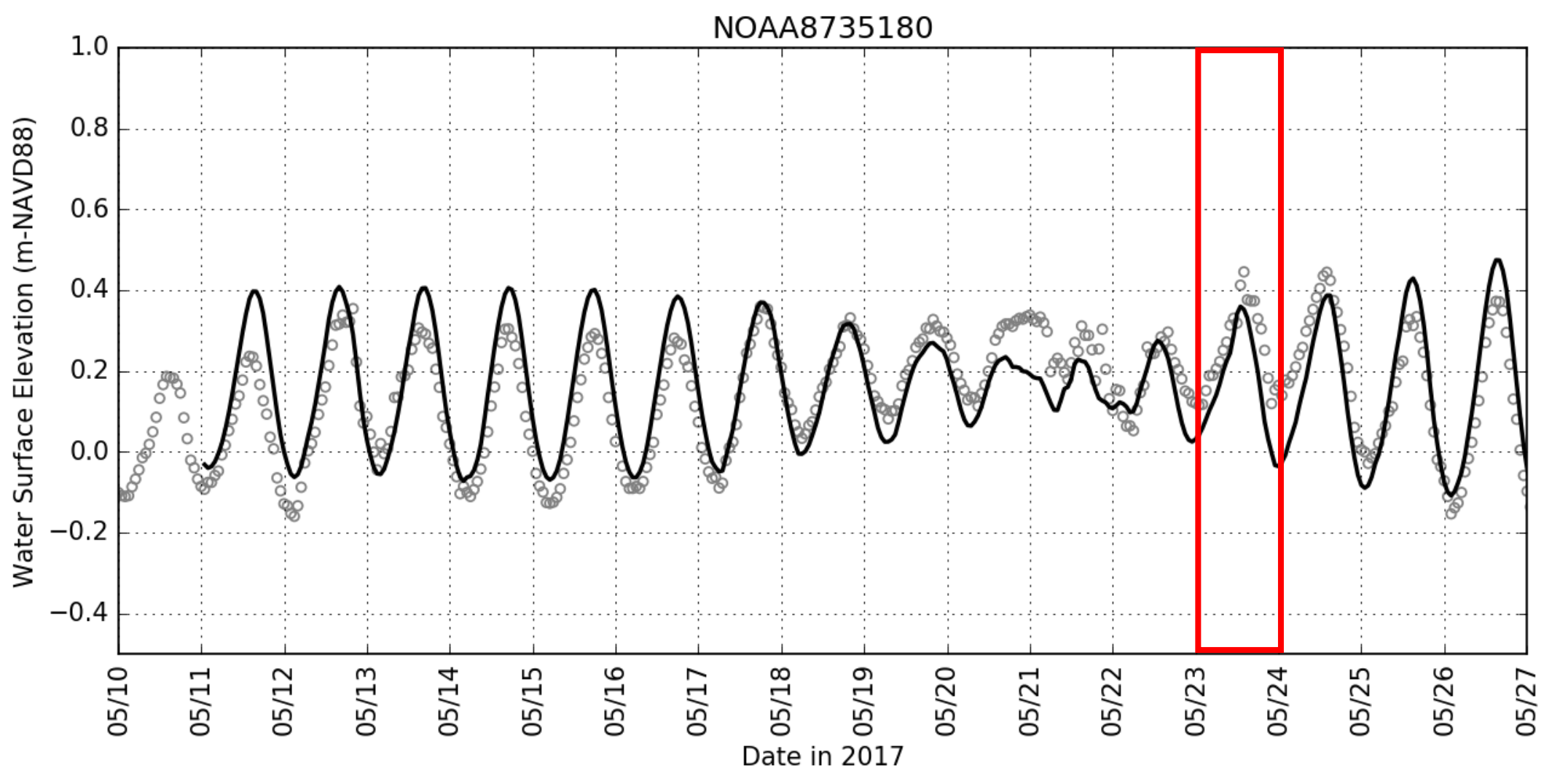
ADCIRC – Long Waves

OUTPUTS

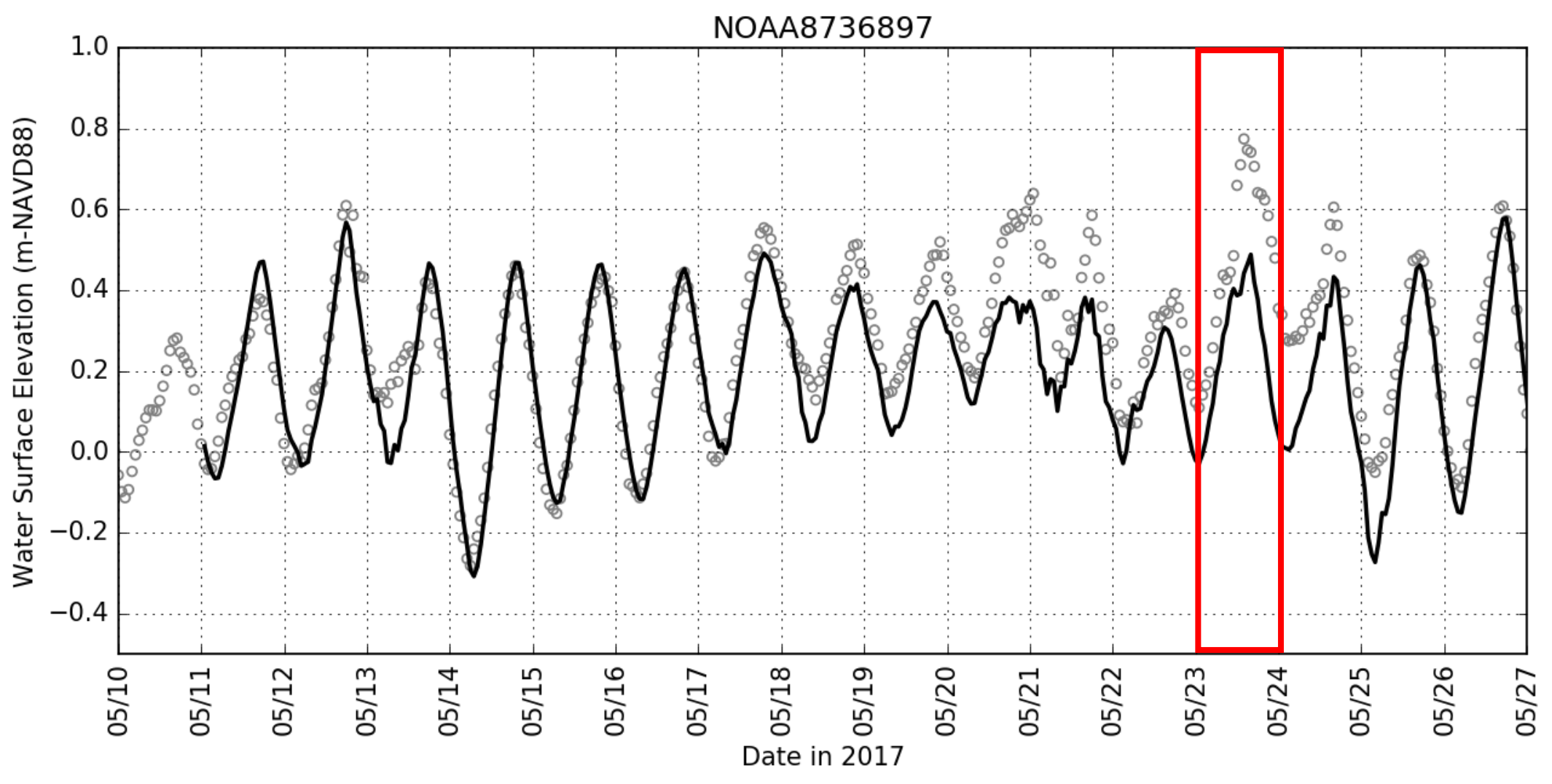
- WATER LEVEL
- CURRENT VELOCITIES
- WAVE RADIATION STRESSES
- WIND SPEEDS
- PEAK WAVE PERIODS
- MEAN WAVE PERIODS
- MEAN WAVE DIRECTIONS
- SIGNIFICANT WAVE HEIGHTS



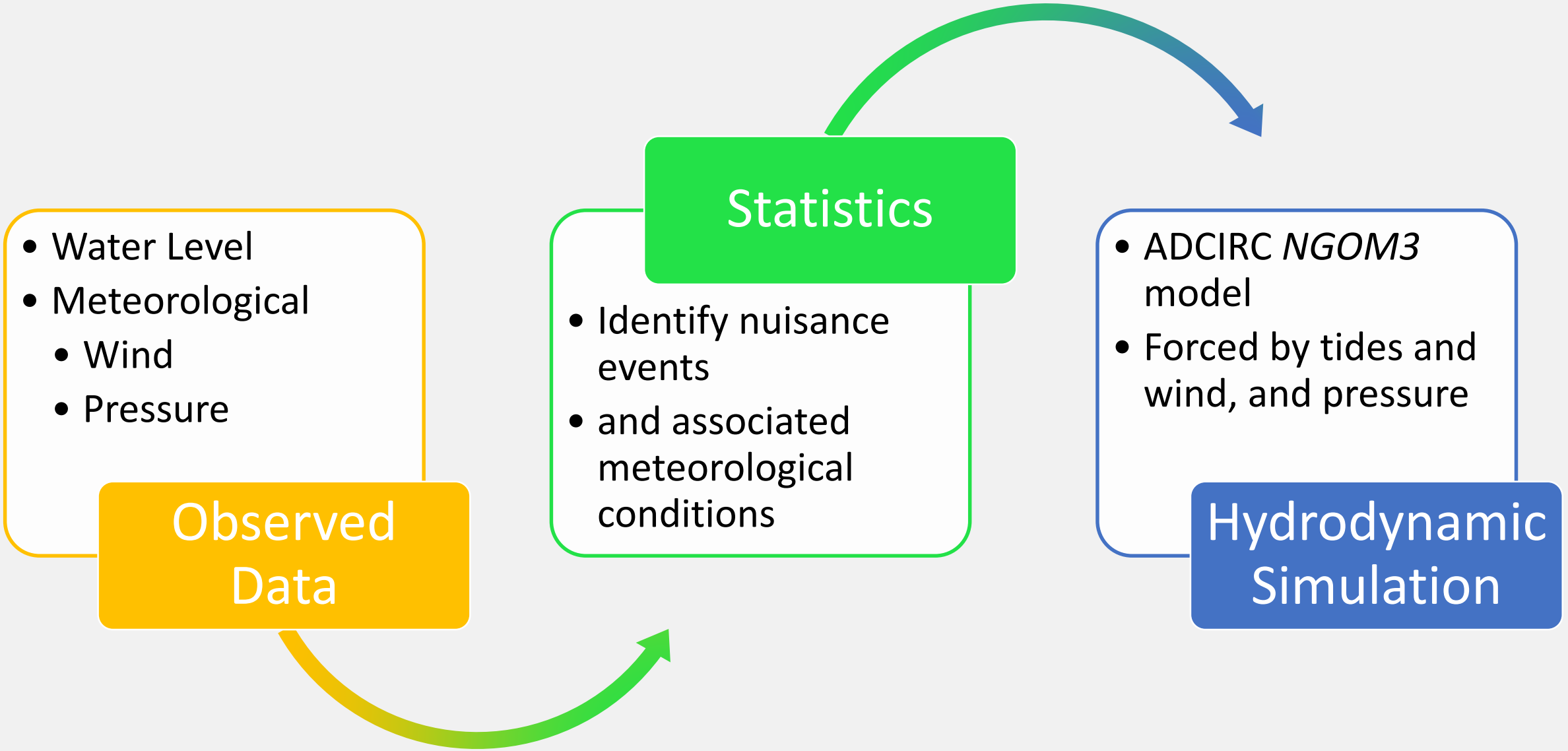
Water Levels at Dauphin Island



Water Levels at Mobile



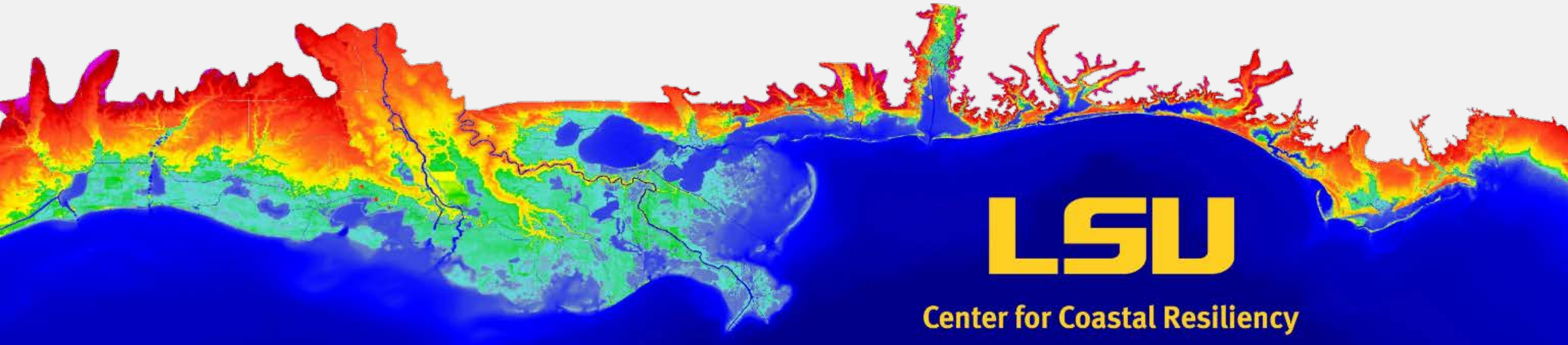
Nuisance Flood Modeling Framework



Summary and Future Work

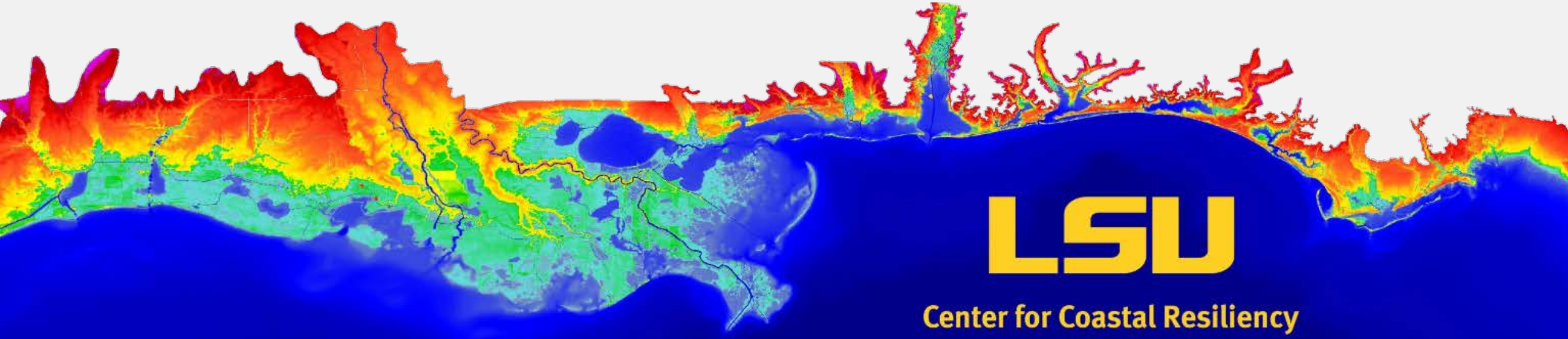
- Historical and present-day coastally-driven nuisance flood events in the NGOM are not as common as those on the US east coast
- Nuisance flood events are likely to become more common into the future (Sweet et al., 2018)
- Nuisance flooding may not always occur during a spring- or King-tide
- High level of temporal and spatial variability of water levels due to nuisance flooding in Mobile Bay during the May 2017 event
- Identified the potential mechanisms that cause nuisance flooding to occur
- The CDSLR approach will enable the assessment of nuisance flooding into the future under SLR
- We will simulate periods of record for present day and for the future in order to adequately describe nuisance flooding
  - Run these events for present day and for future scenarios
  - Perform numerical simulations of nuisance flooding under SLR and with NNBFs
  - Link simulation output with Economic Impact Assessment and Ecosystem Service Valuation

