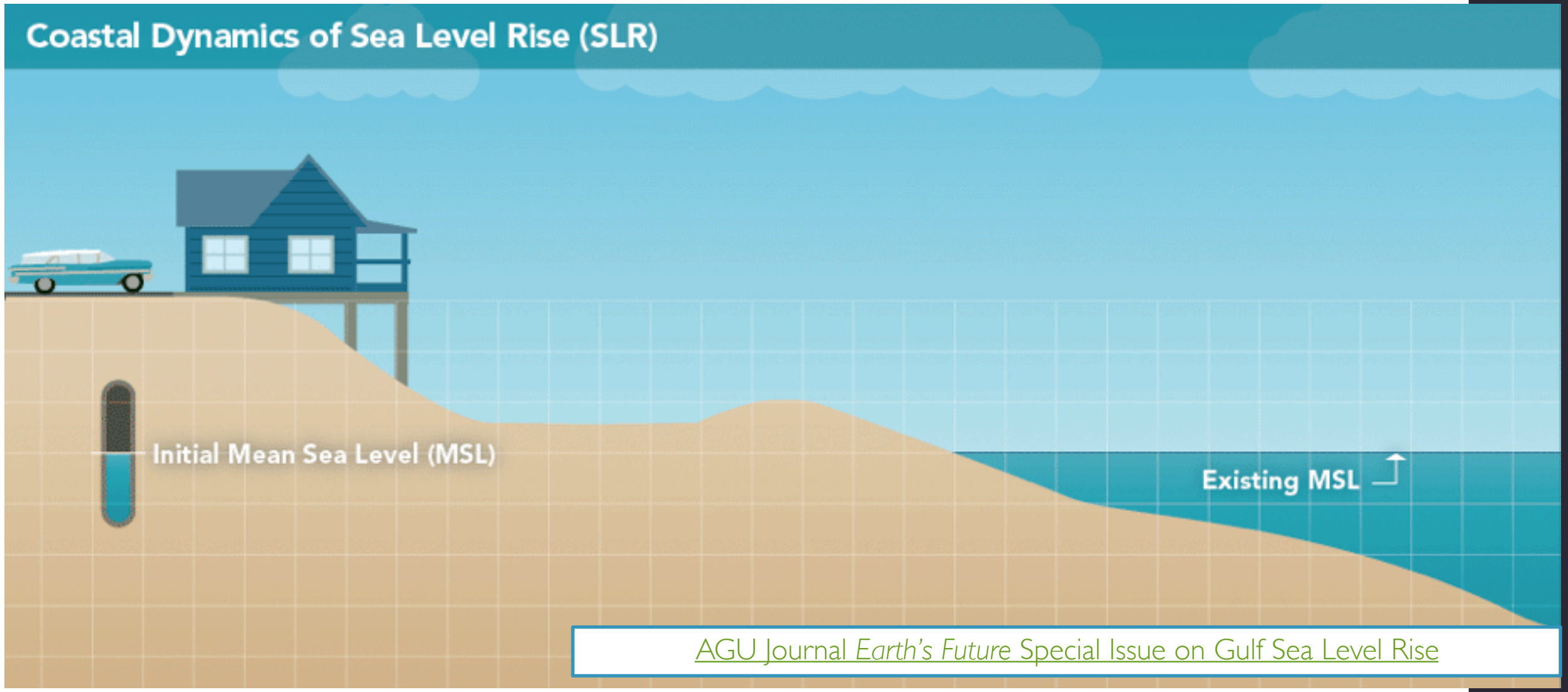
Coastal Change & Community Response

Renee Collini
Rising with the Tides
November 17, 2021

Overview

- Changing Shorelines & Impacts
- Decision-Making for an Uncertain Future
- Case Studies
- Wrap-Up

Small Rise Causes Big Changes



AGU Journal *Earth's Future* Special Issue on Gulf Sea Level Rise

Small Rise Causes Big Changes

AGU Journal *Earth's Future* Special Issue on Gulf Sea Level Rise

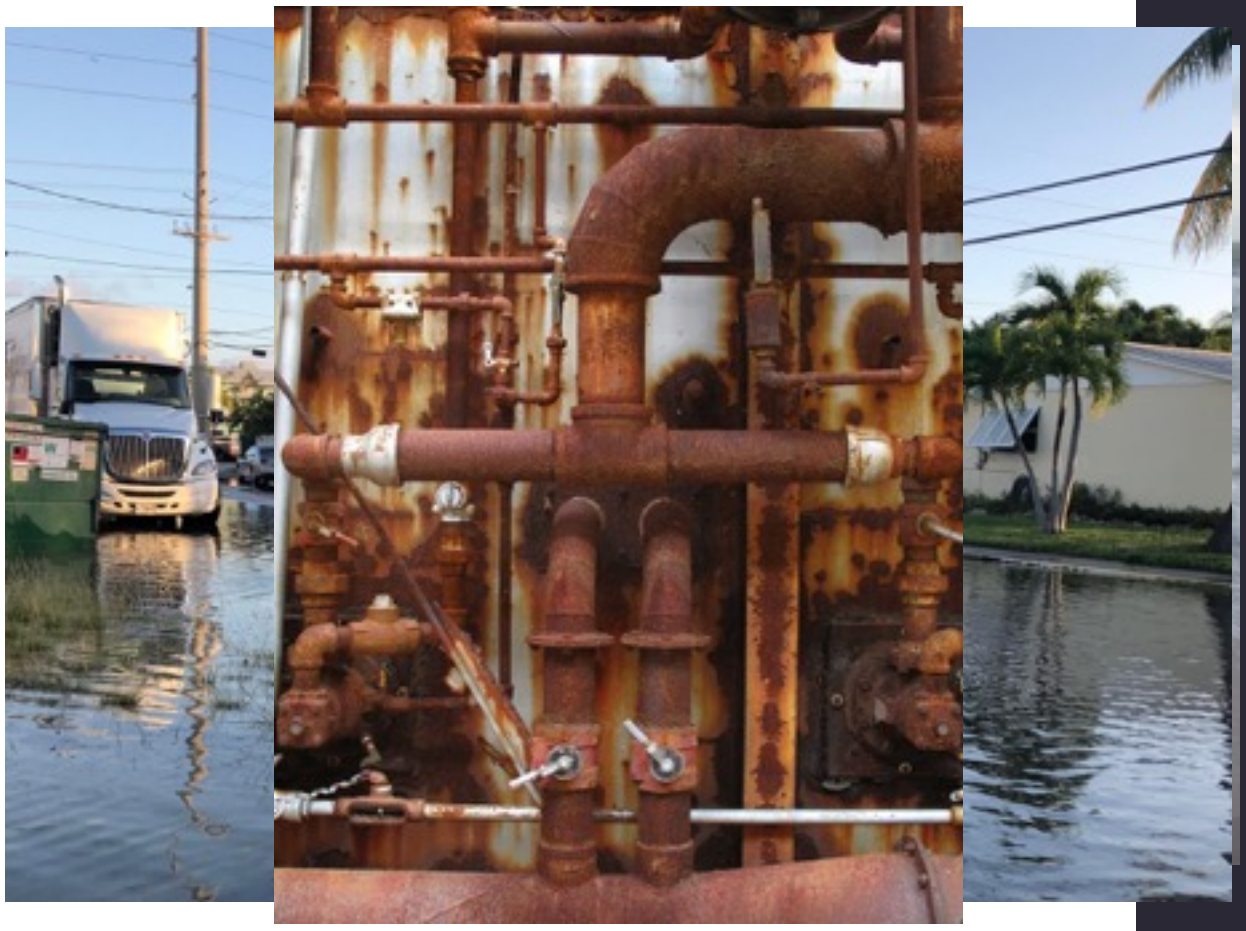
Not a Set "Path" f
SLR Resilienc

- Similar elements
  - Information
  - Action plan
  - Implementation
- Additional similar
  - Stakeholder engage
    buy-in
  - Data gathering
  - Revisiting

How much SLR should I plan for?

What does sea-level rise look like?

- Reduced storm drainage
- Exacerbated storm surge
- Increased erosion
- High tide flooding
- Saltwater intrusion



What does it mean for people?

- Health risks
- Safety issues
- Direct damages
  - Individuals & Communities
- Economic disruptions
- Reduction in services
- Cultural impacts

We can change this outcome!

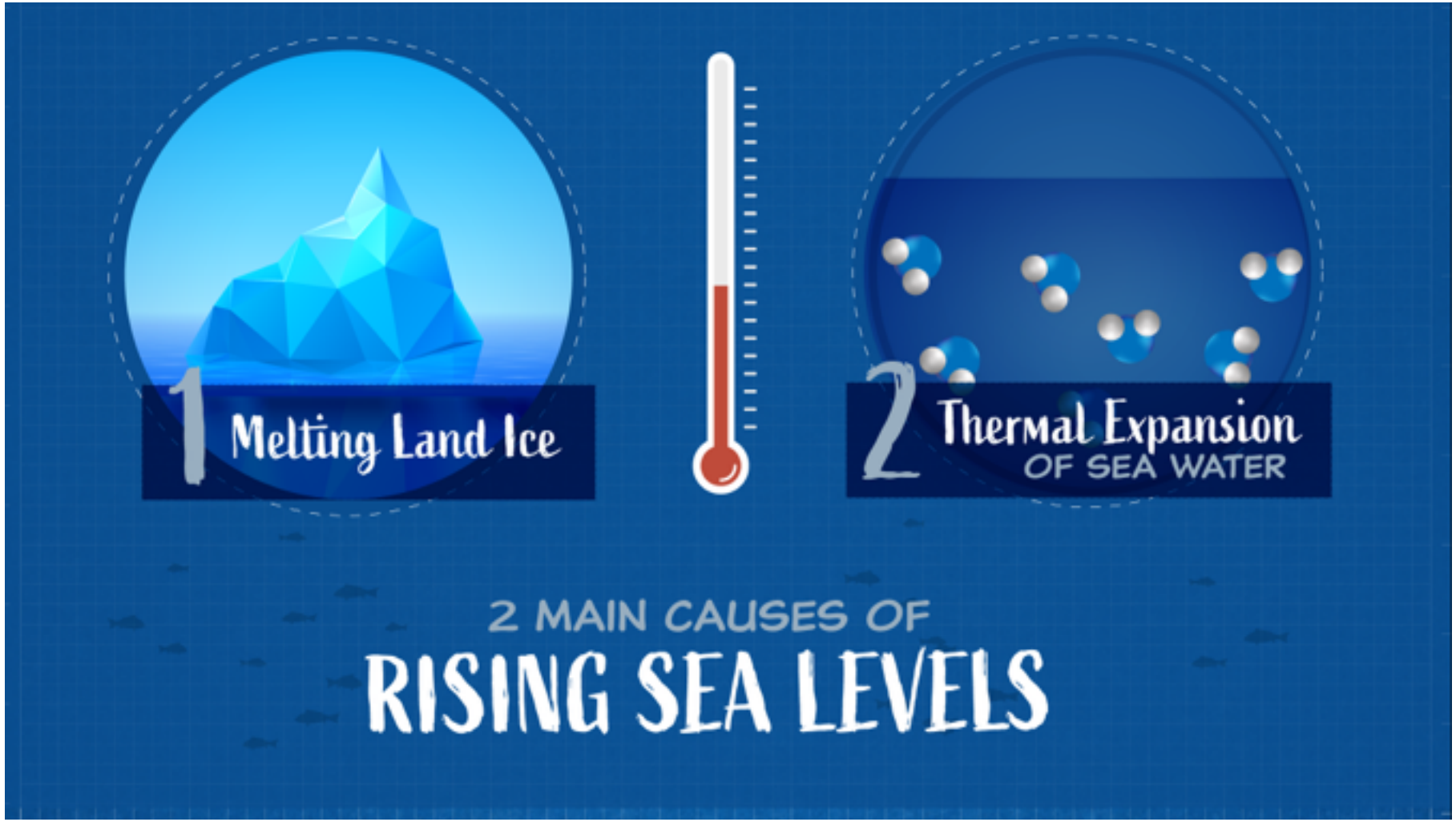
- We can preserve
  - Services
  - Infrastructure
  - Health
  - Communities
  - Cultures
- It will look different