Questions

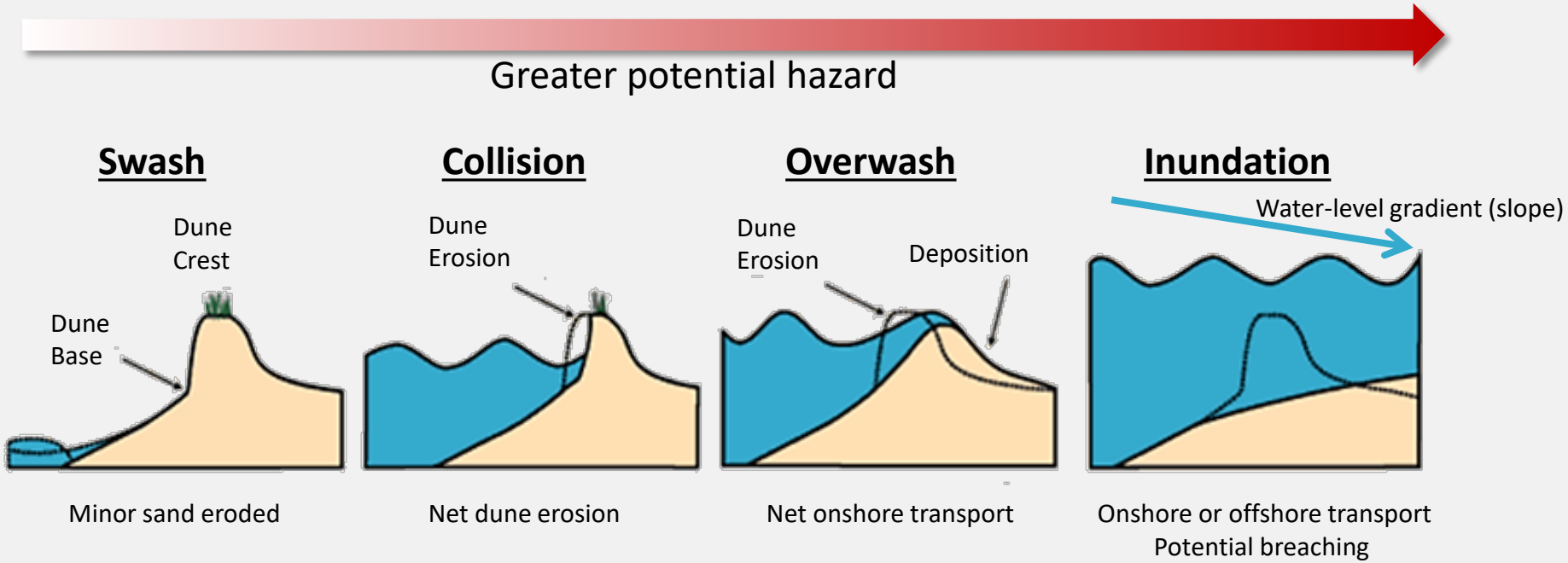


Economic Impact of Dune Maintenance to Reduce Storm-Induced Inundation and Erosion

Davina L. Passeri
USGS St. Petersburg Coastal & Marine Science Center
Matthew V. Bilskie
Center for Coastal Resiliency, Louisiana State University



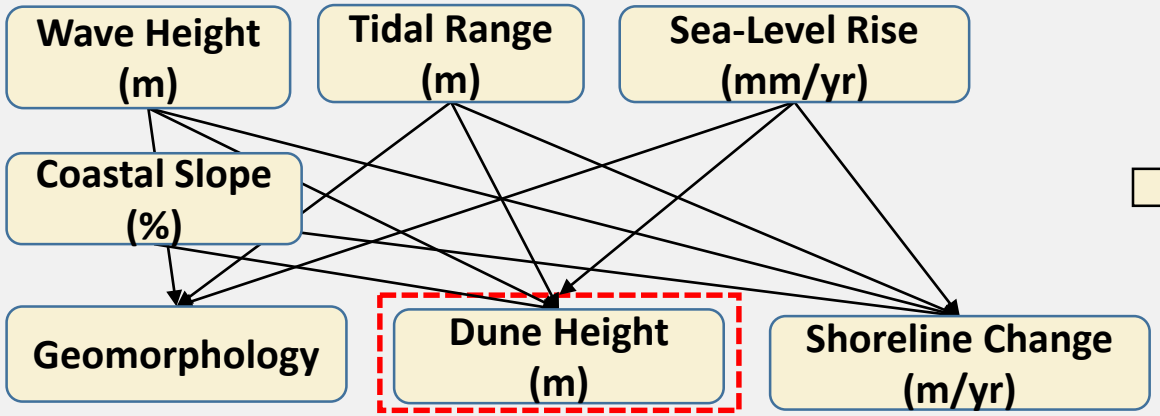
Dunes as a Natural & Nature-Based Feature



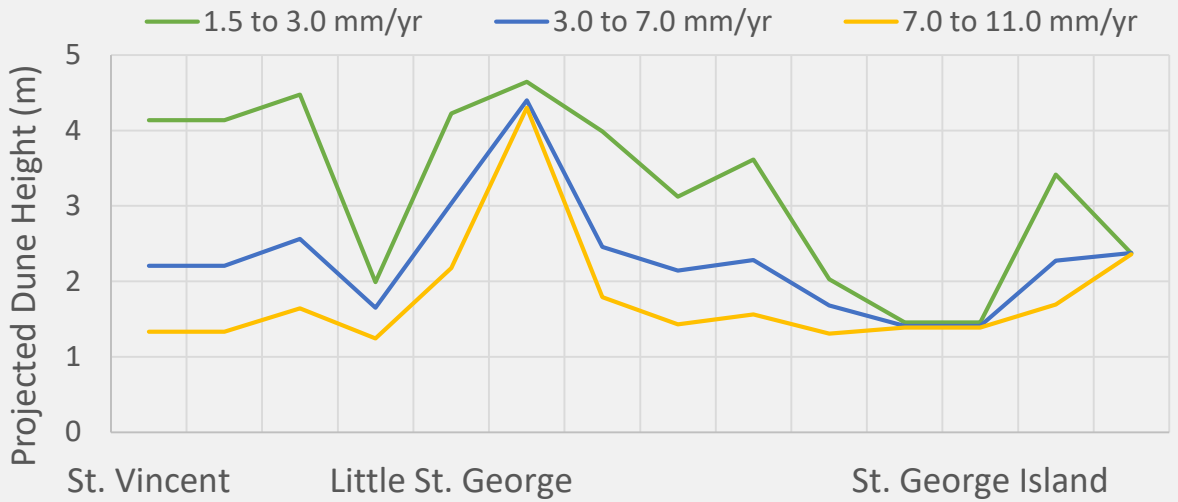
- Dunes are the first line of defense against storm-induced water levels
- As water levels exceed dune heights, sand is transported
- After major storm events, beaches are typically nourished and dunes are restored

Projected Dune Heights under Sea Level Rise (SLR)

Bayesian Network



Probabilistic Projection



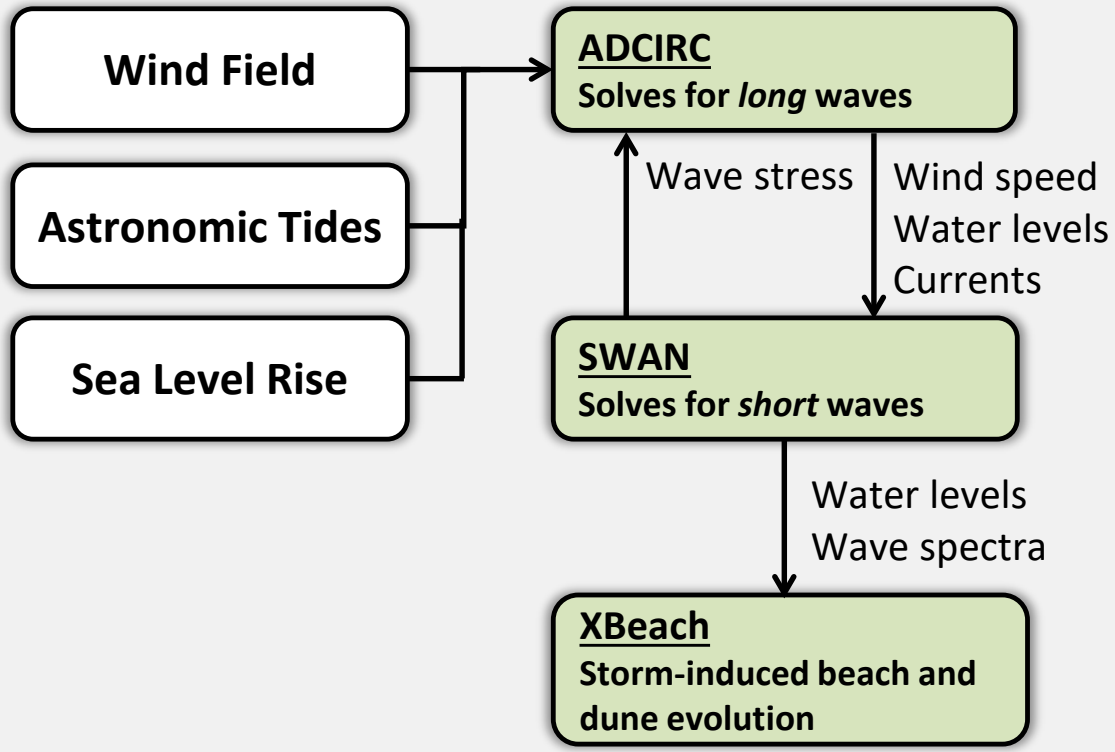
Plant et al., 2016

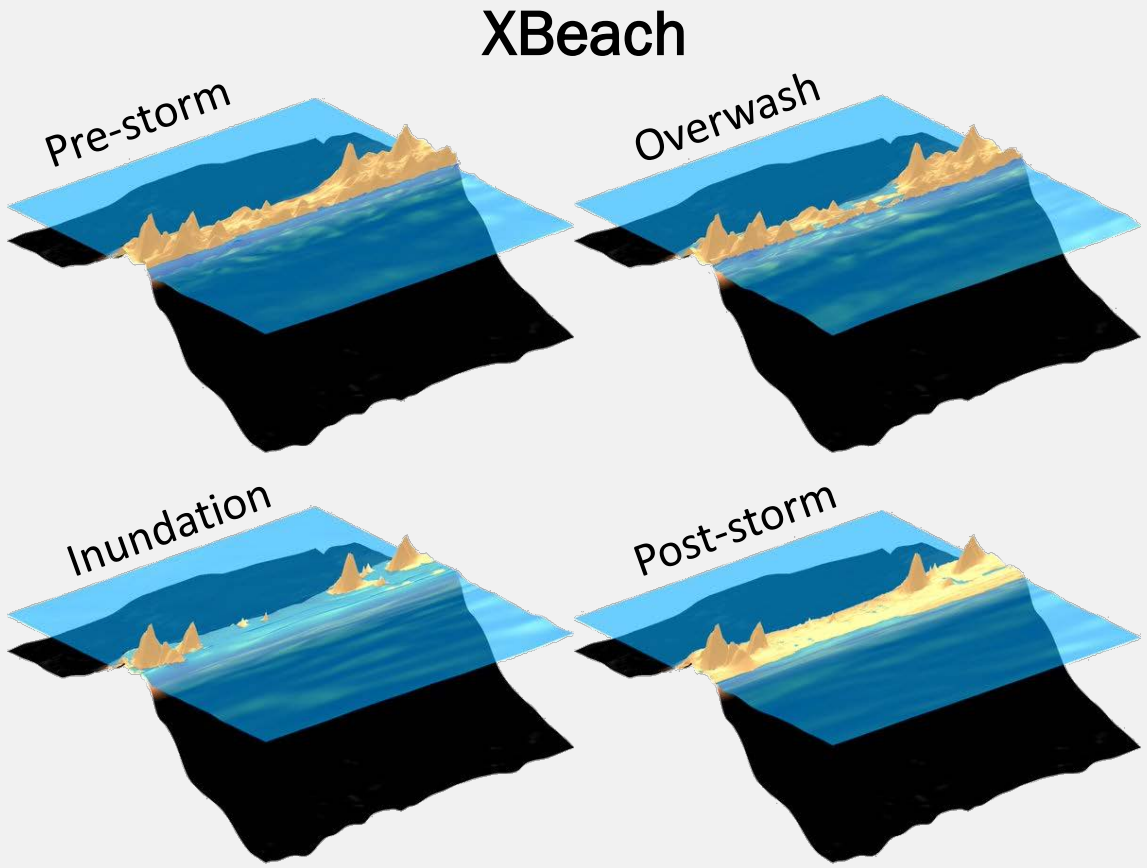
- Higher sea levels allow waves to act further on the beach profile
- Dune heights are projected to decrease with increased rates of SLR
  - The elevation of dune crest relative to mean sea level will decrease
- Potentially more overtopping during storm events – more damage, higher costs

Research Question

- Is there a cost benefit of routine nourishment to maintain dunes over time versus only nourishing after storms?
  - Dune height would be maintained to keep pace with SLR
  - Reduce storm-driven inundation, erosion and related damage costs
  - Reduce cost of post-storm nourishment

Modeling Barrier Island Morphology During Storms





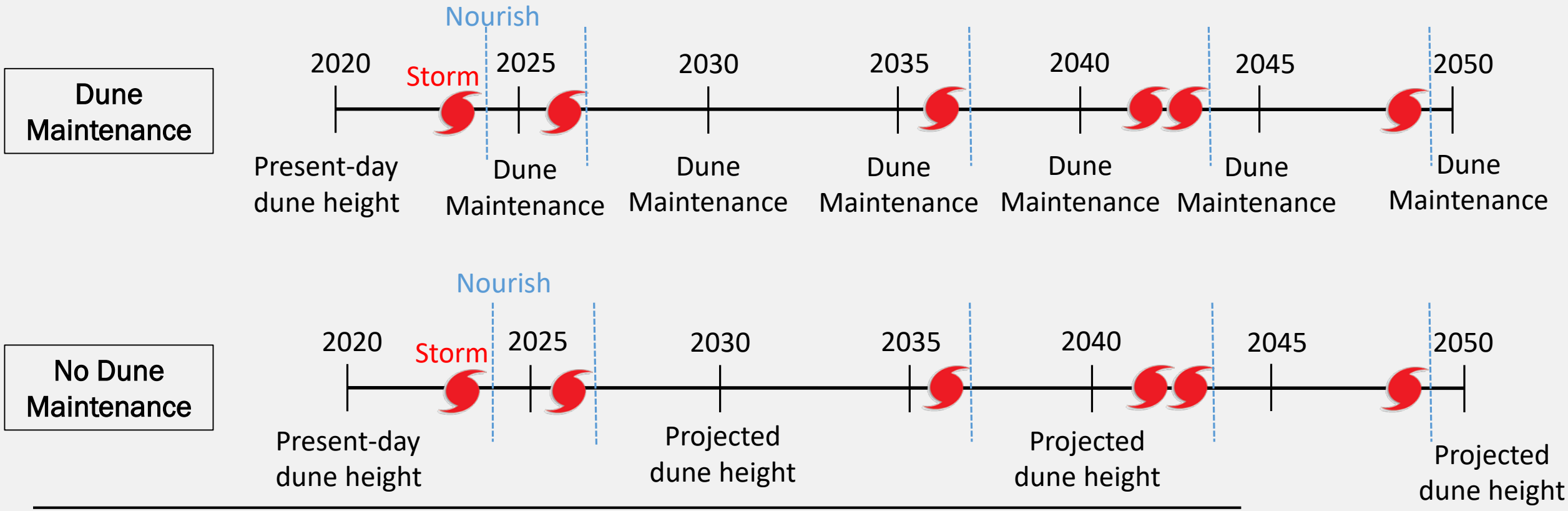
Sea Level Rise Projections

GMSL Scenario (m)	2010	2020	2030	2040	2050
Intermediate-Low	0.04	0.08	0.13	0.18	0.24
Intermediate	0.04	0.10	0.16	0.25	0.34
Intermediate-High	0.05	0.10	0.19	0.30	0.44

GMSL Scenario Rate (mm/yr)	2010	2020	2030	2040	2050
Intermediate-Low	4	5	5	5	5
Intermediate	5	6	7	9	10
Intermediate-High	5	7	10	13	15

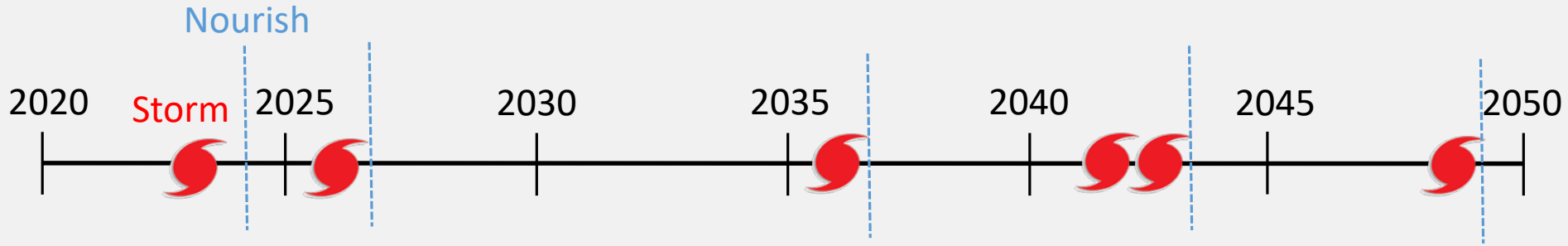
Sweet et al., 2017

Modeling Approach



- Simulate storm scenarios with SWAN+ADCIRC
- Pass water levels and waves to XBeach to simulate morphology
- Nourishment occurs after storms and XBeach is reset to pre-storm island elevations
- **With maintenance** – dune height is increased every 5 years by the amount of SLR to keep pace
- **Without maintenance** – dune height changes based the Bayesian projection given the rate of SLR

Example

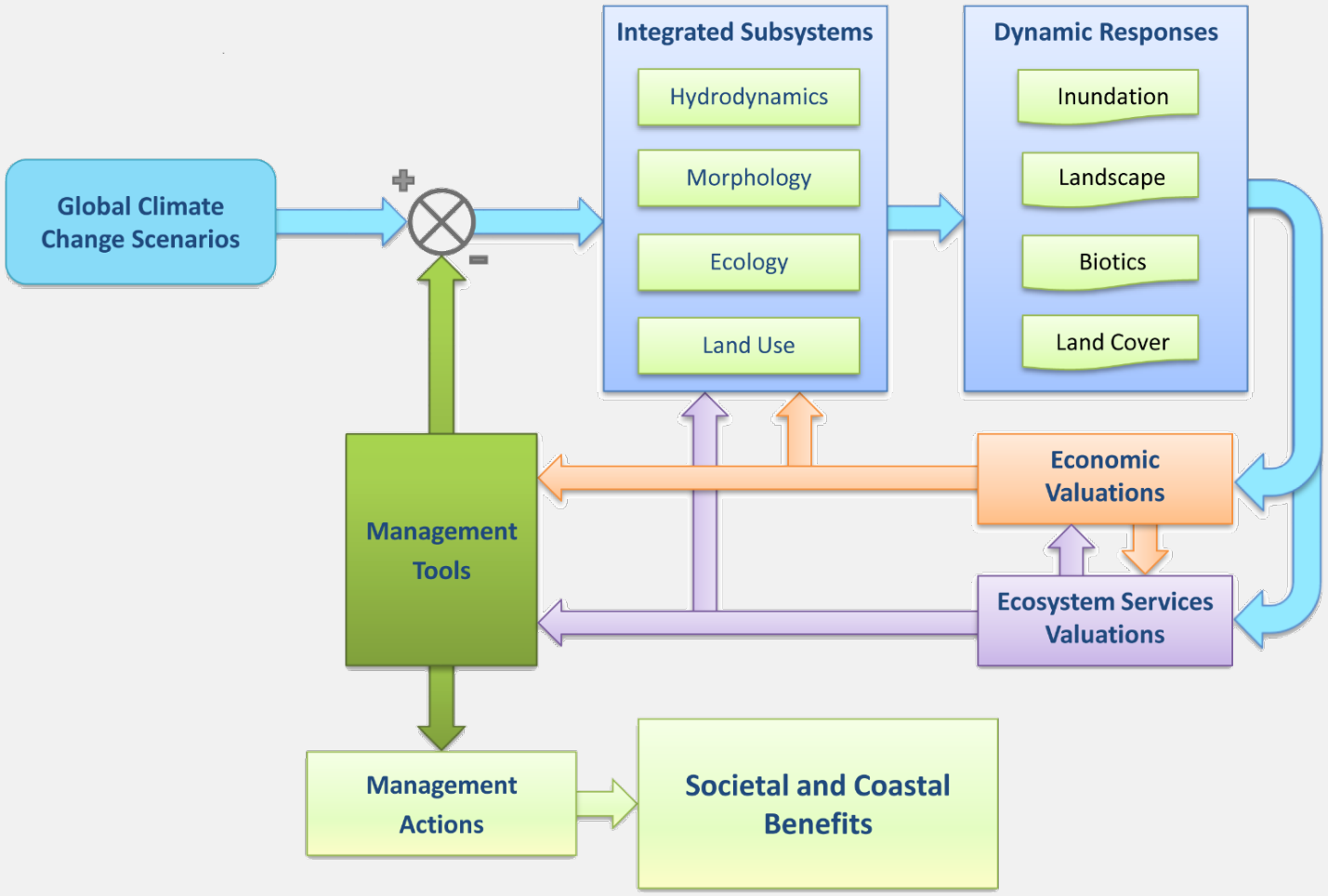


	2020	2025	2030	2035	2040	2045	2050
Intermediate SLR (m)	0.10	--	0.16	--	0.25	--	0.34
Dune height with maintenance (m)	3.00	3.00	3.16	3.16	3.25	3.25	3.34
Dune height without maintenance (m)	3.00	3.00	2.30	2.30	2.30	2.30	2.30

$$Cost\ with\ maintenance = \sum storm\ damage\ cost + \sum nourishment\ cost + \sum dune\ maintenance\ cost$$

$$Cost\ without\ maintenance = \sum storm\ damage\ cost + \sum nourishment\ cost$$

Process Diagram for the NGOM+N2E2 System



"*Systems Approaches for Coastal Hazard Assessment and Resilience*."
in S. Cutter (Ed): Oxford Research Encyclopedia: Natural Hazard Science.
http://naturalhazardscience.oxfordre.com/browse?t0=ORE_NHS:REFNHS063

Considerations

- What are likely storm climatology scenarios over a given span?
- Does nourishment take place after every storm events or only larger ones?
- What is the average cost to nourish a beach ($/m^3 of sand loss)?
- What is the frequency of dune maintenance (e.g., every 5 years)?
- Is the maintained dune height equal to the amount of SLR or + freeboard?
  - Is it spatially variable?

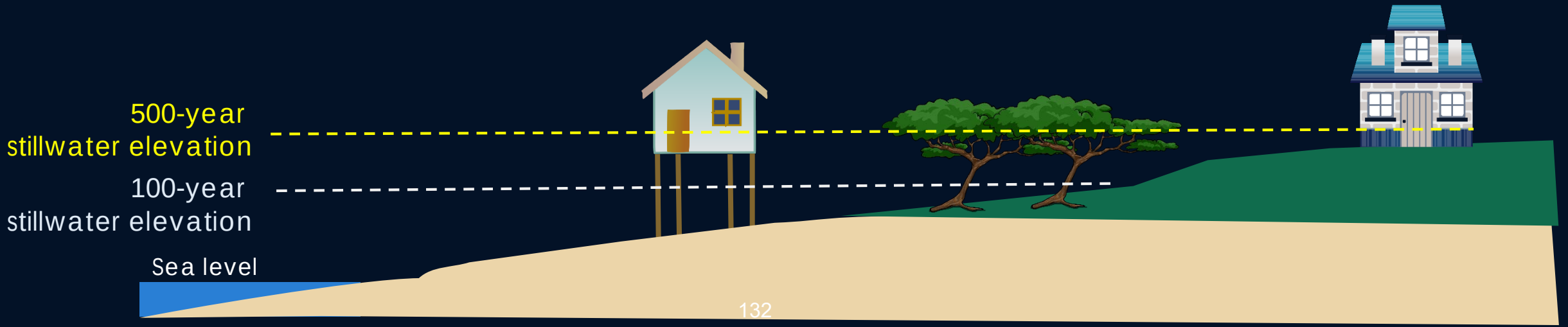
Economic Impact Assessment
Storm Flooding under Sea Level Rise

Diana C. Del Angel[1], David Yoskowitz[1], Scott C. Hagen[2], Matthew V. Bilskie[2]
[1]Texas A&M University – Corpus Christi
[2]Lousiana State University

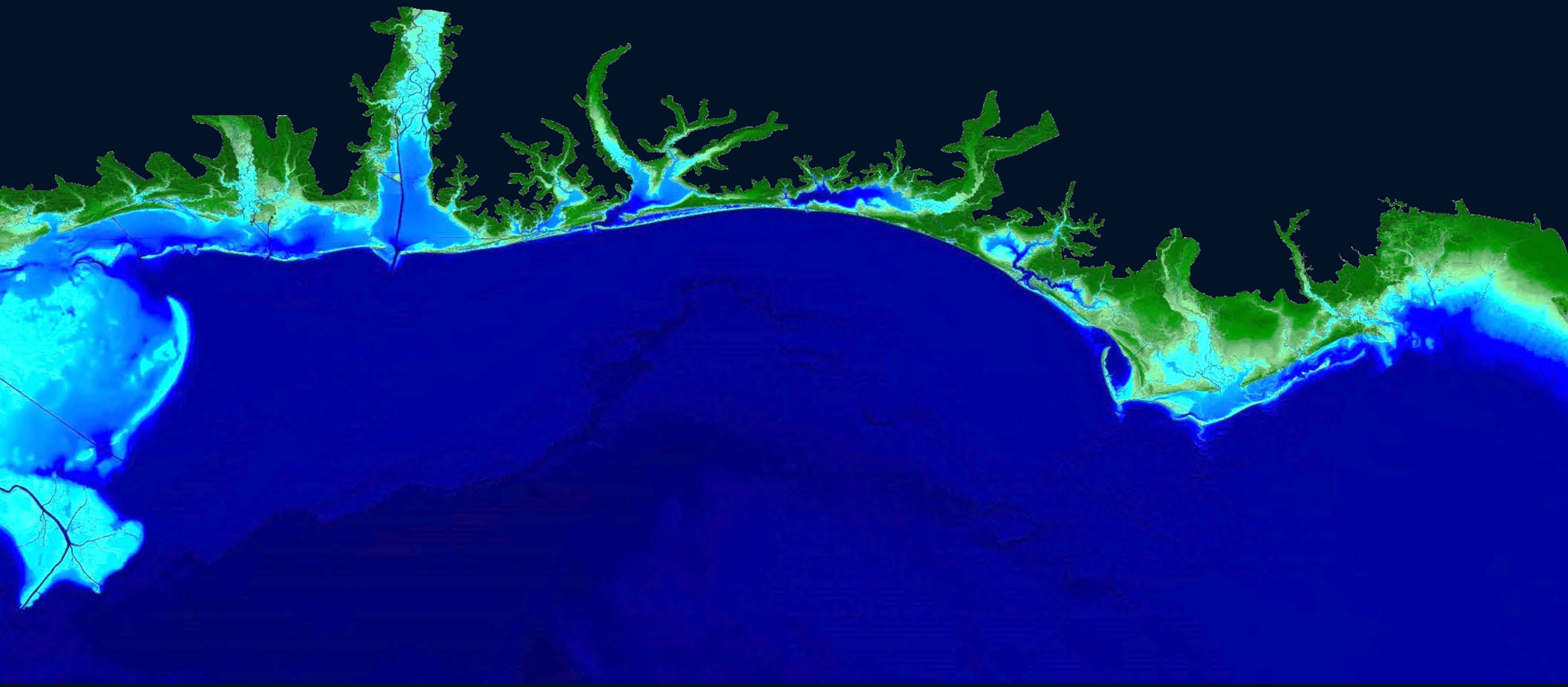
MTAG Workshop
Grand Bay NERR
July 12, 2018

Floodplains

- **High Risk Areas:** Flood insurance is mandatory
  - A- zones- areas with 1% annual chance of flooding and a 26% change of flooding over the life of a 30 year mortgage
- **Moderate Risk Areas:** Flood insurance is available but not required
  - B and X zones: An area inundated by 0.2% annual chance and a 5.8% change of flooding over the life of a 30 year mortgage
- Low Risk Area: area of minimal flood hazard. Above the 500-year flood level.