Understanding SLR

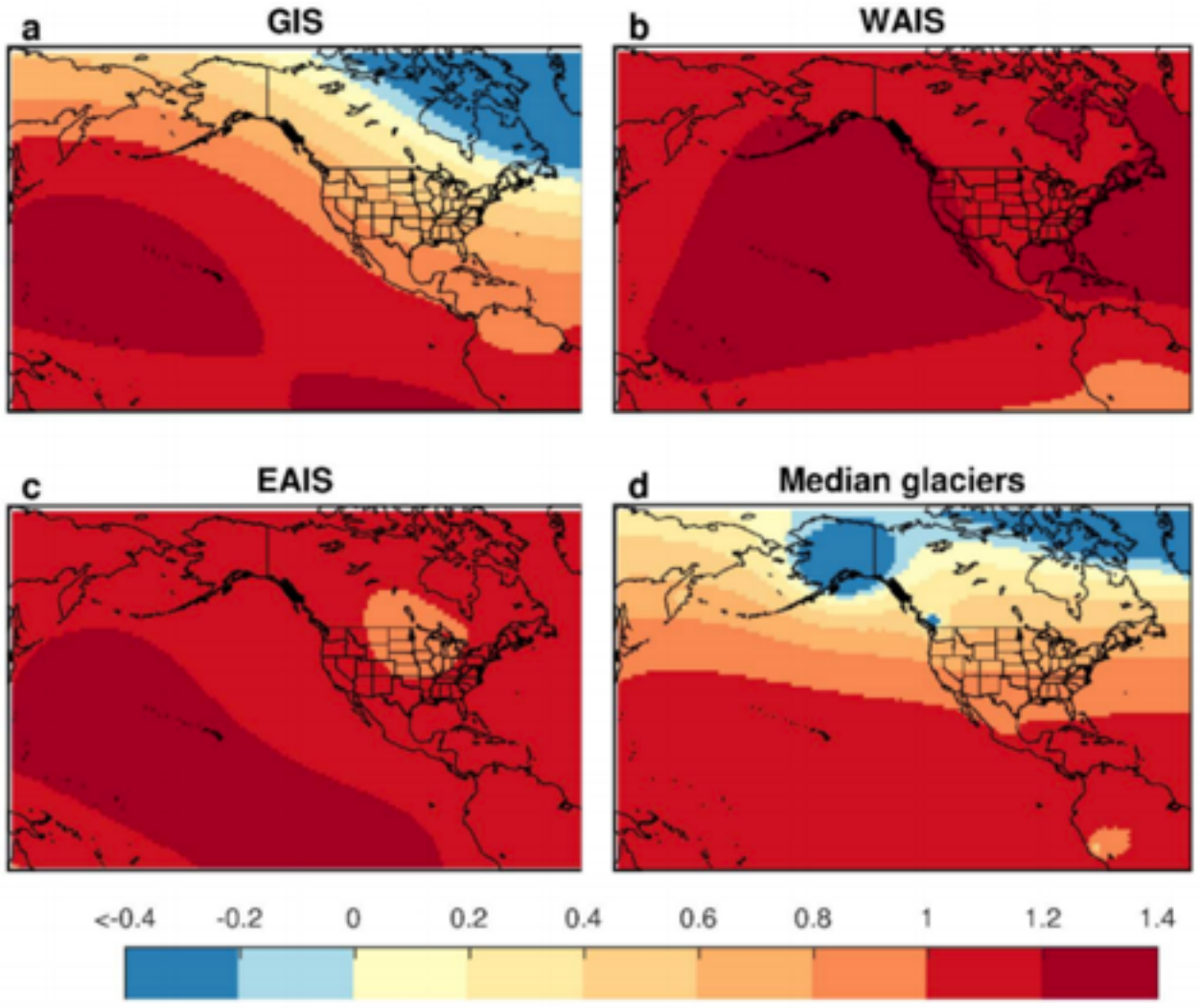
What is sea-level?

How do we know?

What is causing sea-level rise?

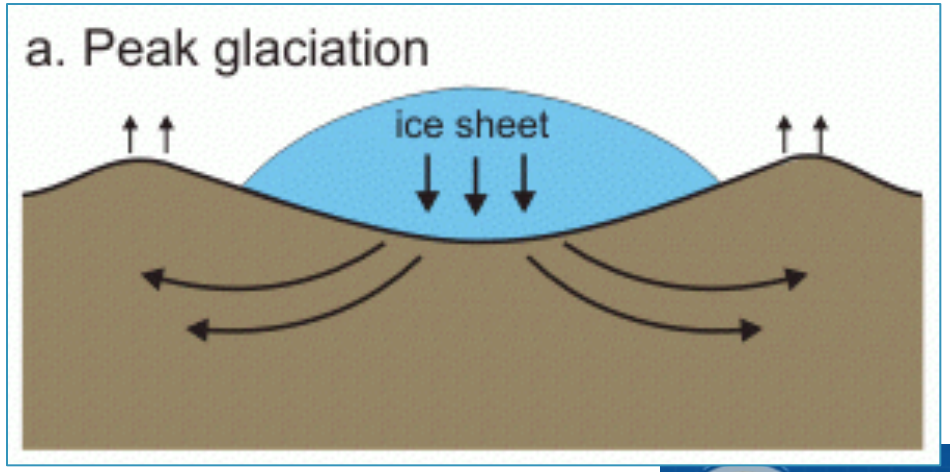


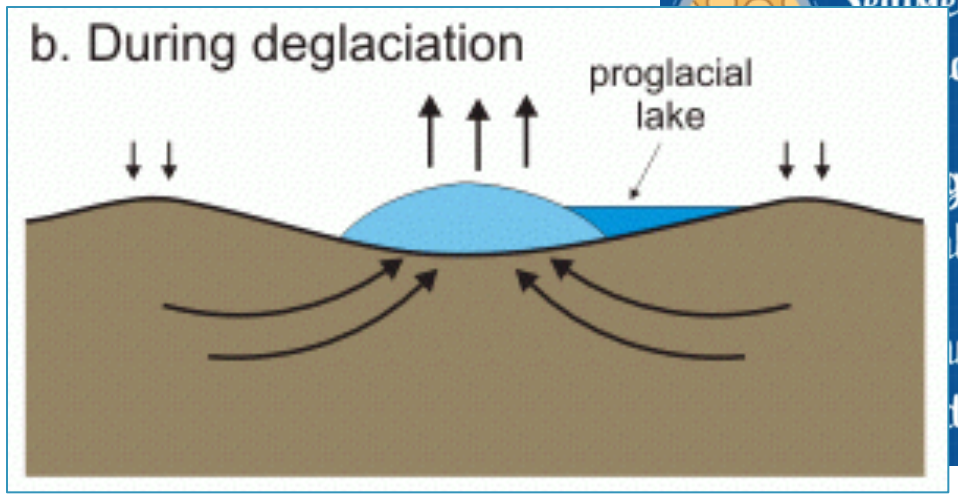
What is causing sea-level rise?

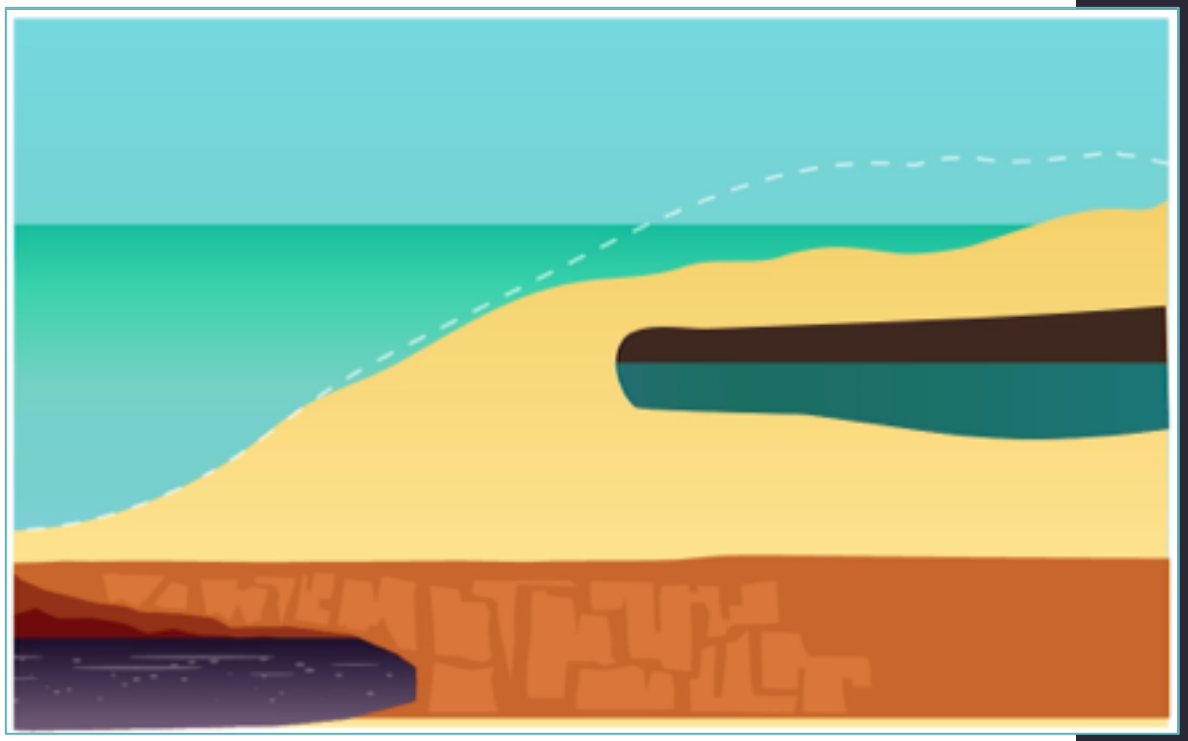


Sweet et al., 2017

What is causing sea-level rise?