NGOM3 Model



M.V. Bilskie, S.C. Hagen, S.C. Medeiros, A.T. Cox, M. Salisbury, D. Coggin (2016). “Data and numerical analysis of astronomic tides, wind-waves, and hurricane storm surge along the northern Gulf of Mexico.” Journal of Geophysical Research, 121(11), pp. 3625-3658, doi: 10.1002/2015JC011400.

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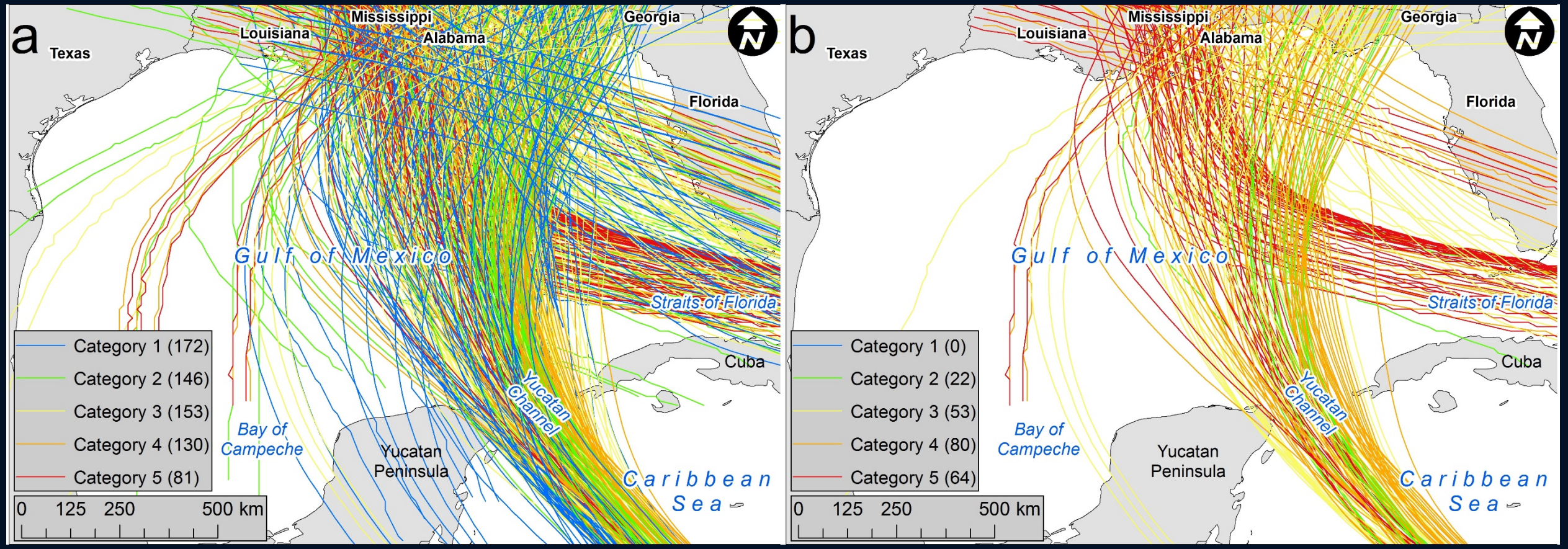
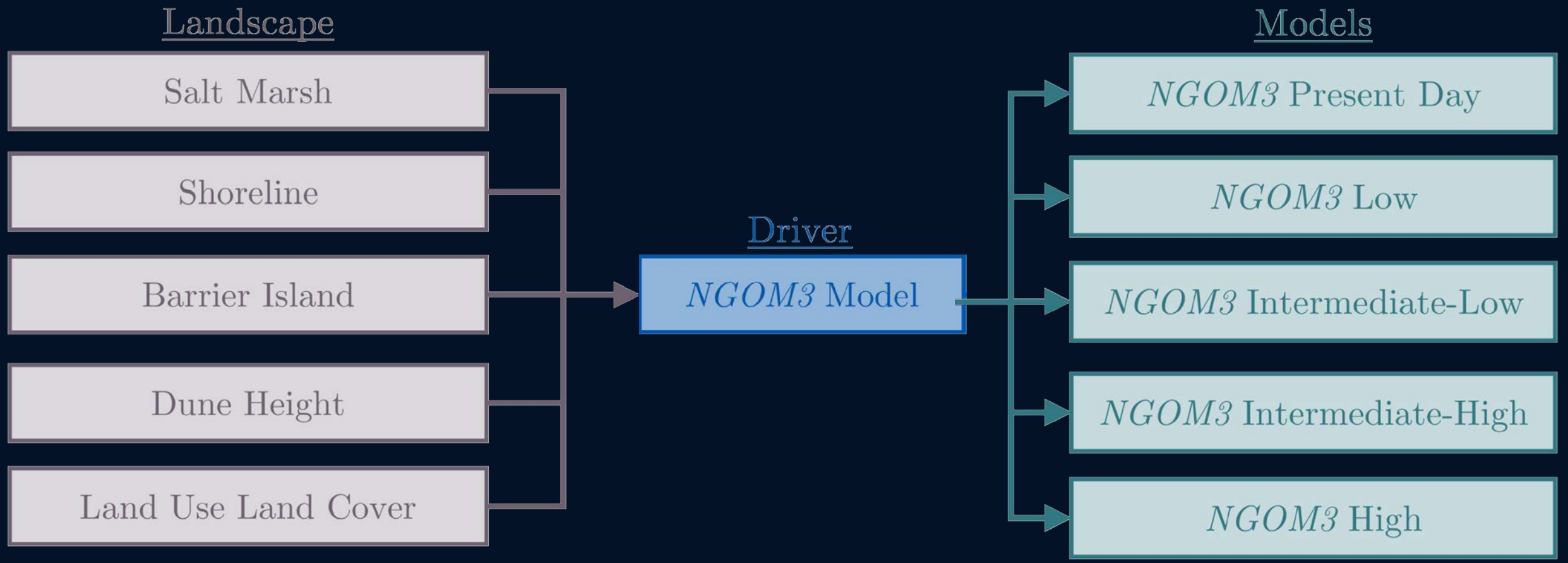
Synthetic Storms



M.V. Bilskie, S.C. Hagen, J. Irish (2018). "Development of return period stillwater floodplains for the northern Gulf of Mexico under the coastal dynamics of sea level rise." *ASCE Journal of Waterway, Port, Coastal, and Ocean Engineering*, In Press.

Considering Coastal Change

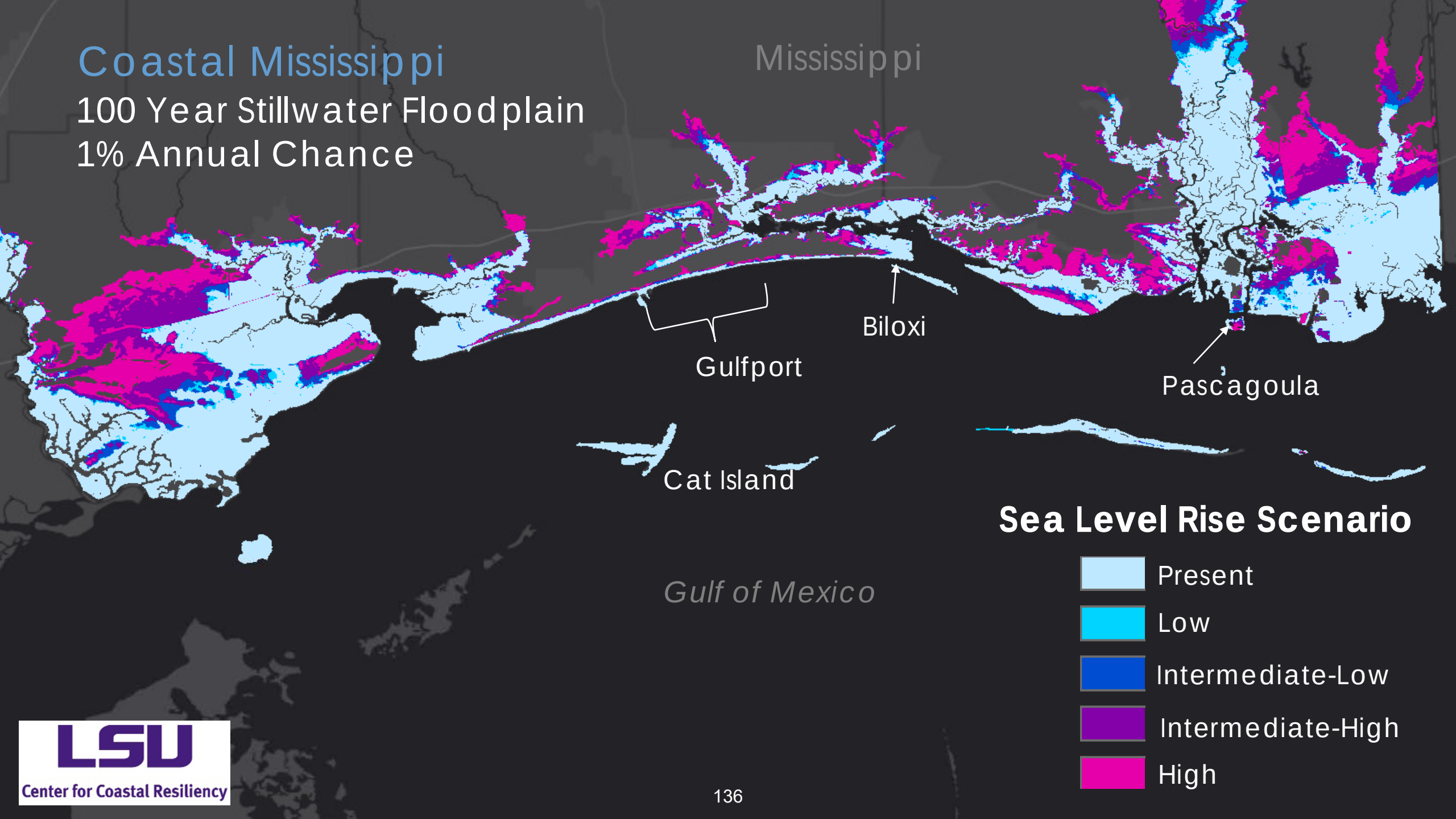


Bilskie *et al.* (2016) Dynamic simulation and numerical analysis of hurricane storm surge under sea level rise with geomorphologic changes along the northern Gulf of Mexico. *Earth's Future.* http://dx.doi.org/10.1002/2015EF000347

LSU Center for Coastal Resiliency

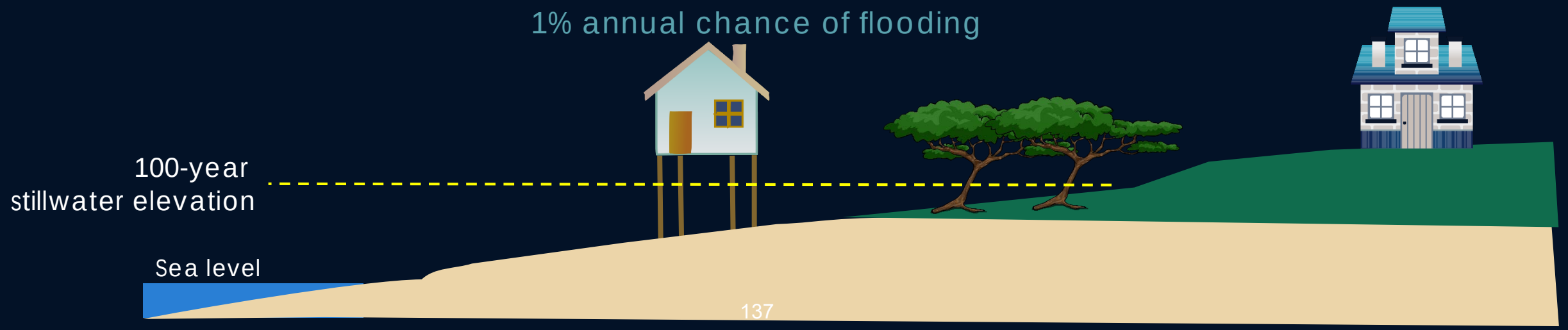
Coastal Mississippi

100 Year Stillwater Floodplain
1% Annual Chance



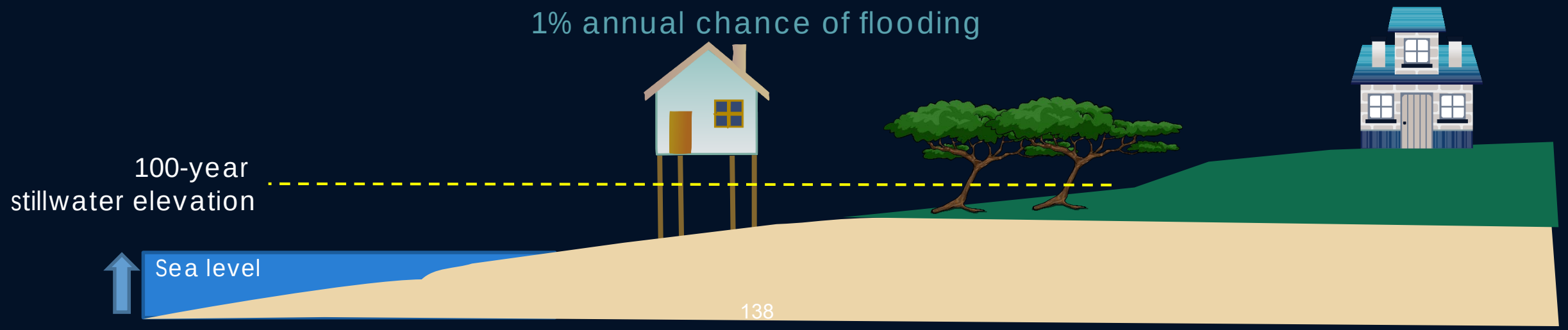
LSU
Center for Coastal Resiliency

The goal of the Economic Impact Analysis



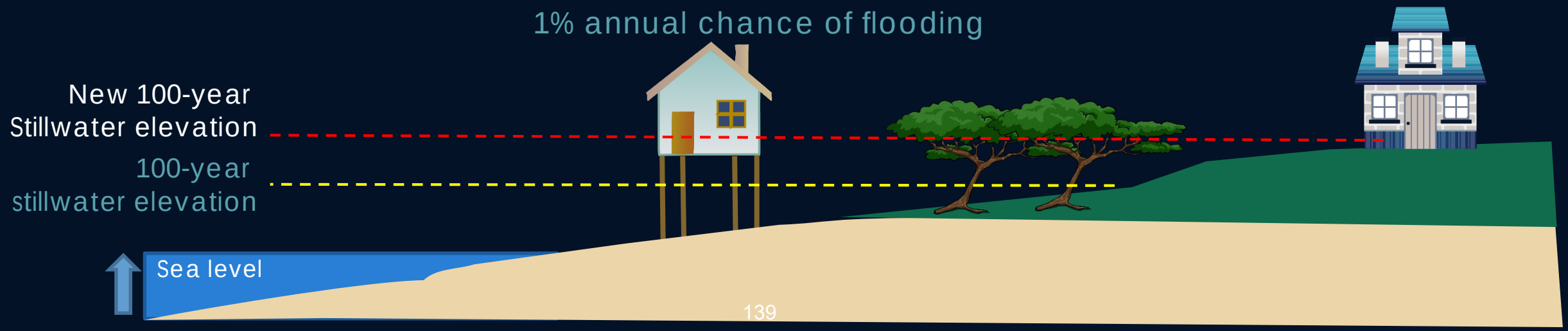
The goal of the Economic Impact Analysis

Considering SLR...

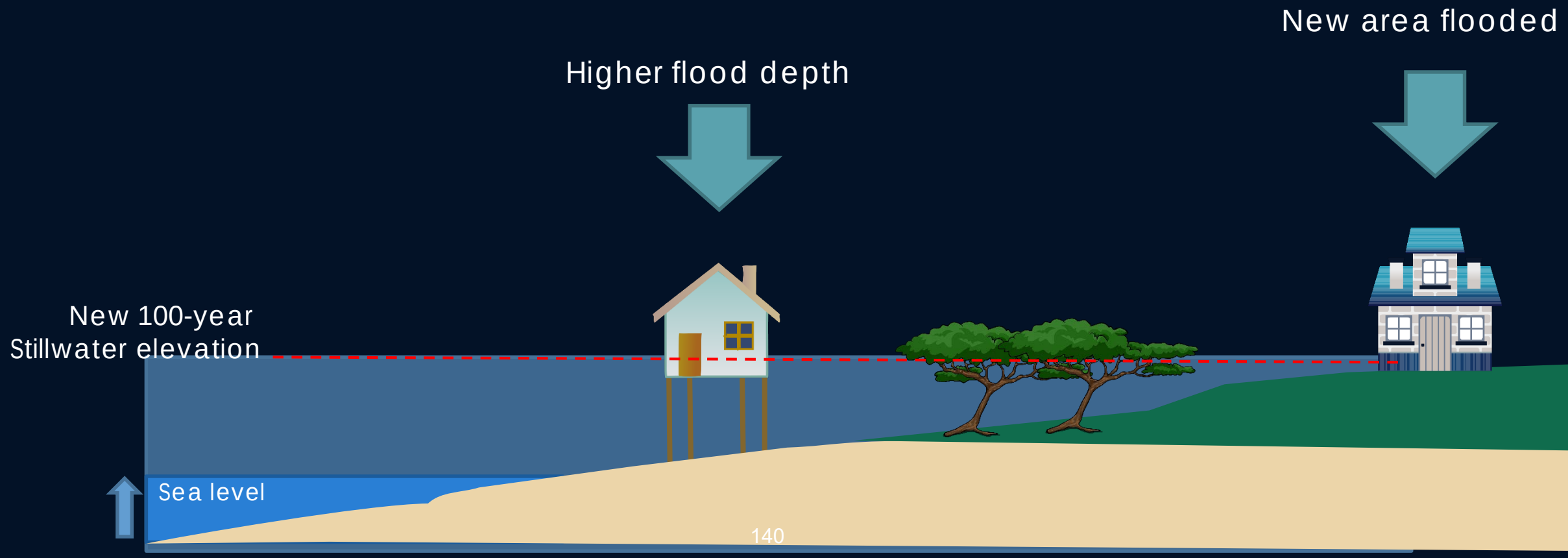


The goal of the Economic Impact Analysis

How will the 1% and .2% annual chance floods change.....



The goal of the Economic Impact Analysis



The goal of the Economic Impact Analysis

# people
$ building and content loses
Infrastructure exposed and/or damaged

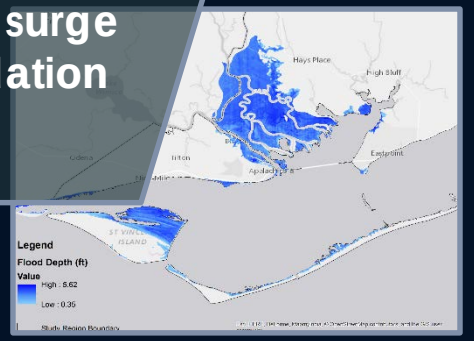
New area flooded

Higher flood depth

HAZUS Damage Assessment Method

Determine study site

Storm surge inundation

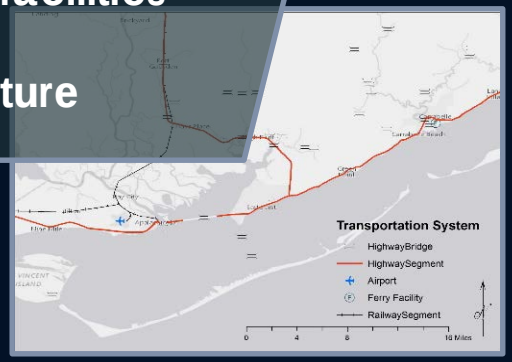


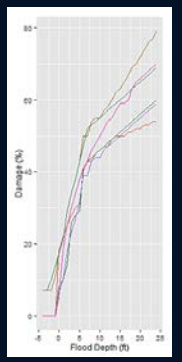
Stillwater Flood Maps

100 & 500 yr Present, Low, Int-Low, Int-High & High

Overlay hazard exposure to inventory

General building stock
Essential facilities & Lifeline infrastructure





Socio-economic impacts

HAZUS MH MULTI-HAZARD LOSS ESTIMATION

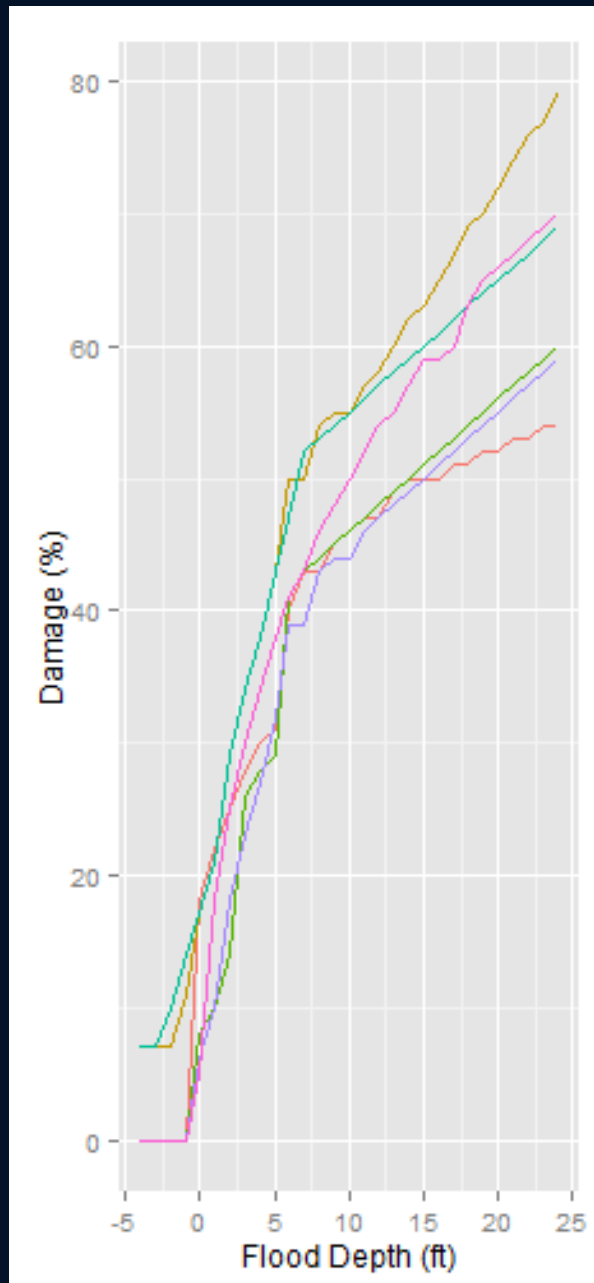
TEXAS A&M UNIVERSITY CORPUS CHRISTI | HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES

EIA Assessments in HAZUS

- **Building**: building stock($)
- **Essential facilities**: Schools ($), police station ($) & medical ($)
- **Hazardous materials facilities**
- **Transportation**: Highway Bridges($), Railway Segments ($) and railway facilities, highway segments
- **Utility Systems** (Potable water system facilities, waste water treatment ($), Power Plants ($), Broadcast facilities ($).
- **Demographics**: displacement and shelter needs

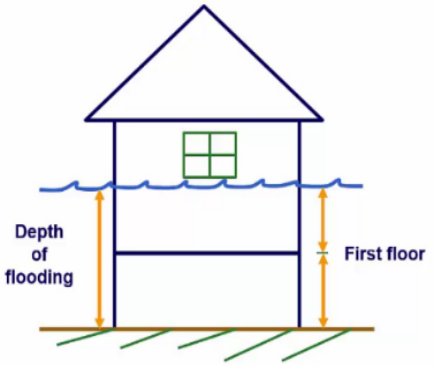
Building Damage

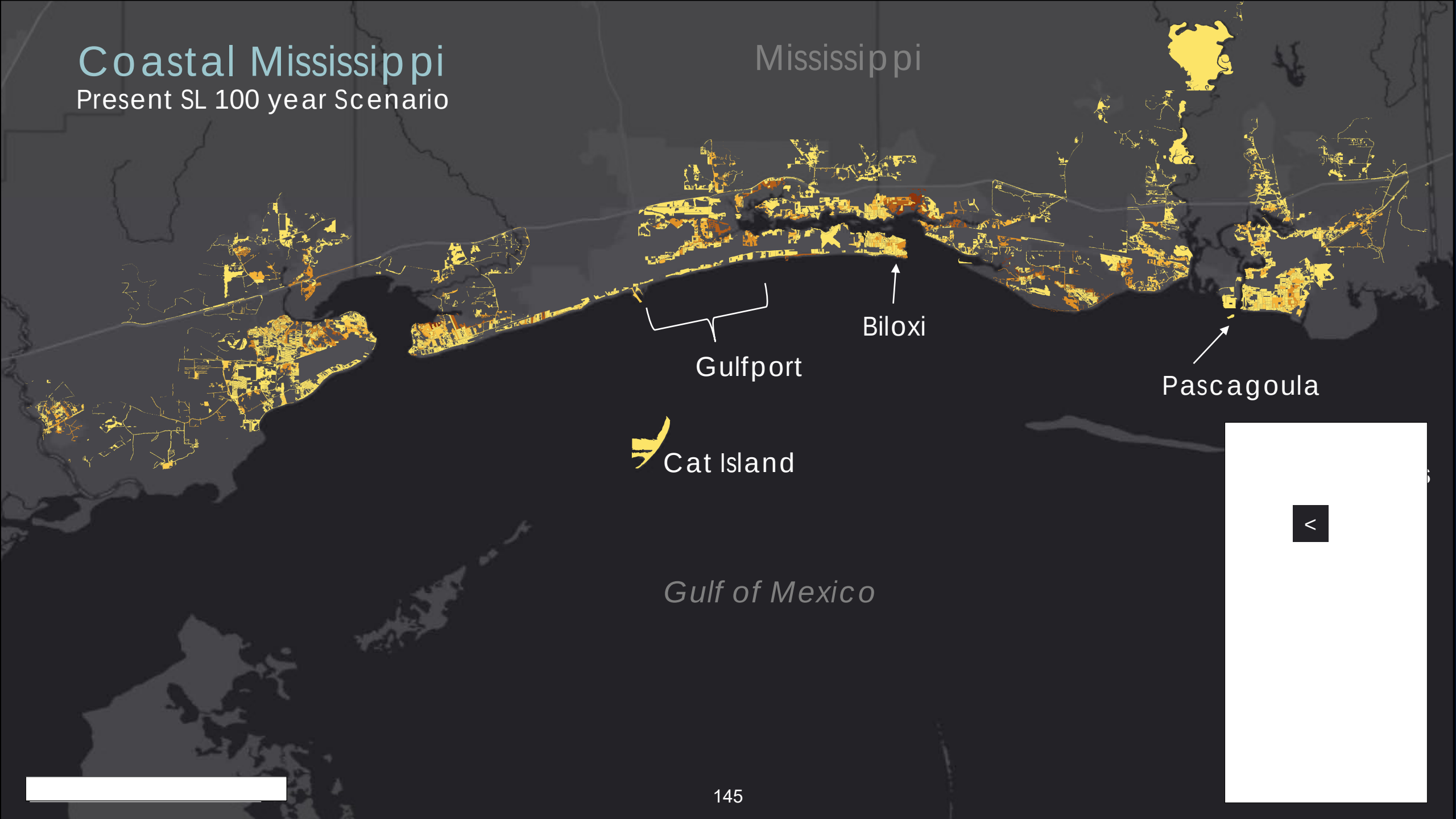
- Census Block data:
- Damage estimated in % using a library of depth damage functions.
- Functions are assigned based on characteristics of buildings