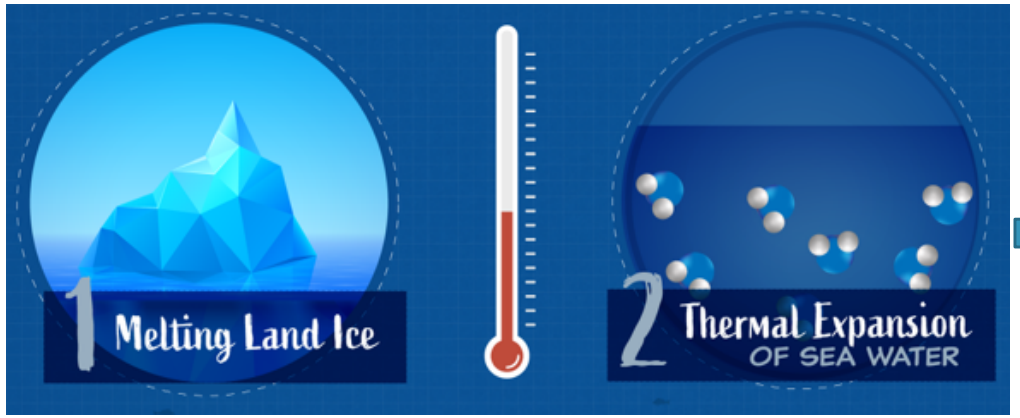


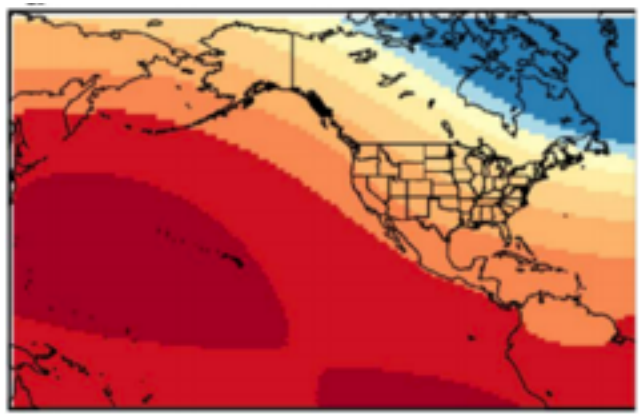


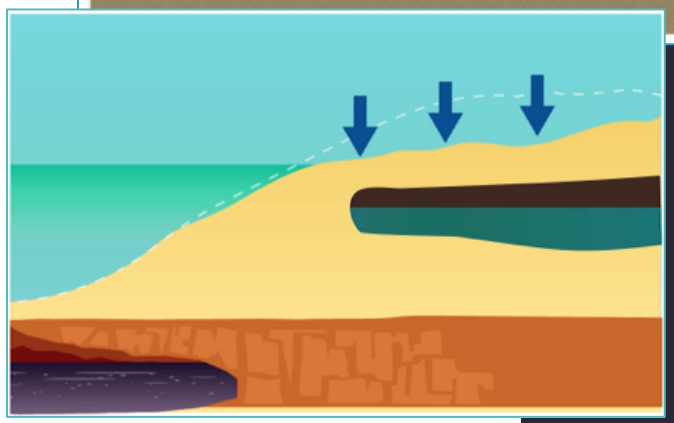


Relative Sea Level Rise

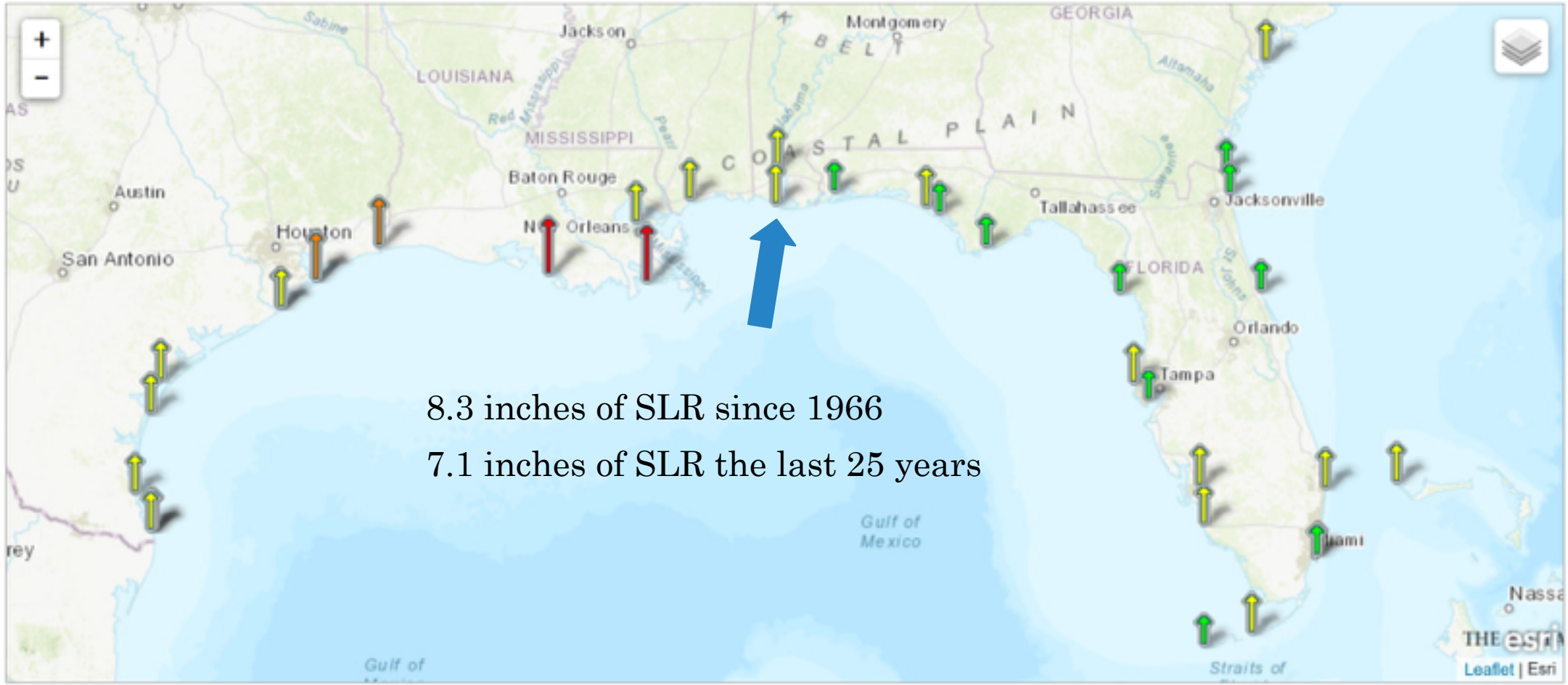
- The localized impacts from the combination of:
  - Eustatic SLR
  - Climatic signals
  - Vertical land motion







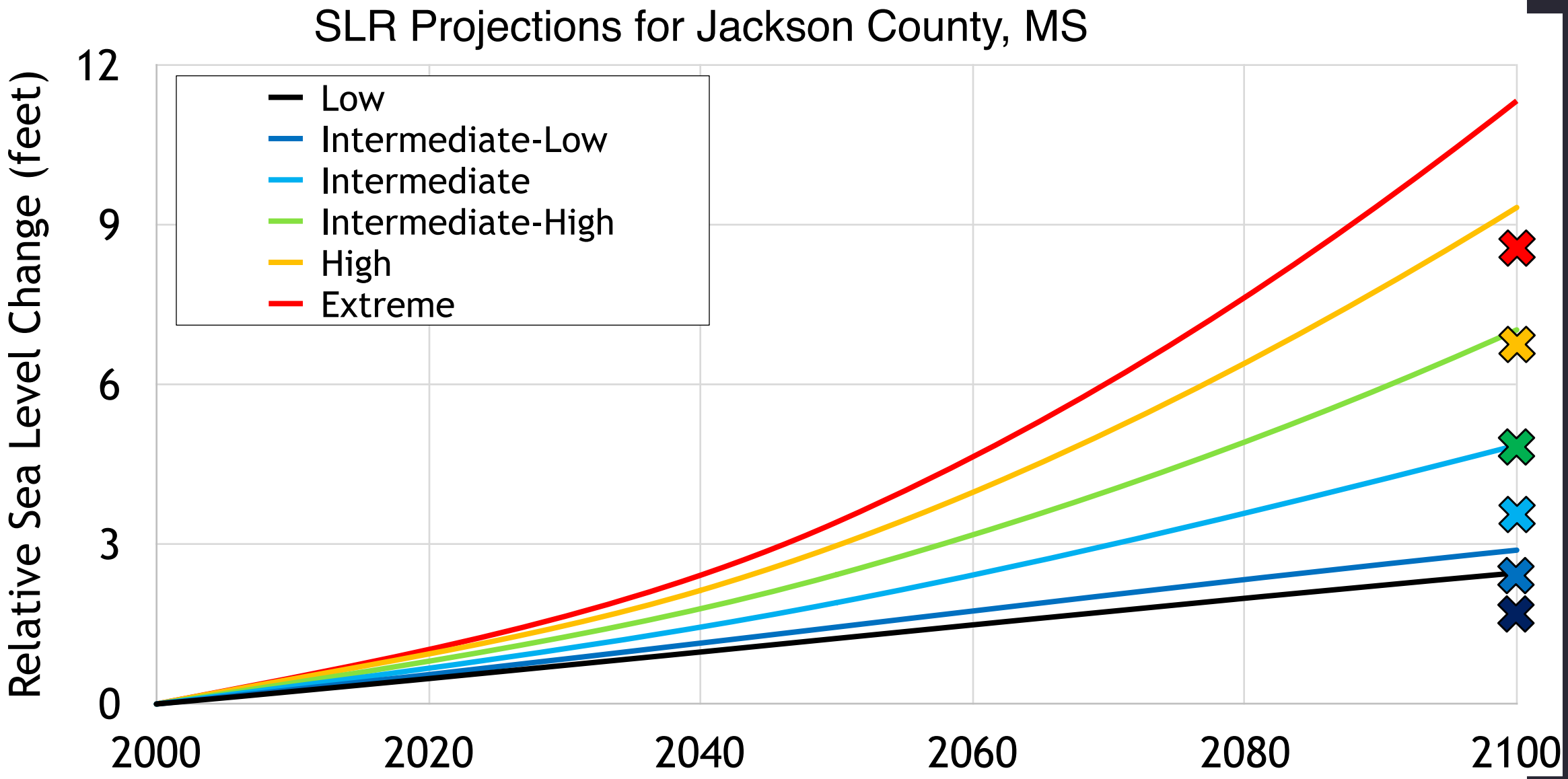
Relative Sea Level Rise



8.3 inches of SLR since 1966

7.1 inches of SLR the last 25 years

Relative Sea-Level Rise Scenarios

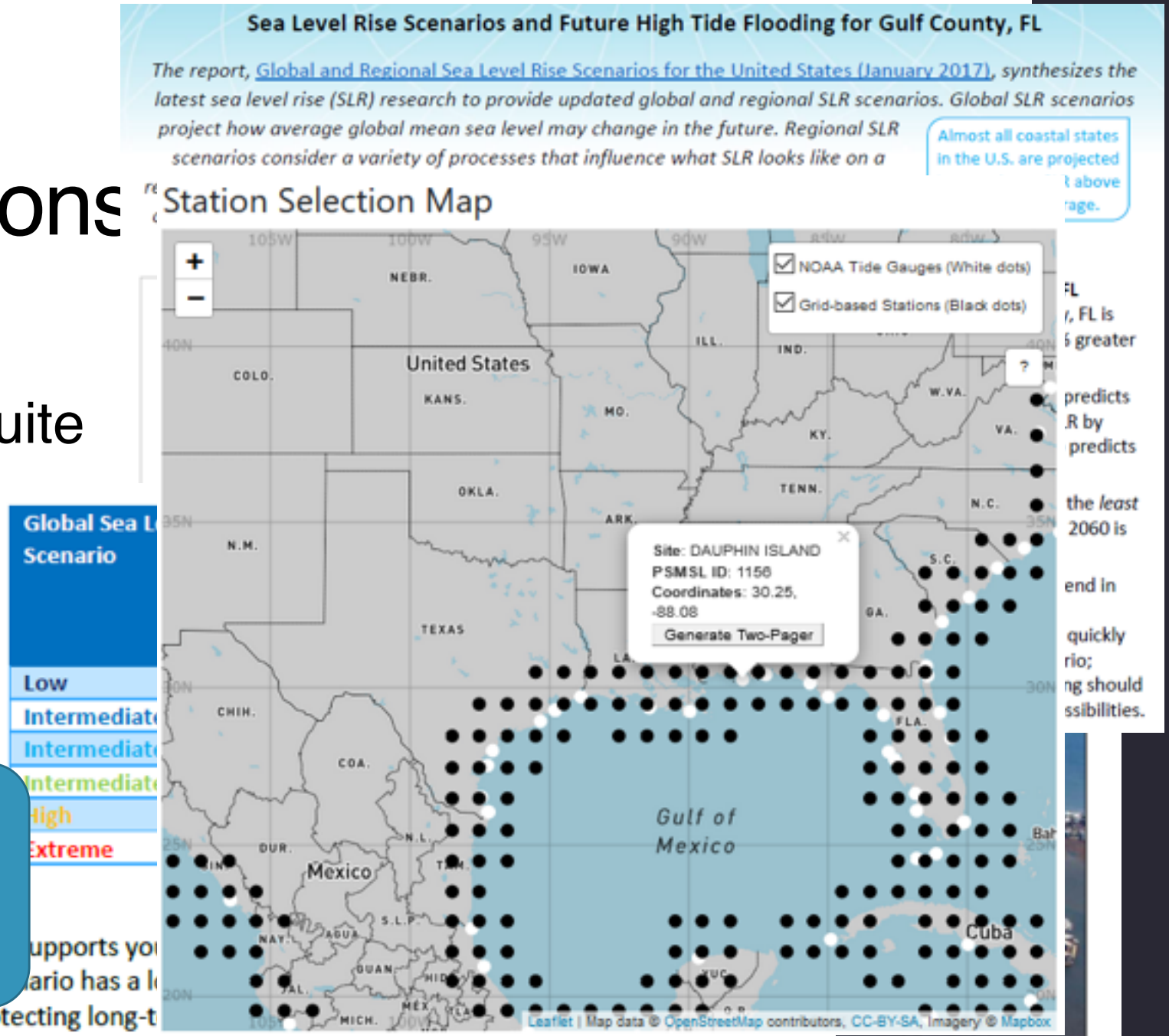


Local SLR Projections

- Sweet et al., 2017
- Printable PDF Resource Suite
- On

What do the probabilities mean?
The updated scenarios, **low** through **extreme**, cover the range of scientifically plausible scenarios. Probabilities help us understand the likelihood of each scenario occurring. For example, under RCP8.5, it is 100% likely that there will be at least 1 foot of SLR by 2100, while there is a low probability that there will be 8.2

www.LocalSLR.org



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How much SLR should I plan for?

How much SLR *should* I plan for?

- There is not the right question
- Replace it with:

How should I deal with uncertainty in SLR for this instance?

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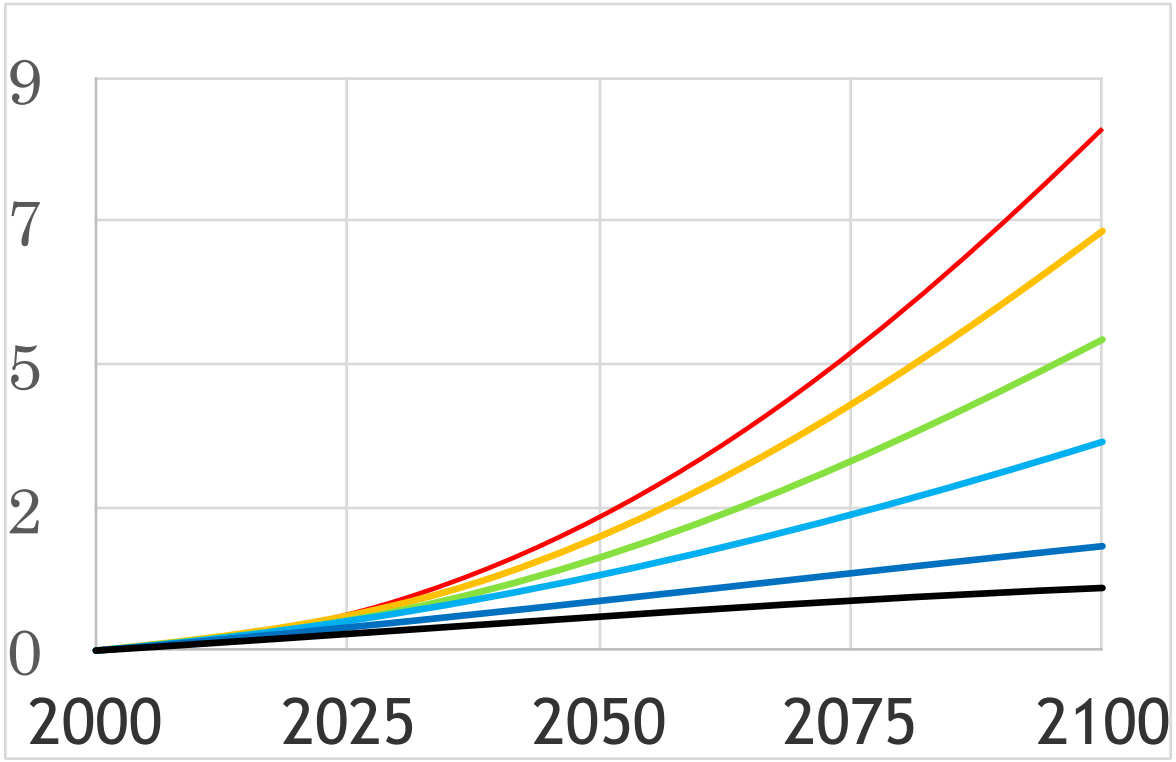
- Replace it with:

How should I deal with **uncertainty** in SLR **for this instance**?

Step One: Understanding Why There Are Scenarios

Why such a large range?



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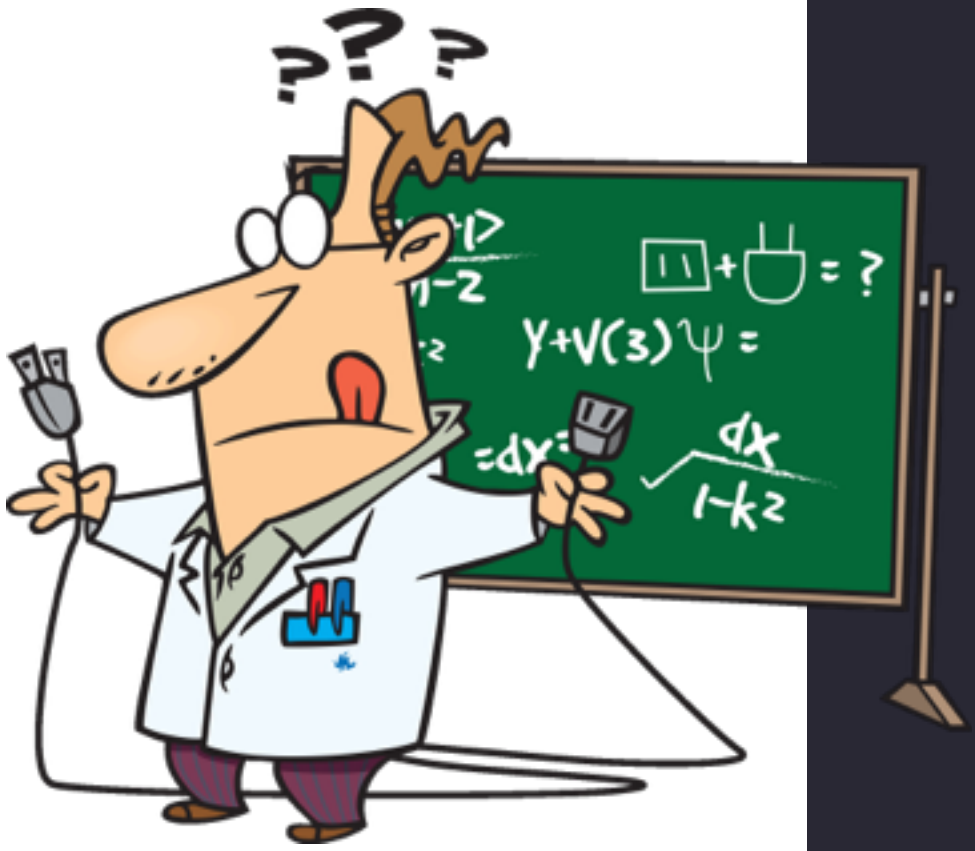


Big companies' climate cl
are 'unambitious', say an

U.S. NEWS

US companies act on climate despite Trump: Survey

- Companies are still among the most ambitious in setting targets to combat global warming despite President Donald Trump's plans to quit the Paris

n a 2017 "A list" of 159 companies
ng climate change and protecting

Ireland secures 'fair deal' on carbon emissions under EU pact

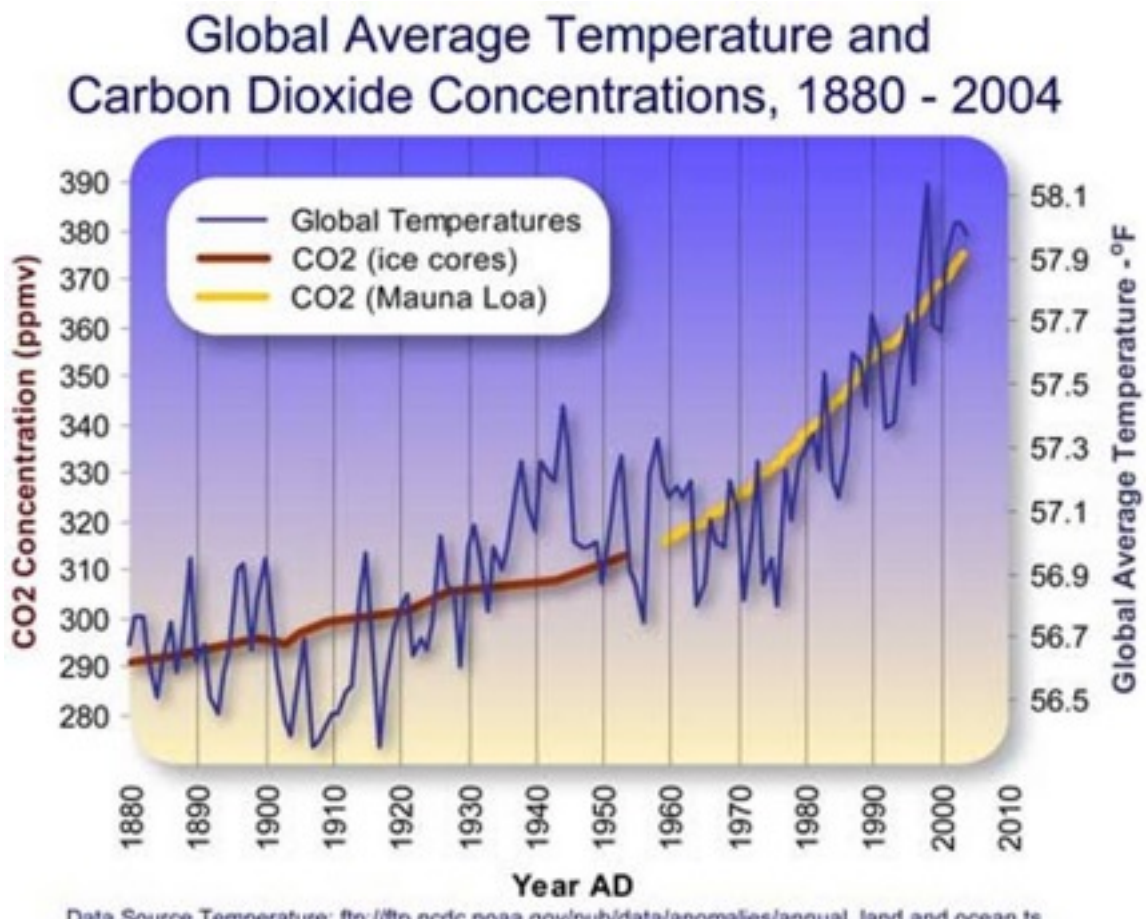
Implementing the Paris Agreement in the Pacific

Over 400 industries reduced CO2 emission by 2% in 2012-15

PTI | Oct 25, 2017, 02.23 PM IST

1 – We do not know how much carbon will be in the atmosphere.

Three major reasons for scenarios

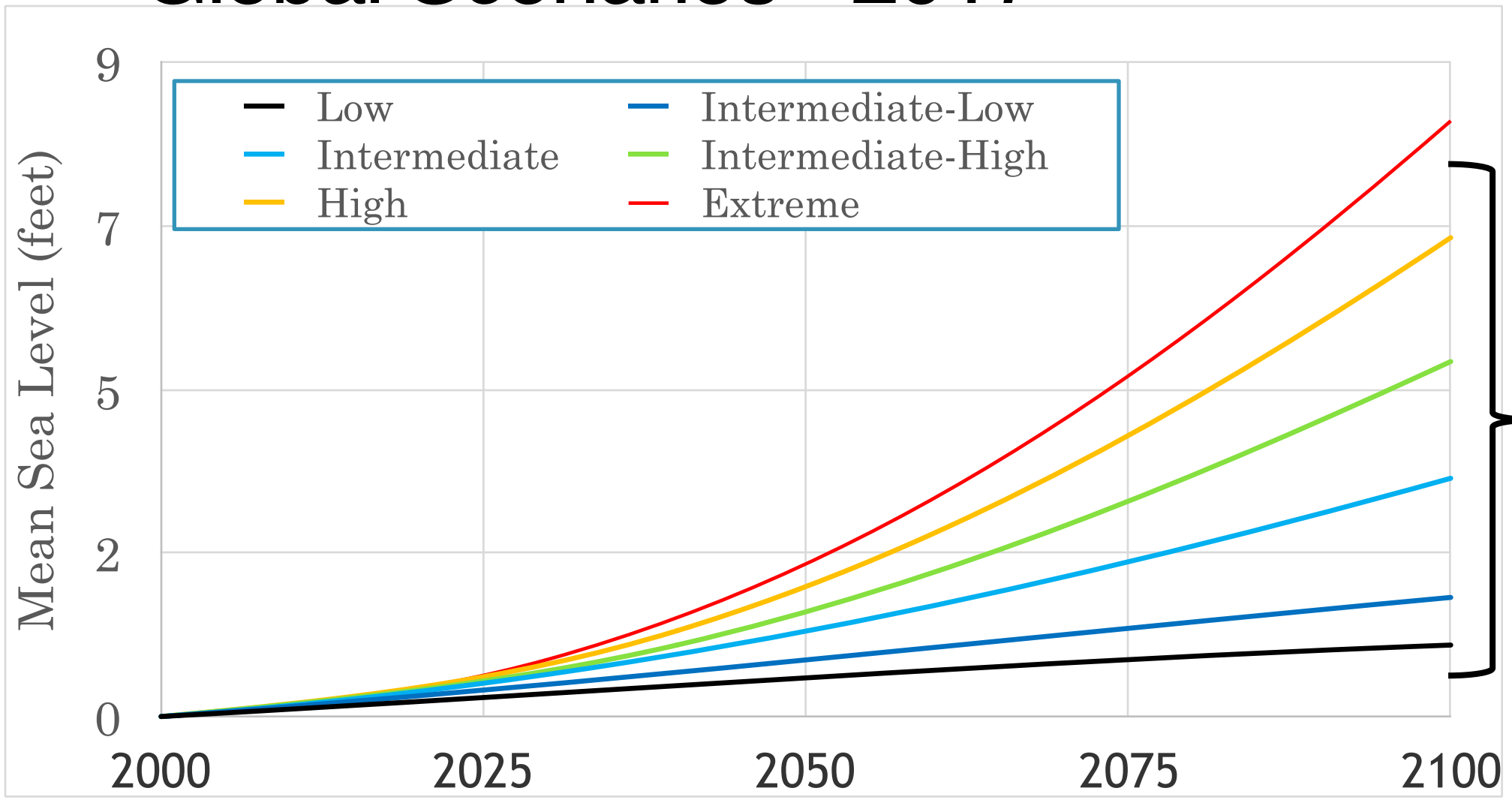


2 – Natural variability

Three major reasons for scenarios

3 – Still studying the ice sheet melt – the science to watch!

Global Scenarios - 2017



Range of scientifically possible scenarios

Likelihood of scenarios

Global Sea Level Rise Scenario	RCP2.6 dramatic	RCP4.5 modest	RCP8.5 no change carbon ssions
Low			0%
Inter			6%
Inter			7%
Inter			3%
High			.3%
Extreme	0.05%	0.05%	0.1%

Scenarios are being updated - will see some shifts in probabilities & the projections.

Questions about the basics of SLR?