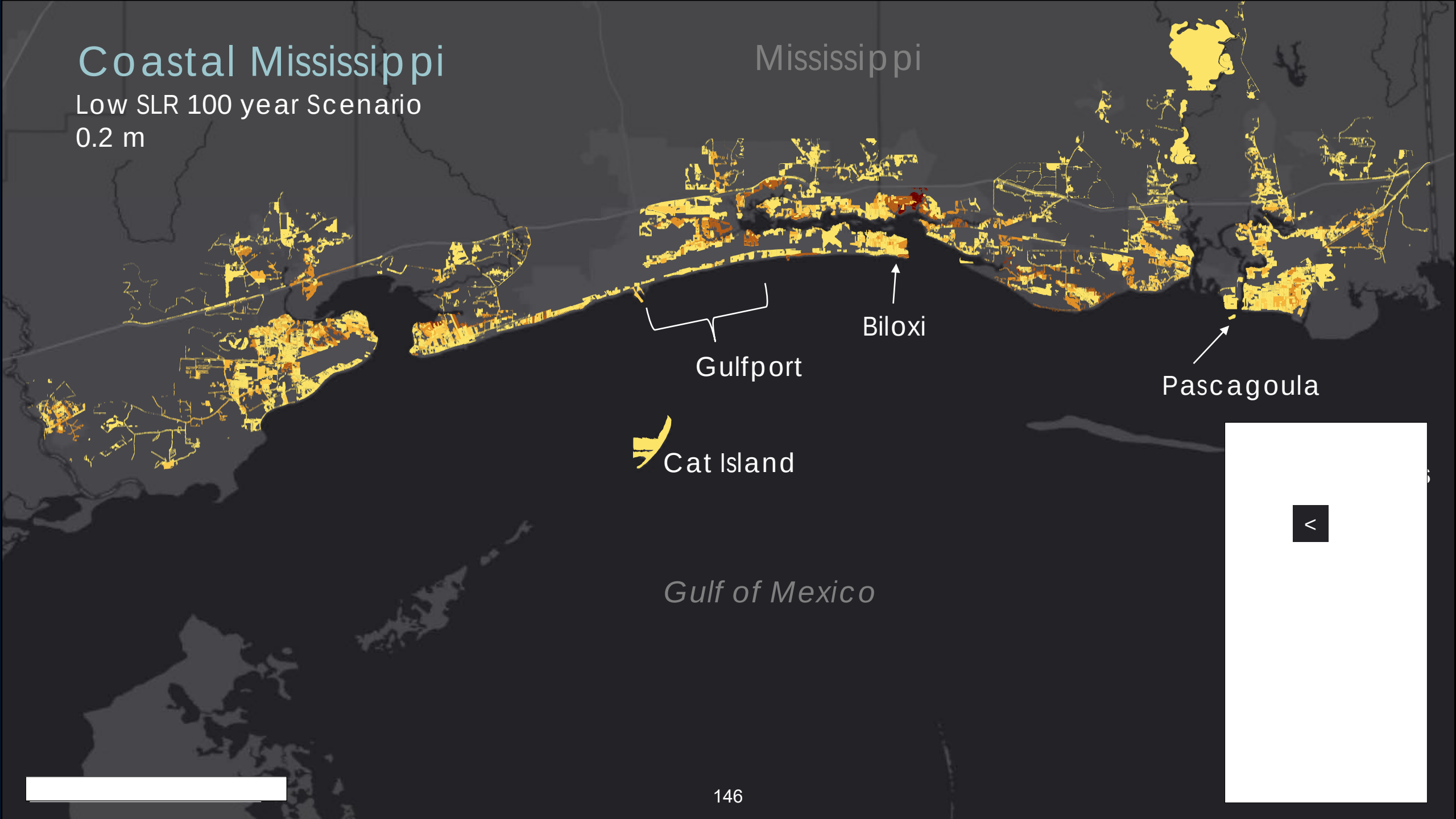


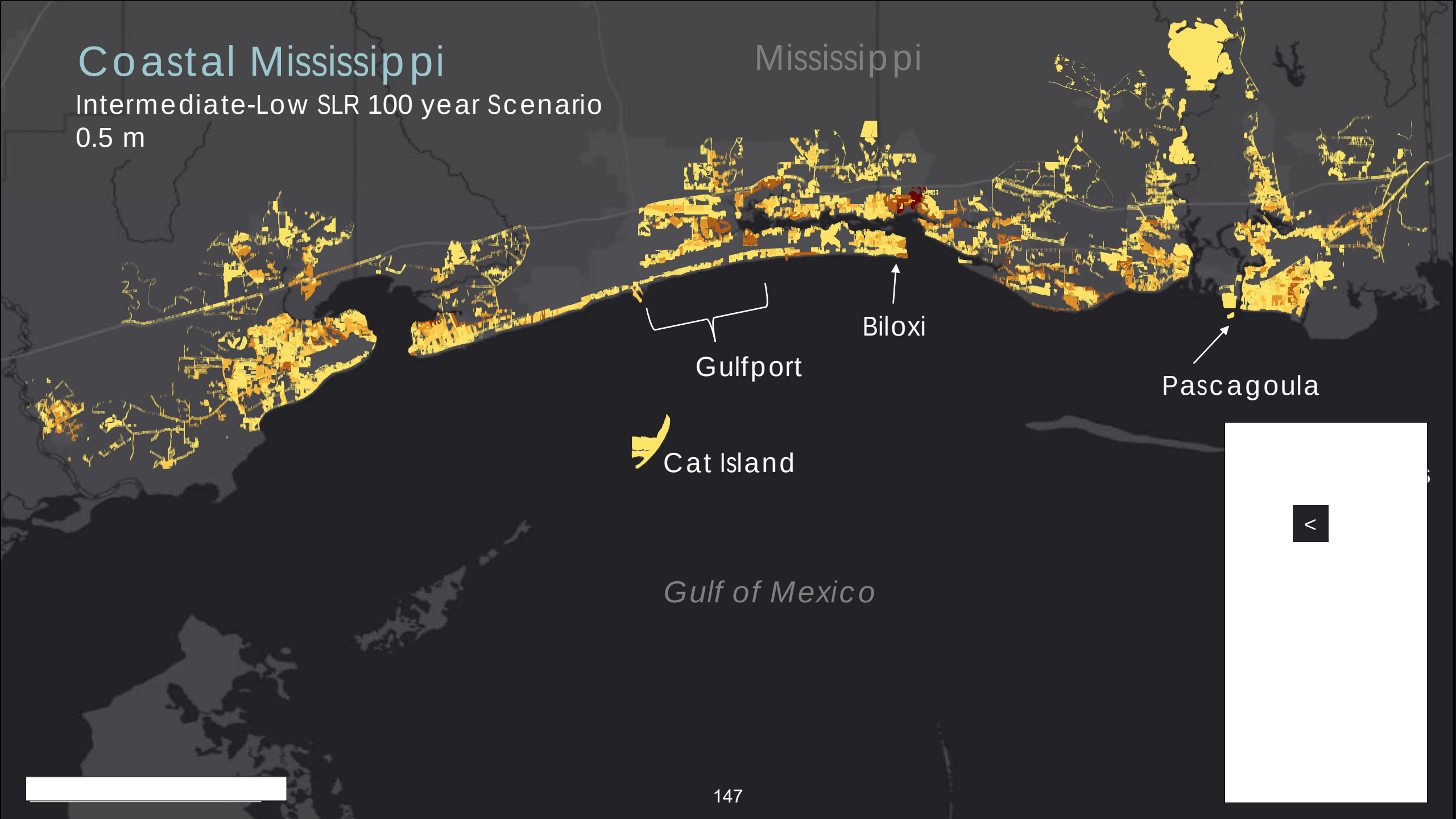
Building Types:

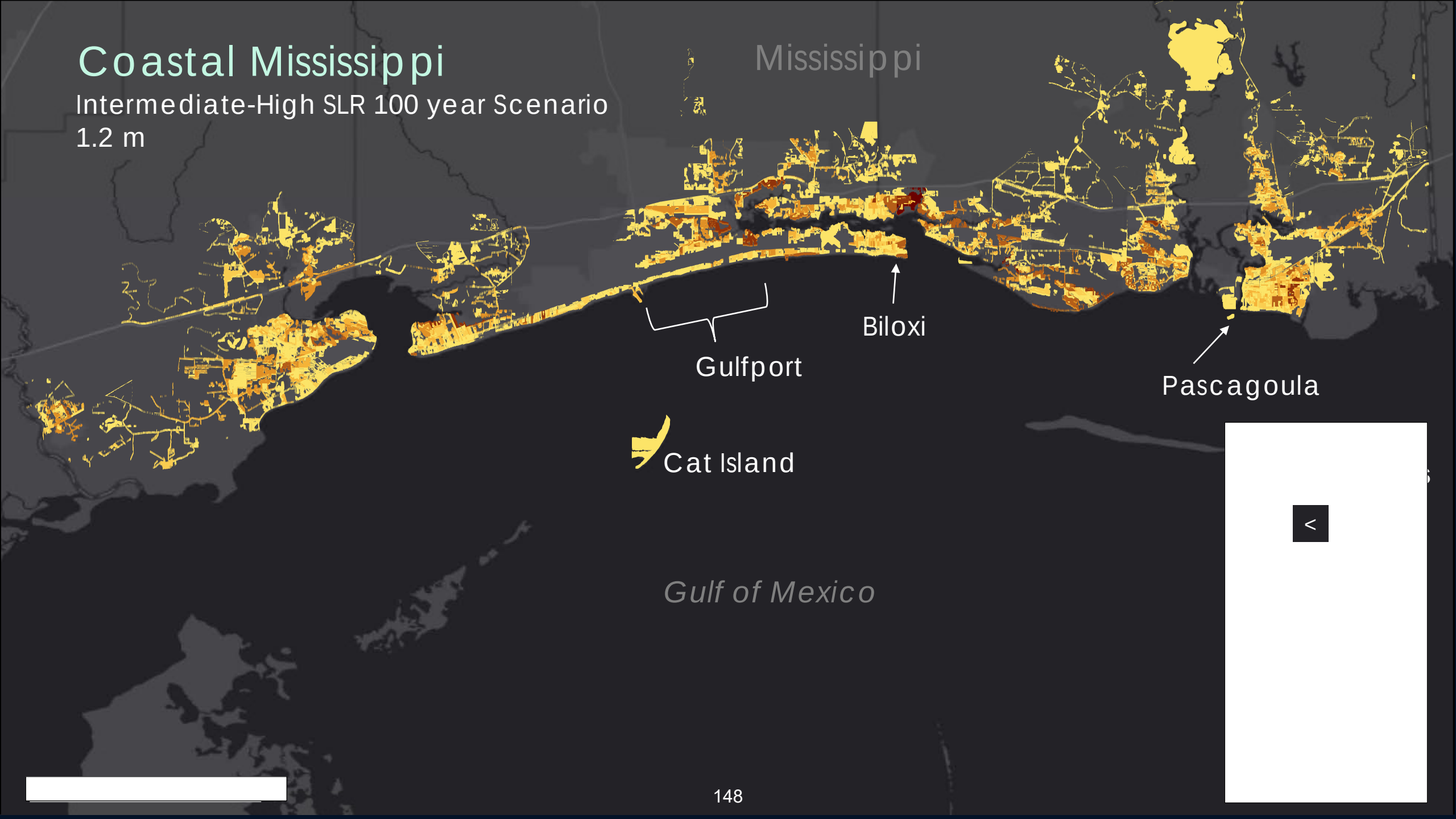
Description
105 one floor, no basement, Structure, A-Zone
106 one floor, w/ basement, Structure, A-Zone
113 one floor, no basement, Structure, V-Zone
114 one floor, w/ basement, Structure, V-Zone
121 one floor, w/ basement, Structure, A-Zone
125 one floor, w/ basement, Structure, V-Zone
206 Apartment, living area on one floor, Structure

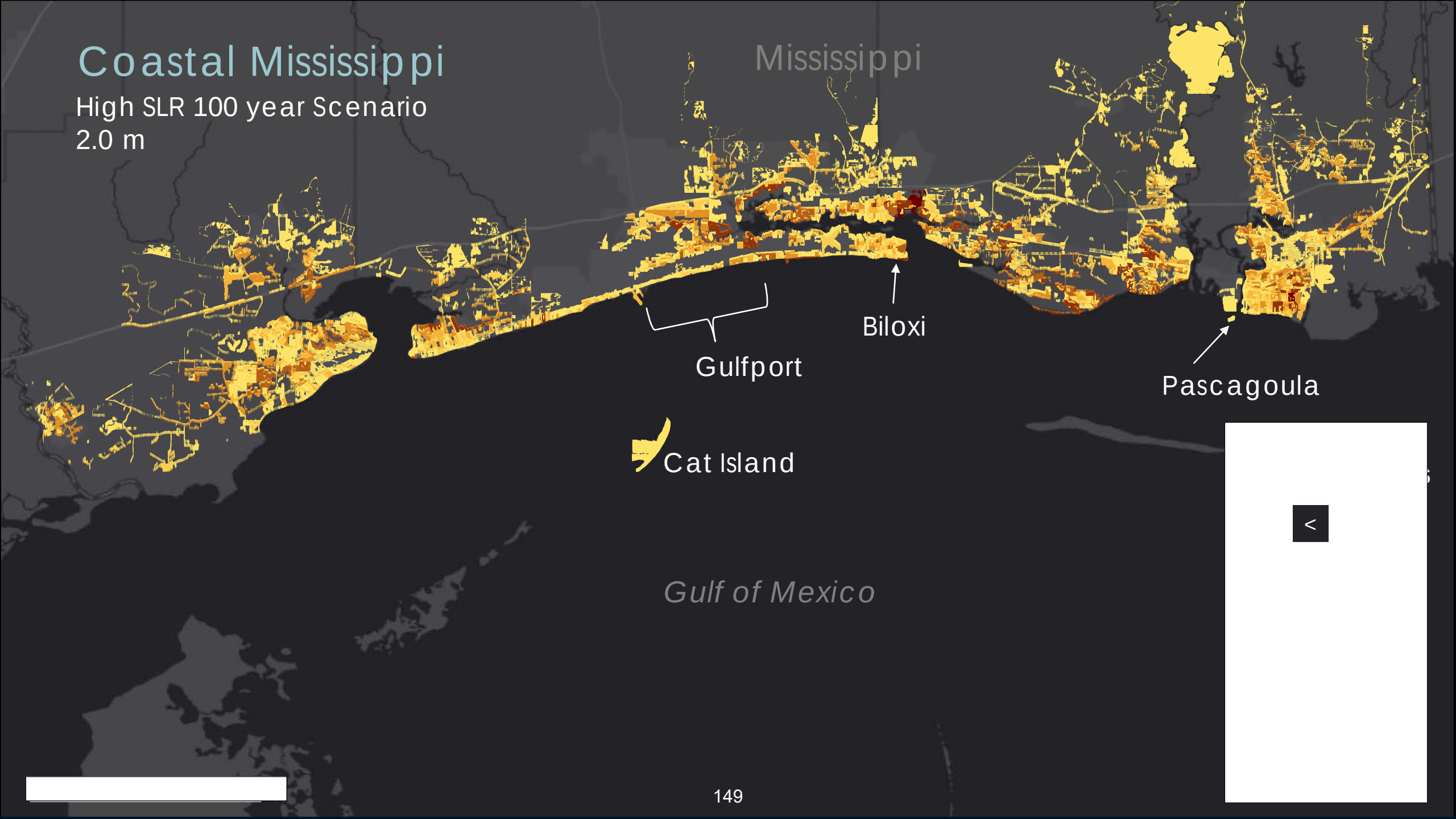



Coastal Mississippi
Present SL 100 year Scenario
Mississippi
Biloxi
Gulfport
Pascagoula
Cat Island
Gulf of Mexico