Step Two: Identifying an approach for dealing with uncertainty

Approaches for Addressing SLR Uncertainty

Approaches for Addressing SLR Uncertainty

- Commonalities
  - Stakeholder integration
  - Permit decision-making in an uncertain future
  - Require clear goals & objectives
  - Can be used as standalone or in combination

Risk Tolerance

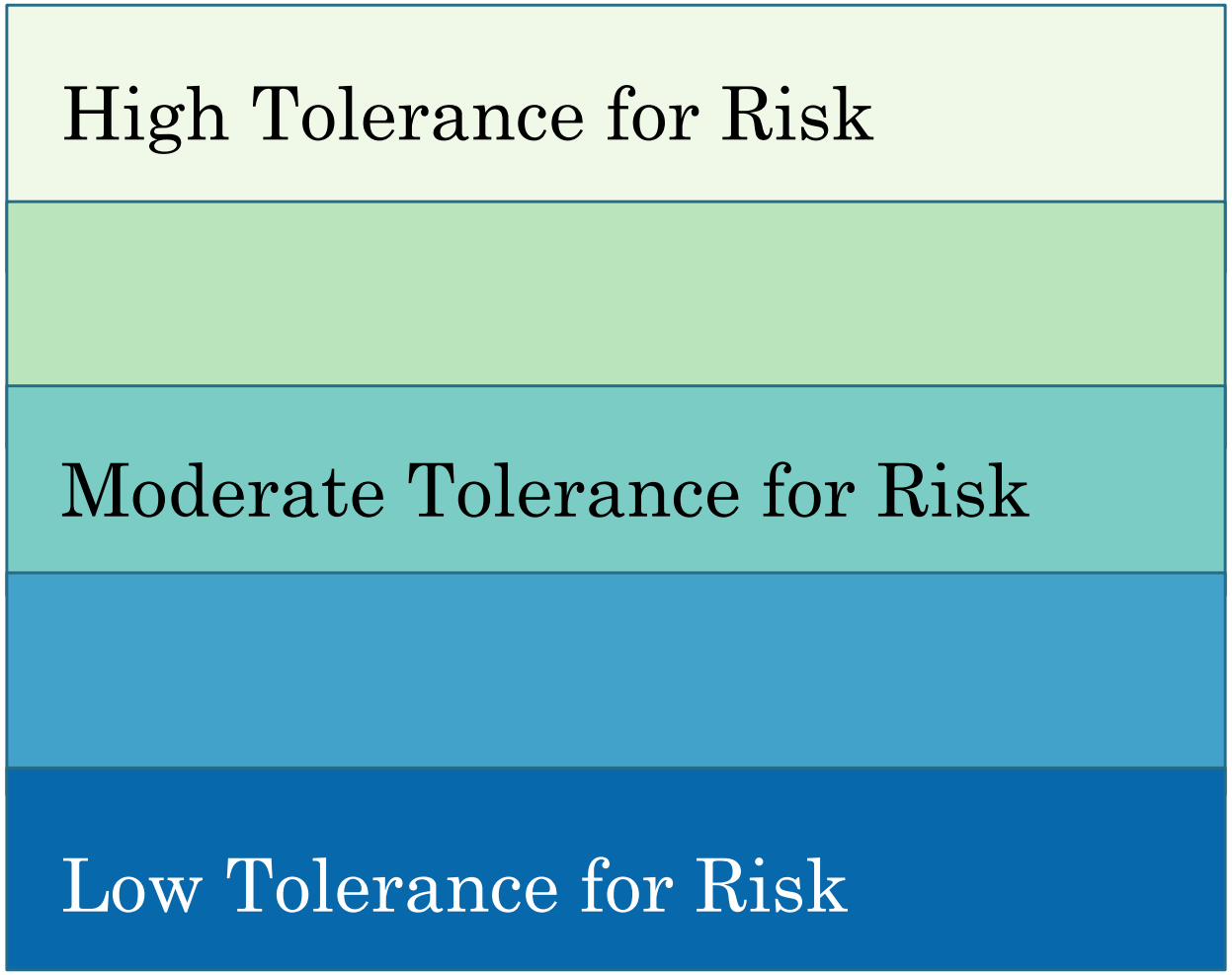
Global Sea Level Rise Scenario	RCP2.6 dramatic reduction of carbon emissions	RCP4.5 modest reduction in carbon emissions	RCP8.5 no change in carbon emissions
Low	94%	98%	100%
Intermediate-low	49%	73%	96%
Intermediate	2%	3%	17%
Intermediate-high	0.4%	0.5%	1.3%
High	0.1%	0.1%	0.3%
Extreme	0.05%	0.05%	0.1%

Adapted from Sweet et al., 2017

Risk Tolerance

- Leverages exceedance probabilities
- Considers project specific-risk tolerance & timeline
- Well suited for:
  - Stable projects and locations (e.g., fixed critical infrastructure)
  - Conservation purchases
  - Built/non-living structures
  - Things that are really important or really unimportant
- Not well suited for:
  - Dynamic environments (e.g., beaches/dunes)
  - Some aspects of restoration activities (e.g., marsh platform design)

What is your flood risk tolerance?



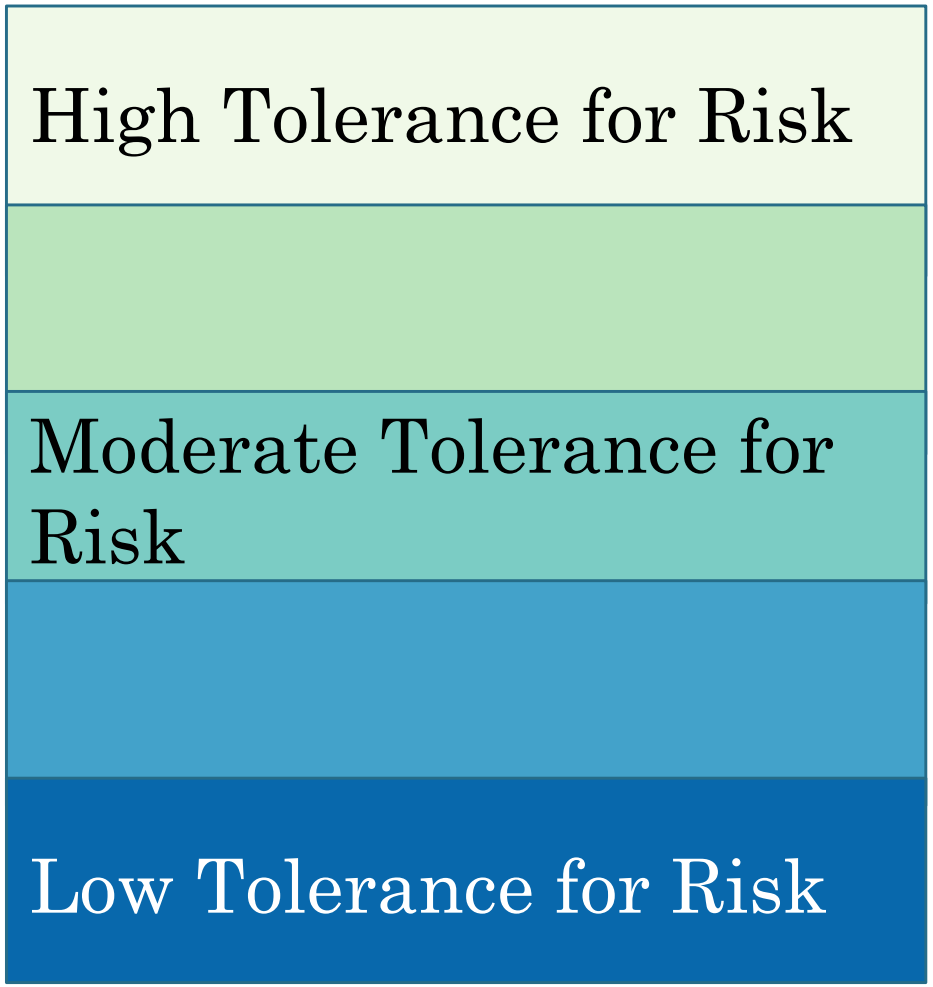
Minor Impact

Moderate Impact

Major Impact

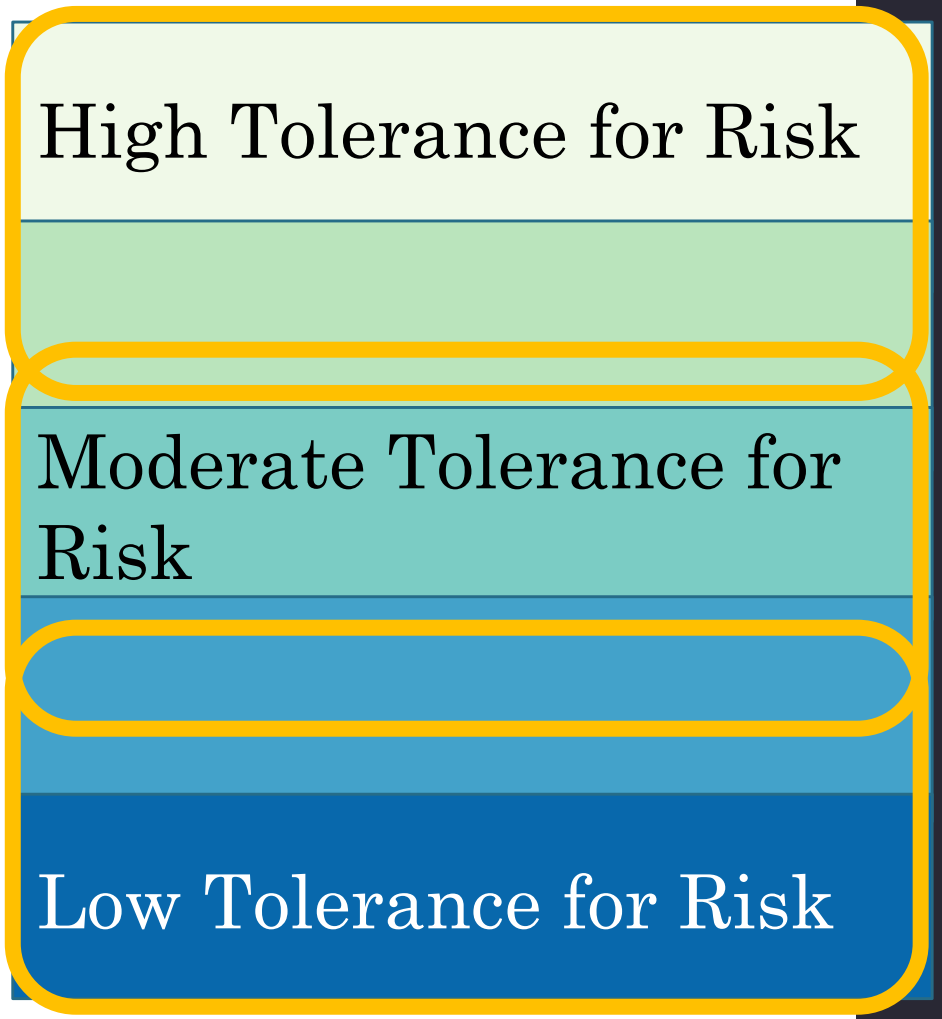
Thinking about your risk tolerance

- Scale dependent
- Location dependent
- Cost/value
- Function
  - Critical service?
  - Number of people impacted
- Length of Time
- Adaptability



Linking risk tolerance & likelihood

Sea level rise scenario	Likelihood
Low	100%
Intermediate-low	96%
Intermediate	17%
Intermediate-high	1.3%
High	0.3%
Extreme	0.1%

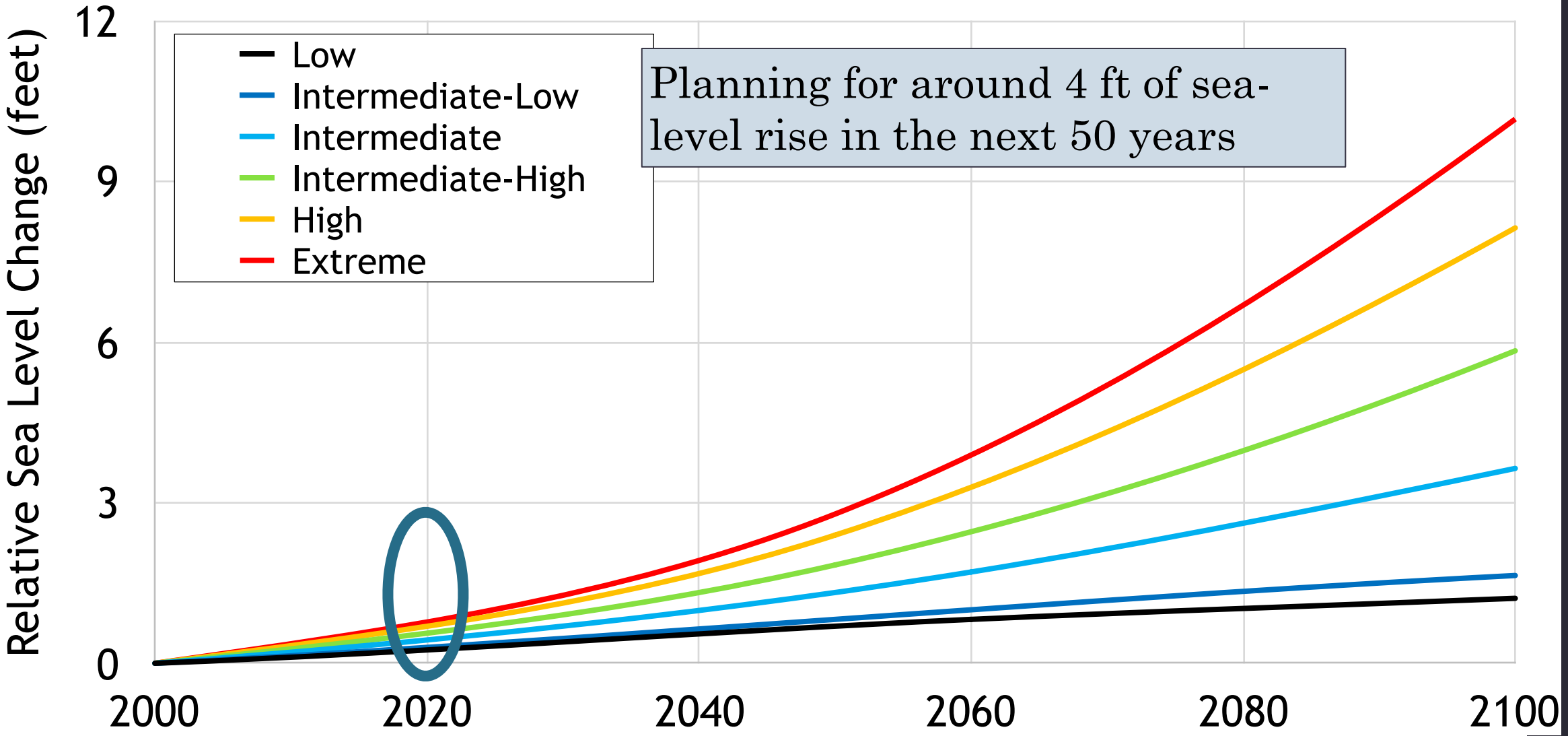


Low chance of happening, but would have a big impact

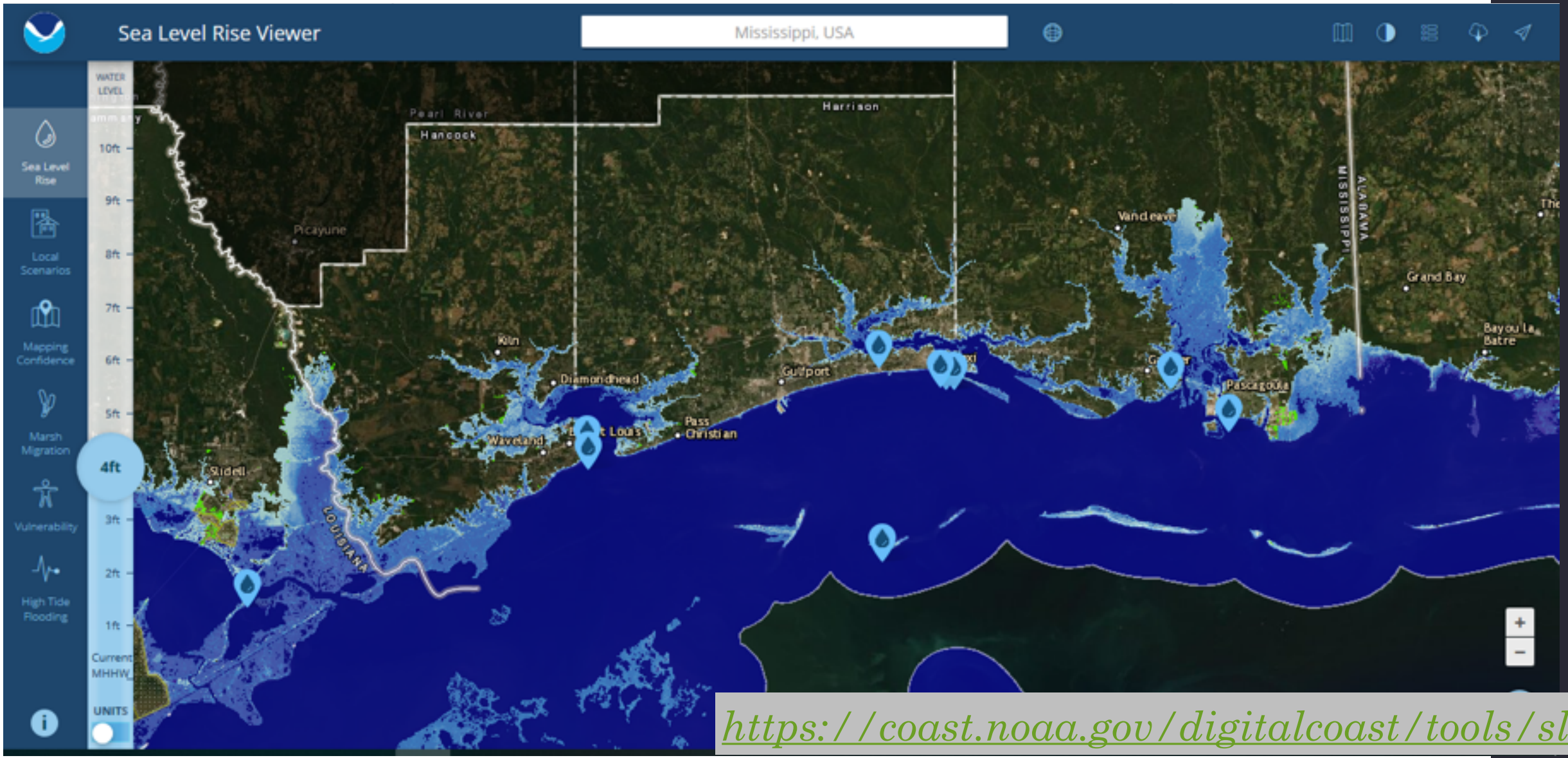
Moderate chance of happening, would have a low impact

Moderate chance of happening, would have a moderate impact

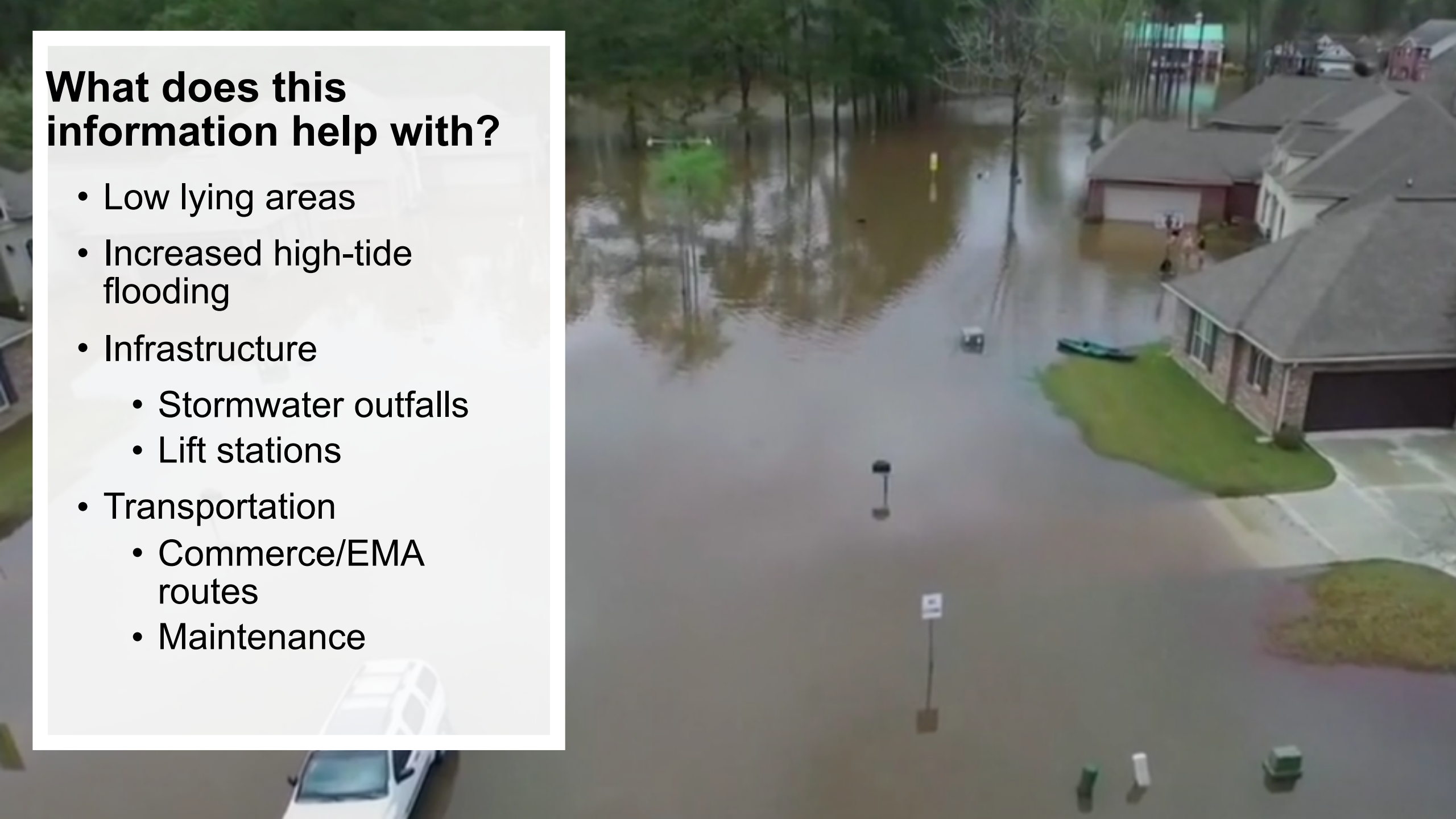
Hospital in Coastal County



Translate your scenario – new high tide



https://coast.noaa.gov/digitalcoast/tools/slr



What does this information help with?

- Low lying areas
- Increased high-tide flooding
- Infrastructure
  - Stormwater outfalls
  - Lift stations
- Transportation
  - Commerce/EMA routes
  - Maintenance

Translate your scenario – future storm surge

An EESLR-NGOM Story Map

Coastal Dynamics of Sea Level Rise: Simulated Storm Surge

Stillwater Storm Surge

Download the data

By using state-of-the-art high-resolution astronomic tide, wind-wave, and hurricane storm surge modeling, **return period (percent annual chance) stillwater elevation** maps under four different sea level rise scenarios were developed. These 1% and 0.2% annual chance data (commonly referred to as 100 and 500 year flood plains) were developed to assess the effects of future coastal change on stillwater storm surge under different SLR scenarios.

Inundation depth above ground (m)

6.0+ (m)
4
2
0.1 (m)

Stillwater storm surge inundation depth above ground (in meters) in 2100 for Low (+0.2m or 0.7ft in left panel) and Intermediate-High (+1.2m or 3.9ft in right panel) sea level rise scenarios. Data ranges shown are equivalent to 0.3 to 19.7 feet.

Shown at right are the 1% annual chance probability of storm surge inundation in 2100 for **Low** (+0.2m or 0.7ft in left panel) and **Intermediate-High** (+1.2m or 3.9ft in right panel) SLR scenarios.

Try this:

Slide the bar to see changes in storm surge inundation depth between these two scenarios. Enter 'Pensacola, FL' in the location search box (top right) to see storm surge differences near Pensacola, FL.

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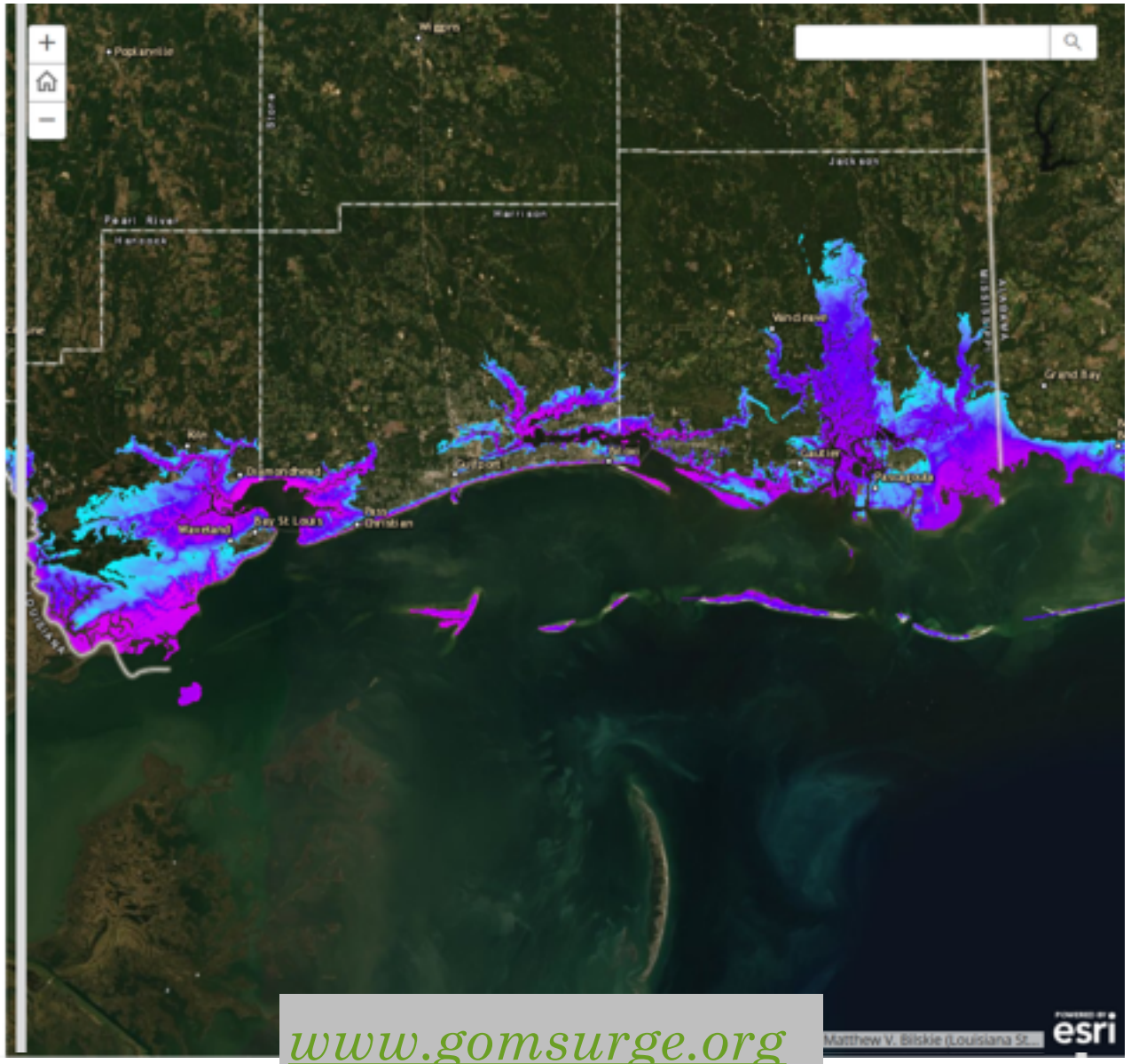
www.msstate.edu/directory/employee/ of future stillwater levels under Low (left) and



www.gomsurge.org

What does this information help with?