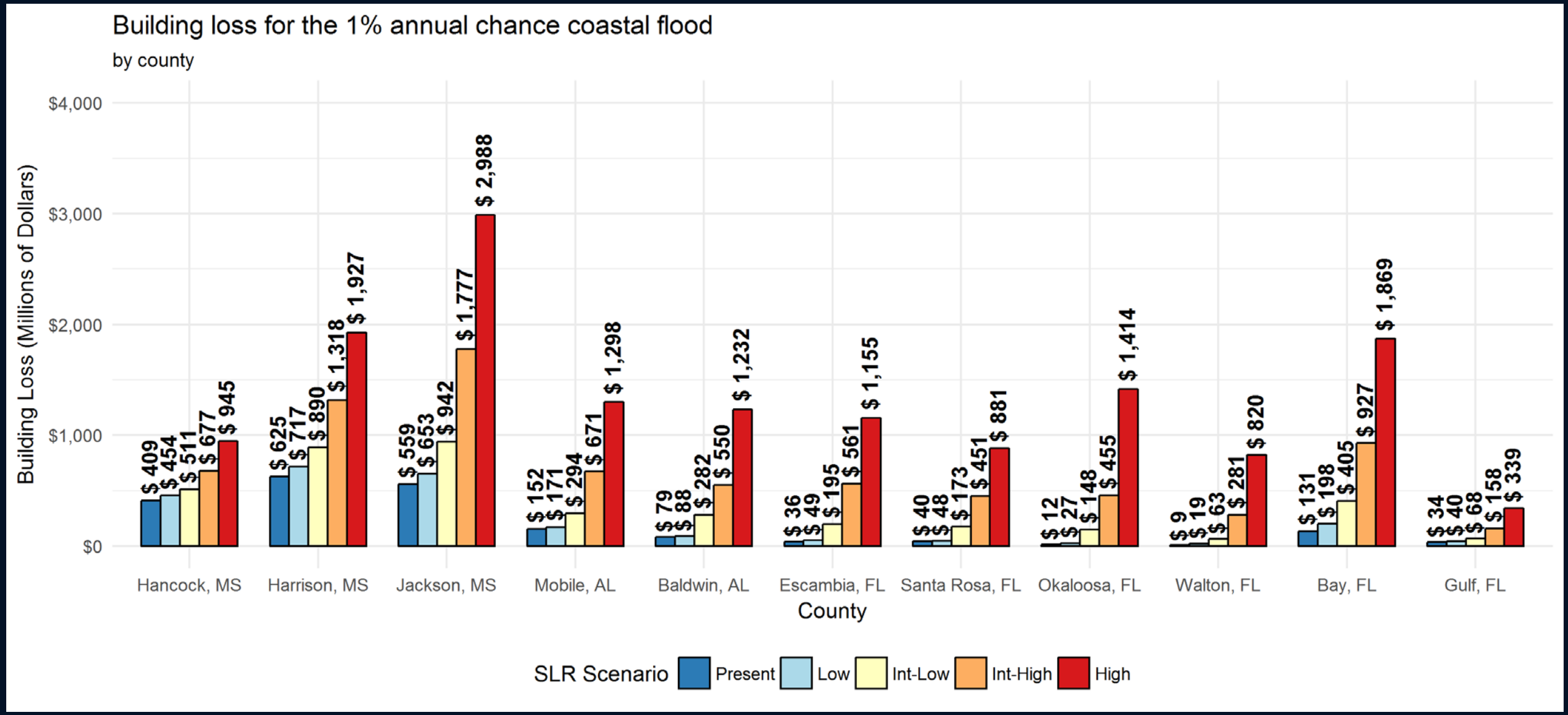

Coastal Mississippi
Low SLR 100 year Scenario
0.2 m
Mississippi
Biloxi
Gulfport
Pascagoula
Cat Island
Gulf of Mexico
<


Coastal Mississippi
Intermediate-Low SLR 100 year Scenario
0.5 m
Mississippi
Biloxi
Gulfport
Pascagoula
Cat Island
Gulf of Mexico
<

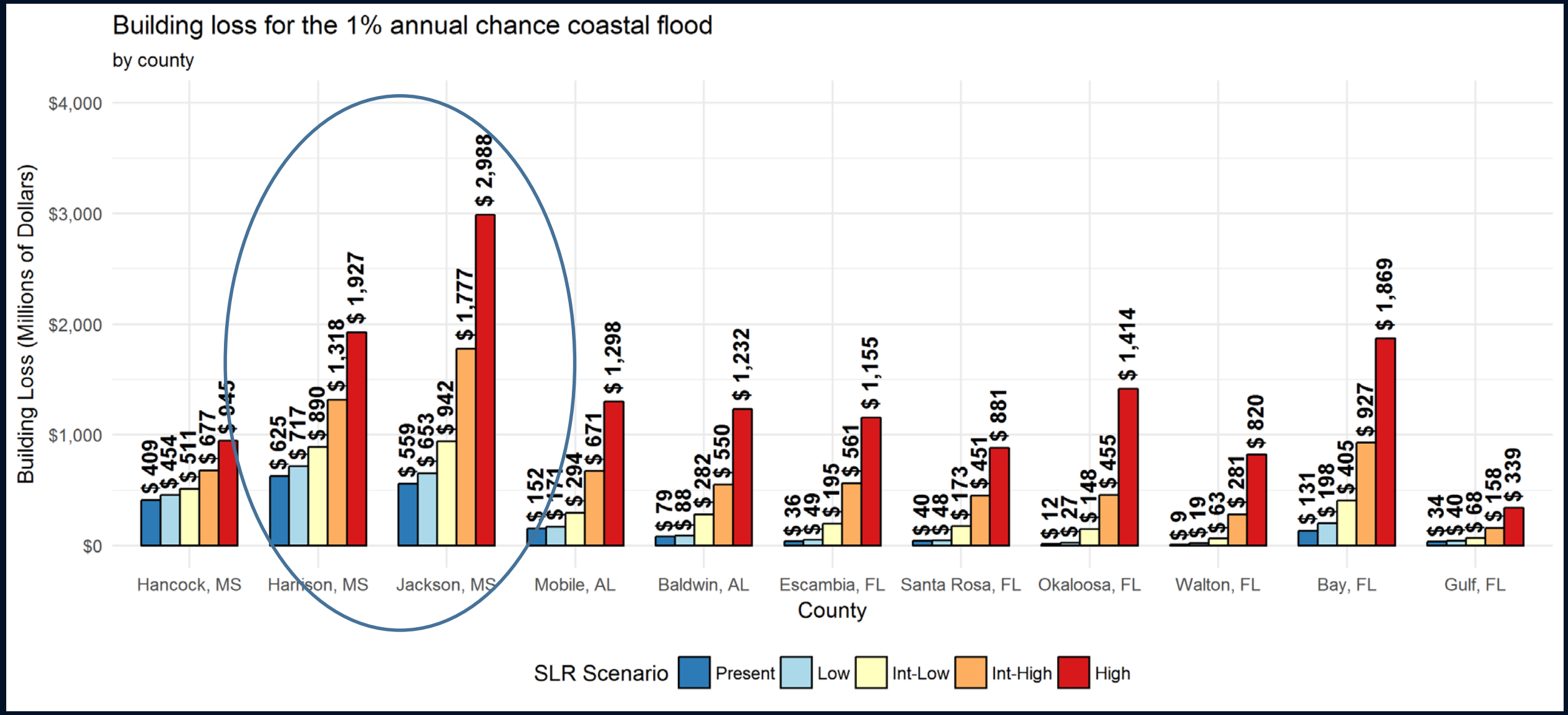

Coastal Mississippi
Intermediate-High SLR 100 year Scenario
1.2 m
Mississippi
Biloxi
Gulfport
Pascagoula
Cat Island
Gulf of Mexico

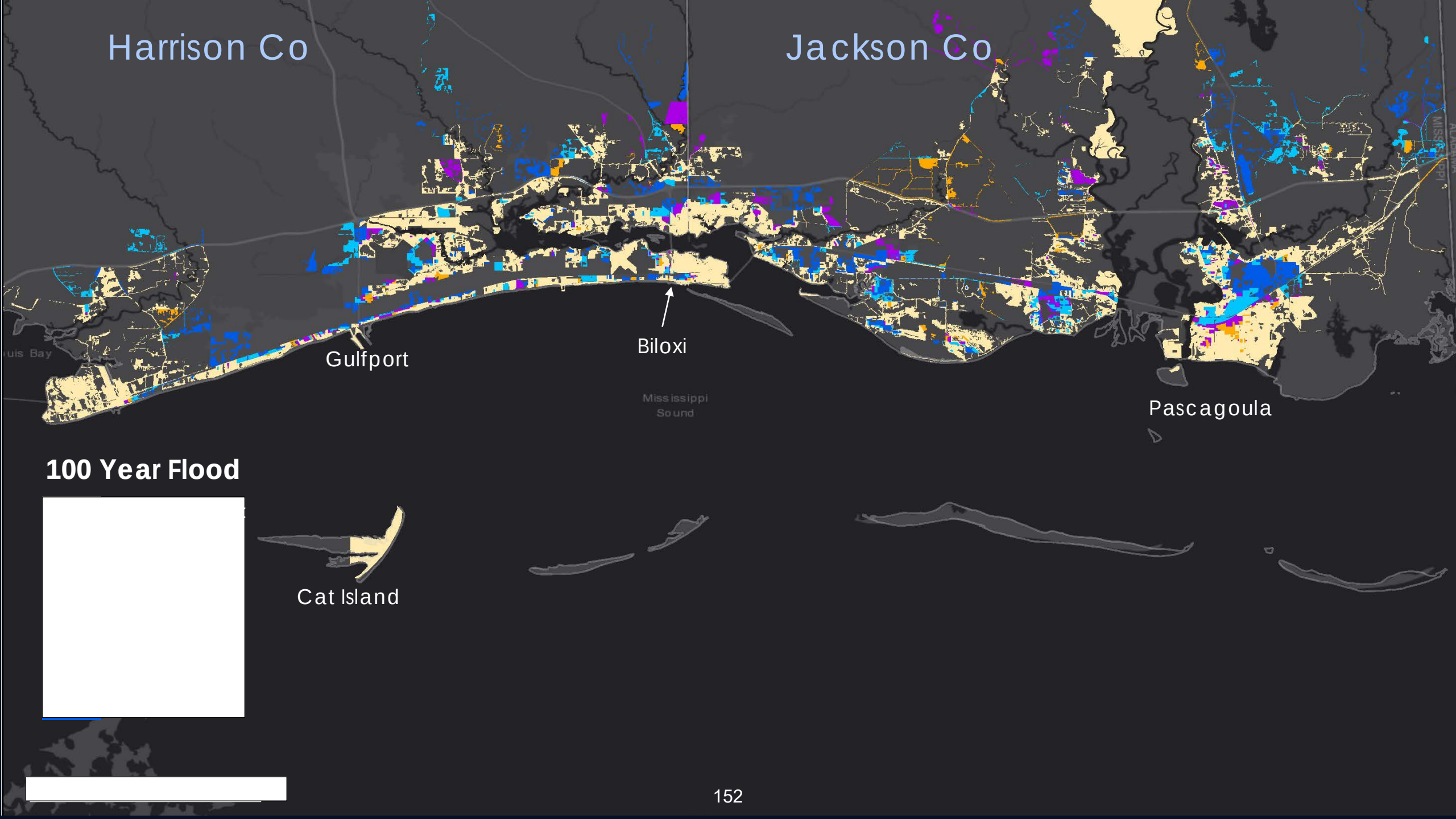

Coastal Mississippi
High SLR 100 year Scenario
2.0 m
Mississippi
Biloxi
Gulfport
Pascagoula
Cat Island
Gulf of Mexico
<

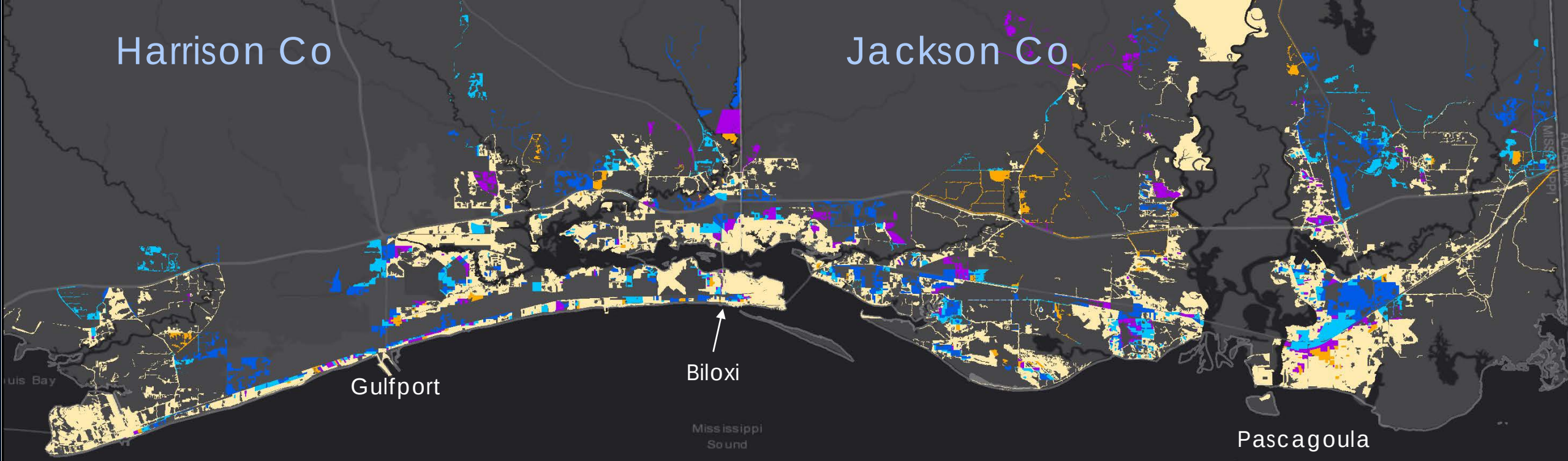
County Comparison



County Comparison:

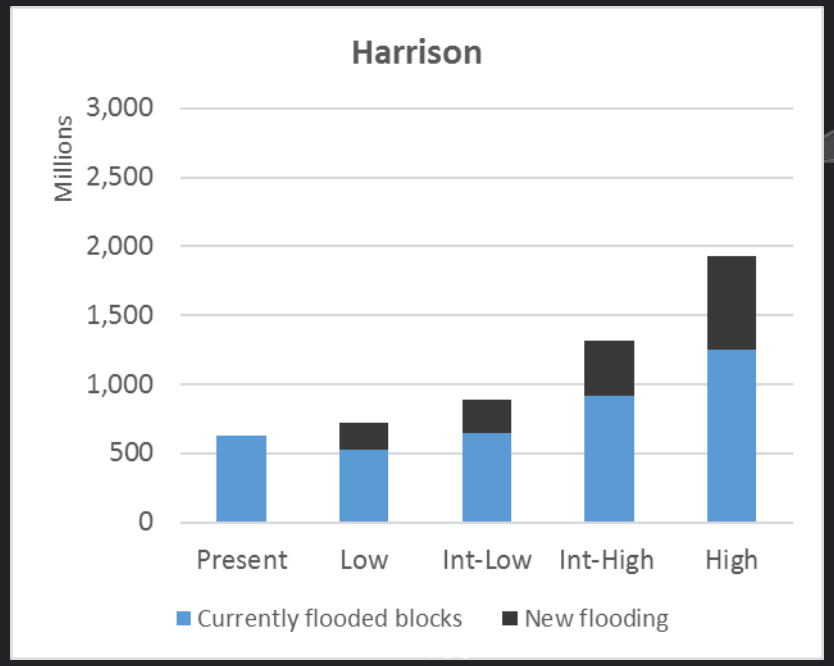


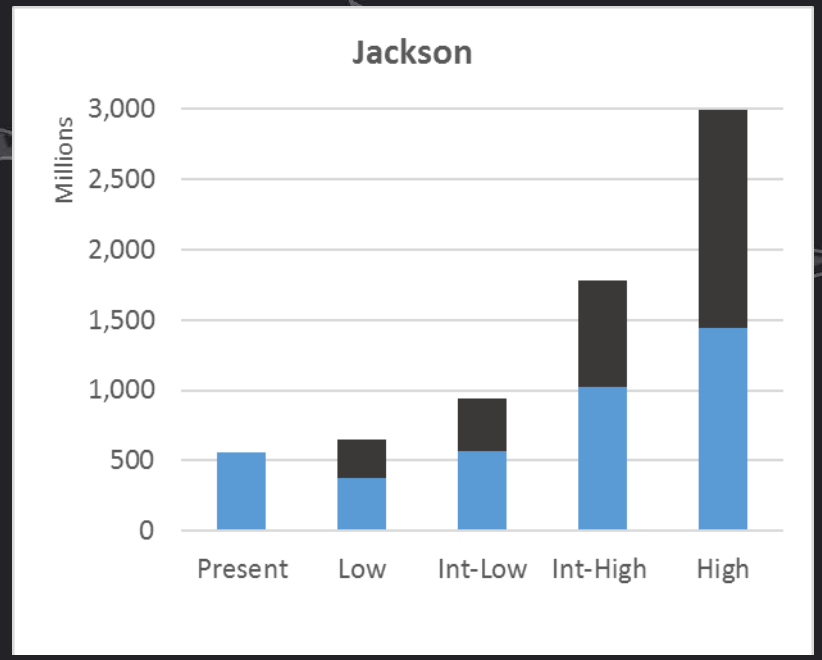

Harrison Co
Jackson Co
Gulfport
Biloxi
Pascagoula
Mississippi Sound
Cat Island
100 Year Flood

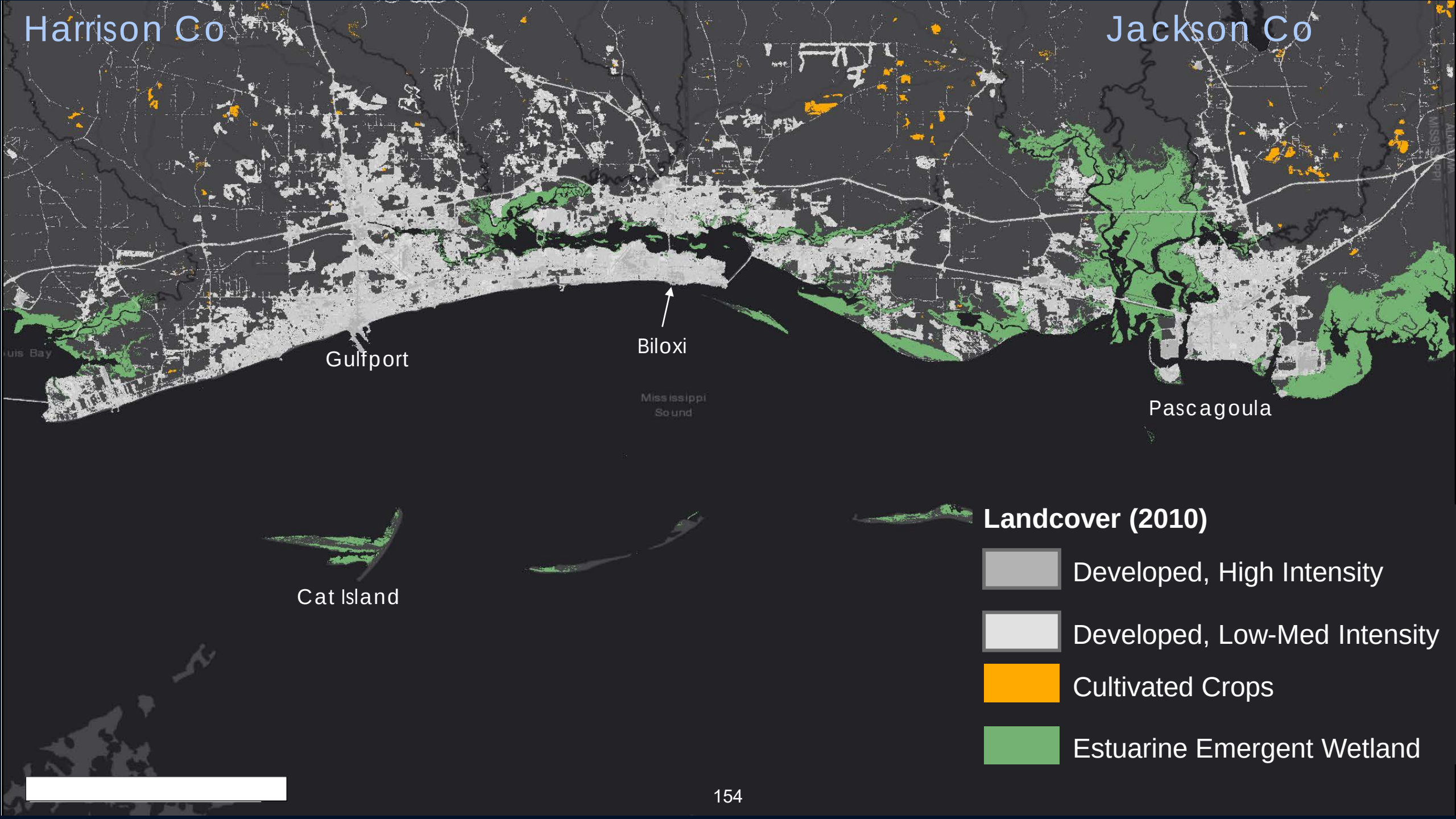


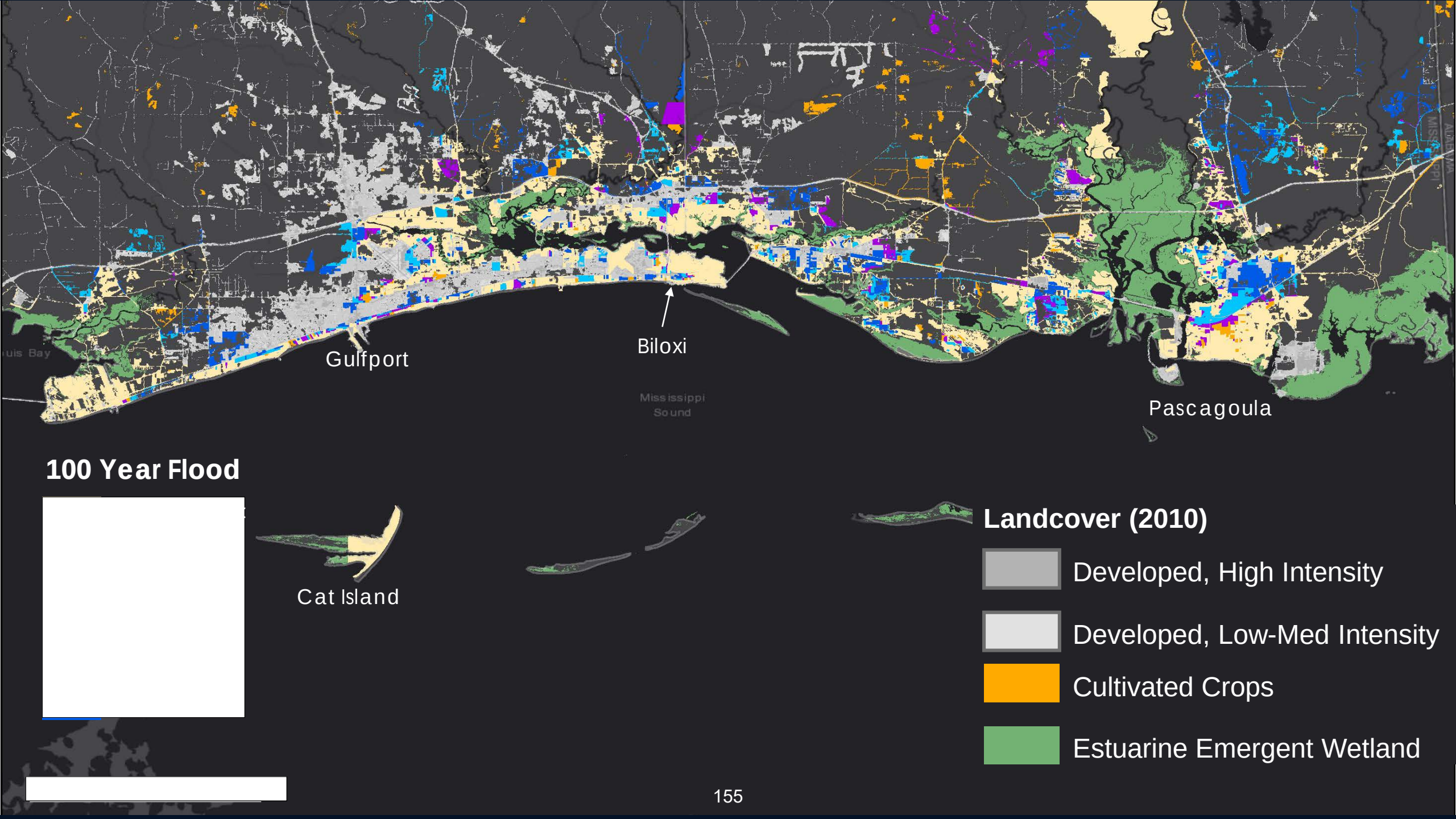
100 Year Flood

Cat Island






Harrison Co
Jackson Co
Gulfport
Biloxi
Pascagoula
Cat Island
Mississippi Sound
Landcover (2010)
Developed, High Intensity
Developed, Low-Med Intensity
Cultivated Crops
Estuarine Emergent Wetland


Gulfport
Biloxi
Mississippi Sound
Pascagoula
Cat Island
100 Year Flood
Landcover (2010)
Developed, High Intensity
Developed, Low-Med Intensity
Cultivated Crops
Estuarine Emergent Wetland

Moving Forward: Priority HAZUS output

- **Building**: building stock and content loss($)
- **Essential facilities**: Schools ($), police station ($) & medical ($)
- **Hazardous materials facilities**
- **Transportation**: Highway Bridges($), Railway Segments ($) and railway facilities, highway segments
- **Utility Systems** (Potable water system facilities, waste water treatment ($), Power Plants ($), Broadcast facilities ($).
- **Demographics**: displacement and shelter needs

Moving Forward: Role of NNBF's

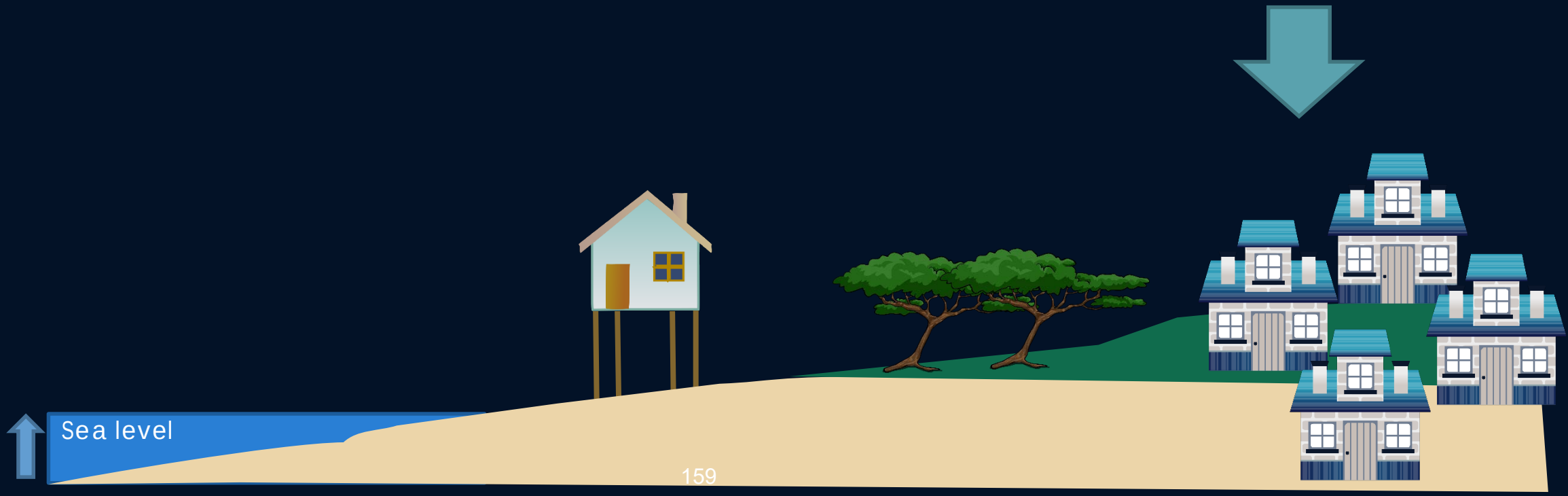
How can natural and nature based features reduce the impact of flooding under SLR?

Moving Forward: Role of NNBF's

How can natural and nature based features reduce the impact of flooding under SLR?

Moving Forward: Increasing development

How will increasing development affect the economic impacts of floods?



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NOAA Center for Coastal and Marine Ecosystems

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Dynamic Sea Level Rise Assessments of the Ability of Natural and Nature-based Features to Mitigate Surge and Nuisance Flooding

This project is led by Louisiana State University, and is funded through the Ecological Effects of Sea Level Rise program (NCCOS). Project partners include Louisiana State University, the University of Central Florida, the University of South Carolina, Texas A&M University–Corpus Christi, and NOAA's Northern Gulf of Mexico Sentinel Site Cooperative.

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APPENDIX D: ACRONYM LIST

Appendix E – Acronym List

Organizations and Agencies

AL DCNR – Alabama Department of Conservation and Natural Resources

FL DEP – Florida Department of Environmental Protection

FL FWCC – Florida Fish and Wildlife Conservation Commission

LSU – Louisiana State University

MASGC – Mississippi Alabama Sea Grant Consortium

MS DMR – Mississippi Department of Marine Resources

NERR – National Estuarine Research Reserve

NGOM SSC – Northern Gulf of Mexico Sentinel Site Cooperative

NOAA NCCOS – National Oceanic and Atmospheric Agency National Centers for Coastal Ocean Science

NOAA NMFS – National Oceanic and Atmospheric Agency National Marine Fisheries Service

NOAA NOS – National Oceanic and Atmospheric Agency National Ocean Service

NOAA OCM – National Oceanic and Atmospheric Agency Office for Coastal Management

OSU – Oregon State University

RPC – Regional Planning Council

TAMU CC – Texas A&M University Corpus Christi

TNC – The Nature Conservancy

UCF – University of Central Florida

US FWS – United States Fish and Wildlife Service

USGS – United States Geological Survey

WMD – Water Management District

Other Acronyms

DEM – Digital Elevation Model

EESLR – Ecological Effects of Sea Level Rise

EESLR-NGOM – Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico project

EIA – Economic Impacts Assessment

ESV – Ecosystem Services Valuation

HAZUS – Hazards US a FEMA model to assess the economic impacts of natural disasters

LULC – Land Use Land Change

MTAG – Management Transition Advisory Group

NGOM – Northern Gulf of Mexico

NGOM+N2E2 – Current project title based on key features of the project (**N**atural and **N**ature Based Features, **E**cosystem Services Valuation, **E**conomic Impacts Assessment)

NNBF – Natural and Nature Based Feature

NWI – National Wetlands Inventory

PCOI – A model that does large-scale assessments of morphologic changes

SLR – Sea Level Rise

TLP – Thin Layer Placement

XBeach – A model that does high resolution analysis of morphologic changes