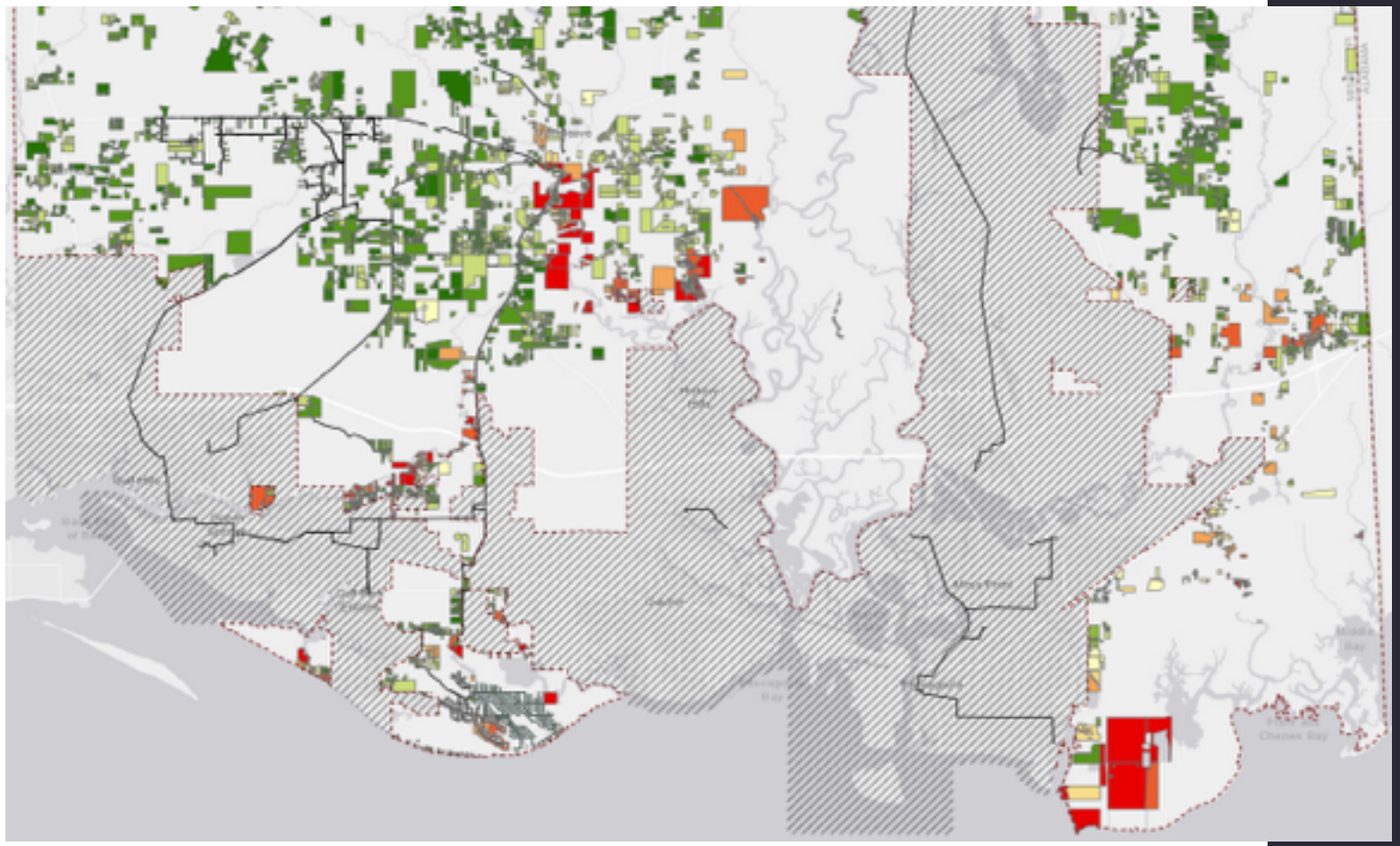
- Changes in 1% and 0.2% annual chance flood area
- Changes in inundation depth
  - Considerations for freeboard
- Infrastructure
  - At risk
  - Future design
- Transportation
  - Evacuation routes

Case Study: Jackson County Utility Authority

- Design and construction of new wastewater reclamation facility
- SLR during two-phases
  - Planned for 6 ft of SLR
  - Site selection: high-tide
  - Berm design: 0.2% event over 50 years
- Conducting a cost benefit analysis
- Engagement occurred just after 15% design was completed

Case Study Jackson County Utility Authority

- Understanding and prioritization of septic tanks at risk to SLR
- SLR for the near term (30 years)
  - Looked at 1 and 2 ft of SLR
  - Looked at changes in high tide, surge, and ground water



Questions about Risk Tolerance?

Scenario Planning

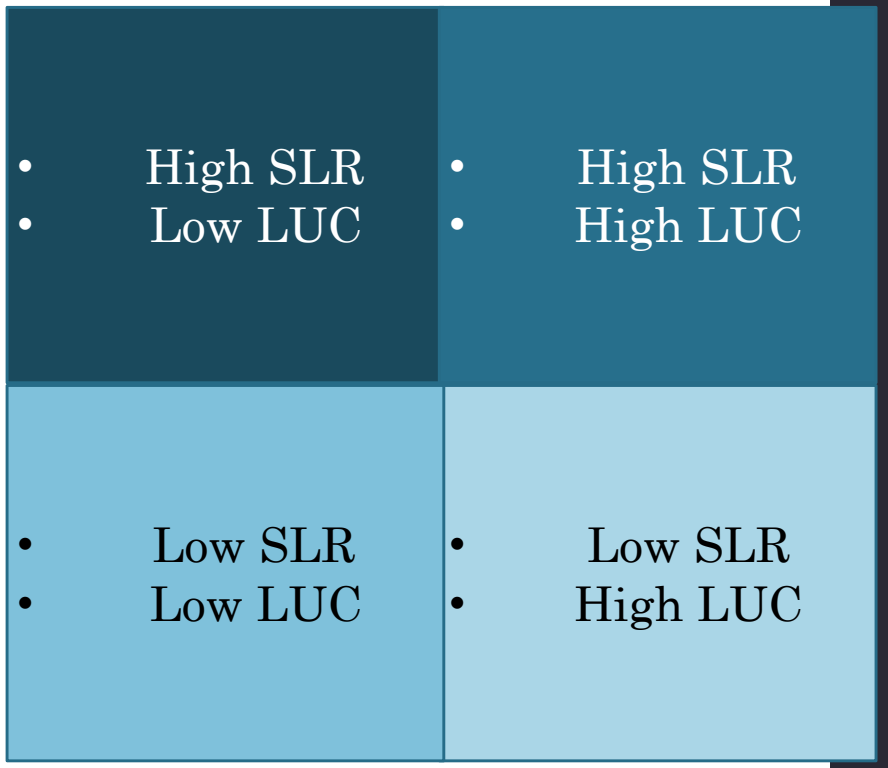
- Explores plausible not probable futures
- Considers outcomes of specific management actions
- Identifies actions that work under many futures
- Well suited for:
  - Complex situations with multiple interactions
  - Natural resource management
  - Mid/high-level importance
- Not well suited for:
  - Simple situations
  - Critical infrastructure/Low-risk tolerance projects
  - High-risk tolerant projects

Scenario Planning

1. Identify drivers of change/impact
2. Develop scenarios
3. Model scenarios

- Sea-level rise
- Land use changes/ development

Our Example: Preserve services and benefits provided by marshes in a rapidly developing area that is also at risk to rising seas.



Scenario Planning

1. Identify drivers of change/impac
2. Develop scenarios
3. Model scenarios
4. Develop response strategies

High SLR/Low LUC • Poor inland migration capacity • Land available for migration • Poor vertical accretion	**High SLR/High LUC** • Poor inland migration capacity • Little land available for migration • Poor vertical accretion
Low SLR/Low LUC • Substantial inland migration capacity • Land available for migration • Good vertical accretion	**Low SLR/High LUC** • Substantial inland migration capacity • Little land available for migration • Good vertical accretion

Scenario Planning

1. Identify drivers of change/impact
2. Develop scenarios
3. Model scenarios
4. Develop response strategies
5. Identify which strategy/strategies are the most robust

- Conserve lands at risk for development that are key for migration
- Beneficial use
- Living shorelines
- Restoration

Scenario Planning

	High SLR/Low LUC	High SLR/High LUC	Low SLR/High LUC	Low SLR/Low LUC
Conserve lands				
Beneficial use				
Living shorelines				
Restoration				

Scenario Planning

	High SLR/Low LUC	High SLR/High LUC	Low SLR/High LUC	Low SLR/Low LUC
Conserve & Restore				
Conserve & Beneficial use				
Conserve & Living shorelines				

Questions about Scenario Planning

Adaptation Pathways

- Series of adaptation strategies
- Pathway developed from tipping points
- Allows for action based on observed changes
- Actions build on each other
- Well suited for:
  - Dynamic systems (e.g., dunes/beaches)
  - Low-budget situations
- Not well suited for:
  - Low adaptive capacity situations
  - Multiple-drivers of change relevant to the question

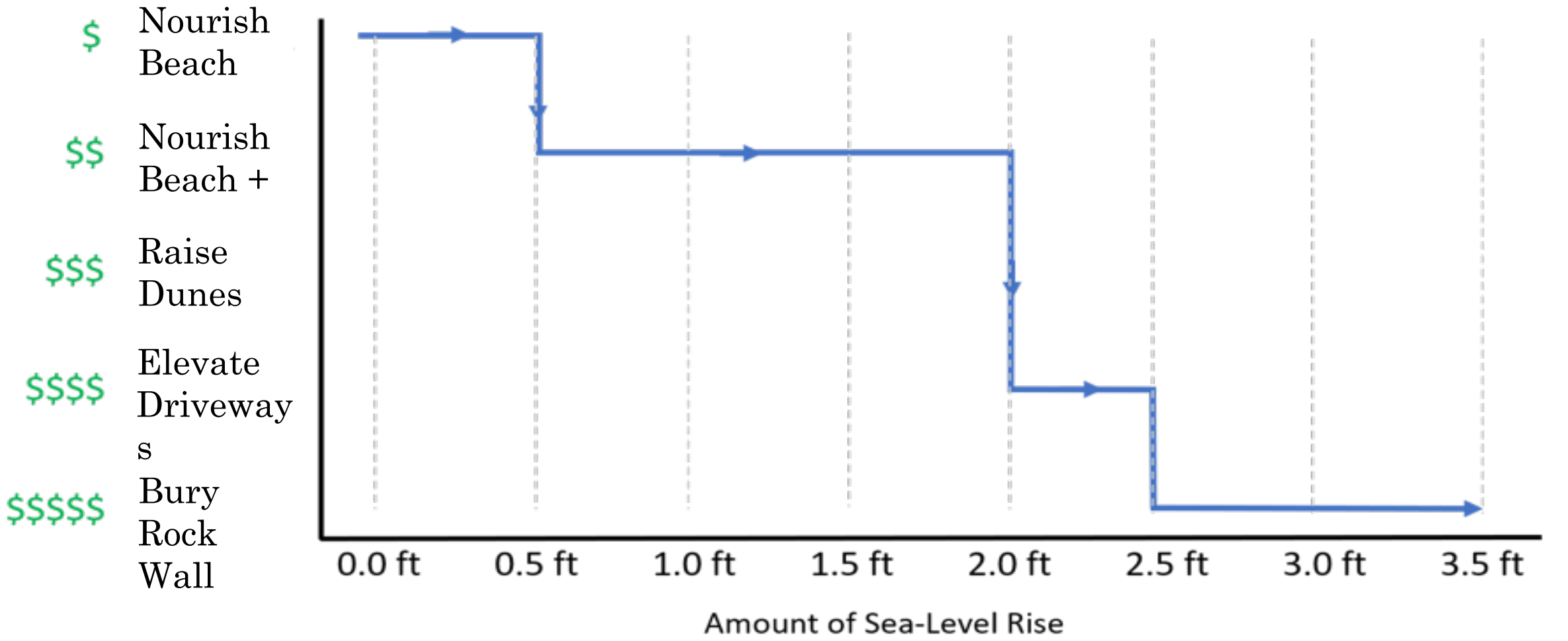
Adaptation Pathways

- Identify suitable actions
- Test effectiveness of each action under different SLR scenarios
  - Identify tipping points
- Arrange into a pathway

Our Example: Prevent barrier island from breaching

- Nourish beach to current footprint – 0.5 ft
- Nourish beach to historic footprint – 2.0 ft
- Raise dunes – 2.0 ft
- Elevate driveways – 2.5 ft
- Bury rock wall under dunes - > 3.5 ft

Adaptation Pathways



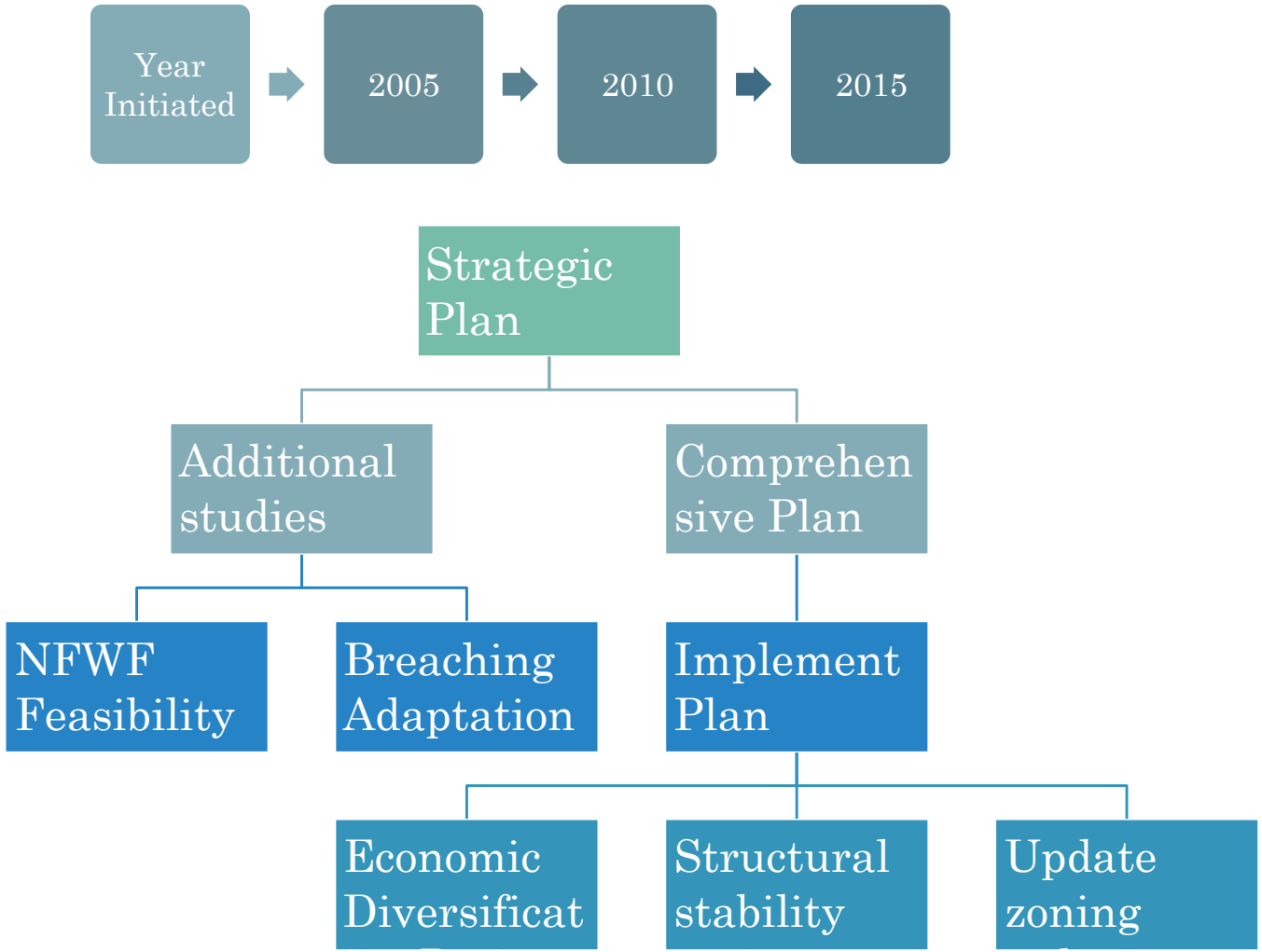
Adapted from Smallegan et al. 2017

Questions About Adaptation Pathways?

Case Studies

Putting it all together

SLR Adaptation in Dauphin Island, AL



SLR in Dauphin Island, AL

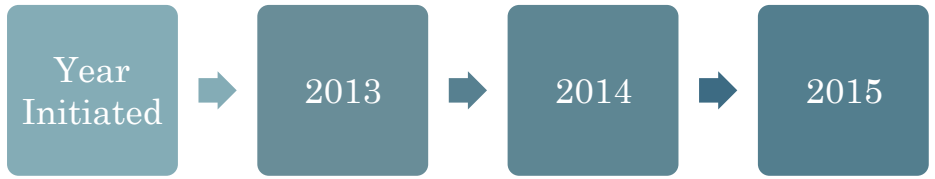
Additional Factors

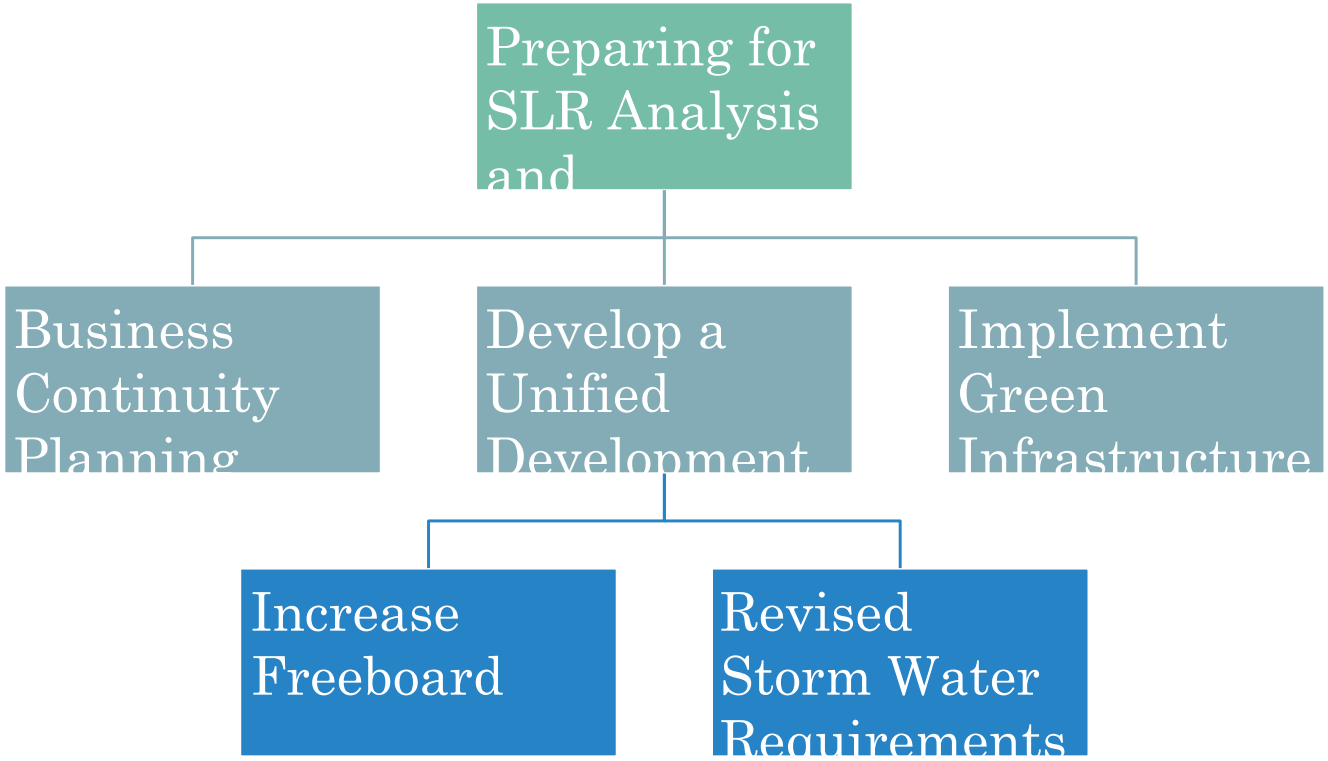
Additional Capacity
- Mississippi-Alabama Sea Grant
  - PLACE:SLR
- Dauphin Island Sea Lab

Dedicated community officials

Multiple planning & implementation grant opportunities
- MS-AL Sea Grant
- RESTORE

SLR Adaptation in Ocean Springs, MS





SLR in Ocean Springs, MS

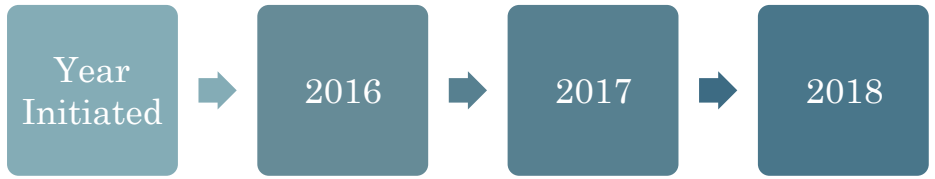
Additional Factors

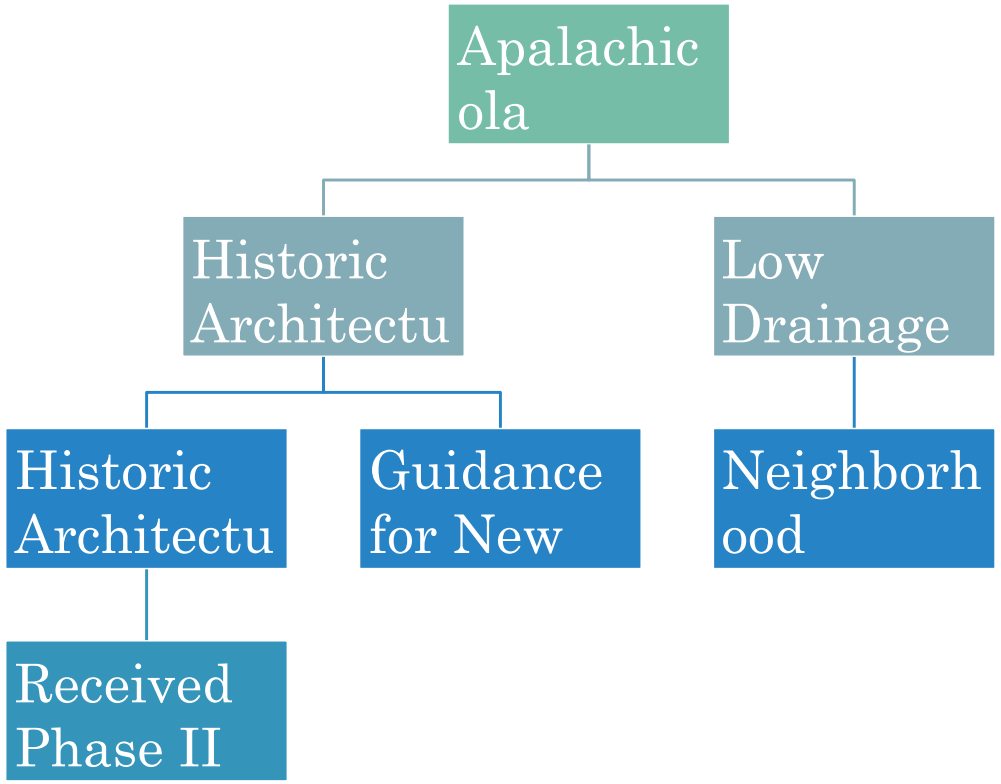
Additional Capacity
- Mississippi-Alabama Sea Grant
- Climate Community of Practice

Dedicated community officials

Multiple small grant award opportunities
- MS DMR
- Climate Community of Practice

SLR Adaptation in Apalachicola, FL





SLR in Apalachicola, FL

Additional Factors

Additional Capacity
- National Estuarine Research Reserve
- Sentinel Site Cooperative

Dedicated community officials

Multiple small grant award opportunities
- FL DEP & DEO

Florida Peril of Flood Act

Things to Remember

- Again… no right answer to which approach to use
  - Consider the complexity of the question, the importance of the project/effort, the adaptability, etc.
- This is not everything needed to plan for SLR
  - These are suggested approaches for dealing with uncertainty in the amount of rise
  - Robust and inclusive stakeholder engagement is needed
- SLR resilience is an ongoing process
  - Need to gather information, plan, implement, review, revisit
  - Science will continue to update

Summary

- SLR is already negatively impacting communities
- Increases in science available to support adaptation/mitigation
- Resources available to facilitate integration of science and community values
- Adaptation is diverse and these resources can serve as foundational tools in a variety of situations
- Leverage the many resources for supporting these efforts
  - Technical expertise – Sea Grant, NOAA OCM, NERRs
  - Colleagues w/similar efforts– CoP, GOMA, S. FL Climate Compact

Thank you!!!

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