Coastal Protection and Restoration Authority of Louisiana:

Considerations for Climate Adaptation

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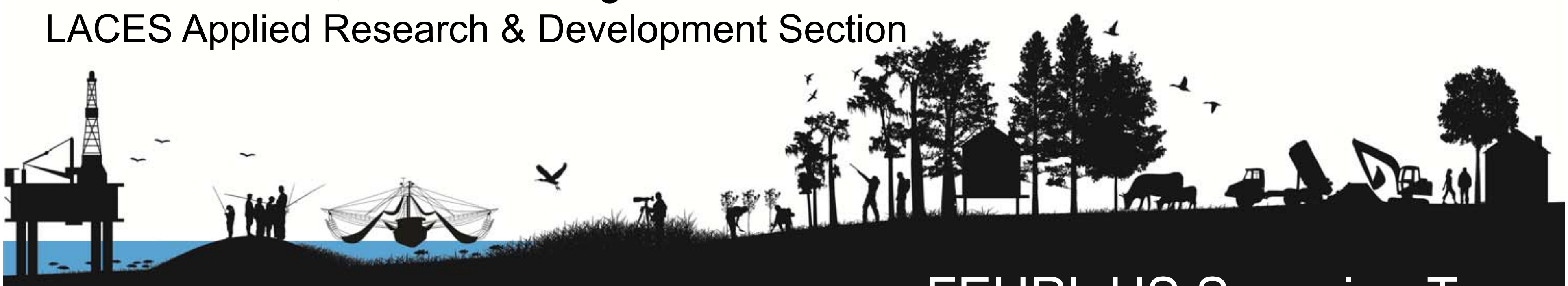


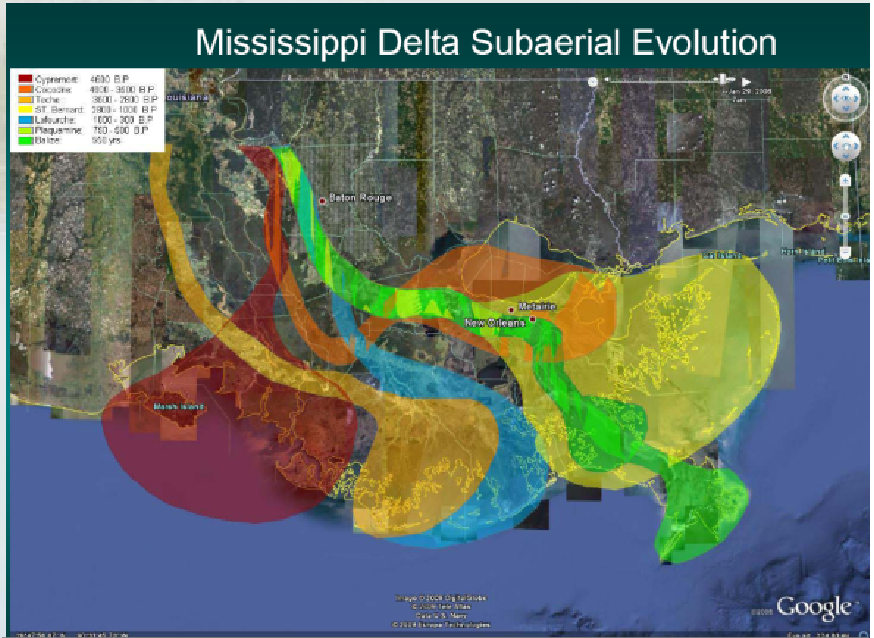
FEHRL US Scanning Tour
30 March 2012

The Mississippi River Watershed

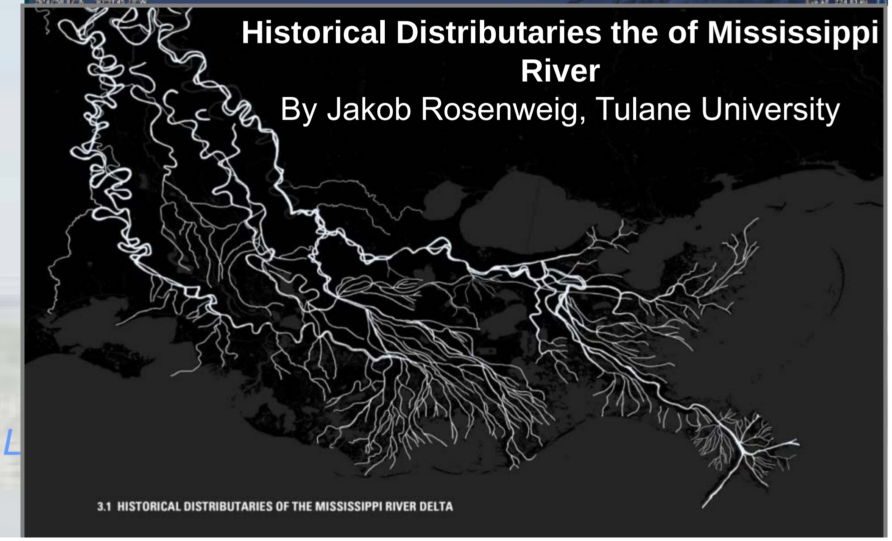
- Two-thirds of the continental United States
- Third largest drainage basin in the world

Emerged through Natural Processes

- Coastal Louisiana was built by the deposition of sediment over thousands of years.

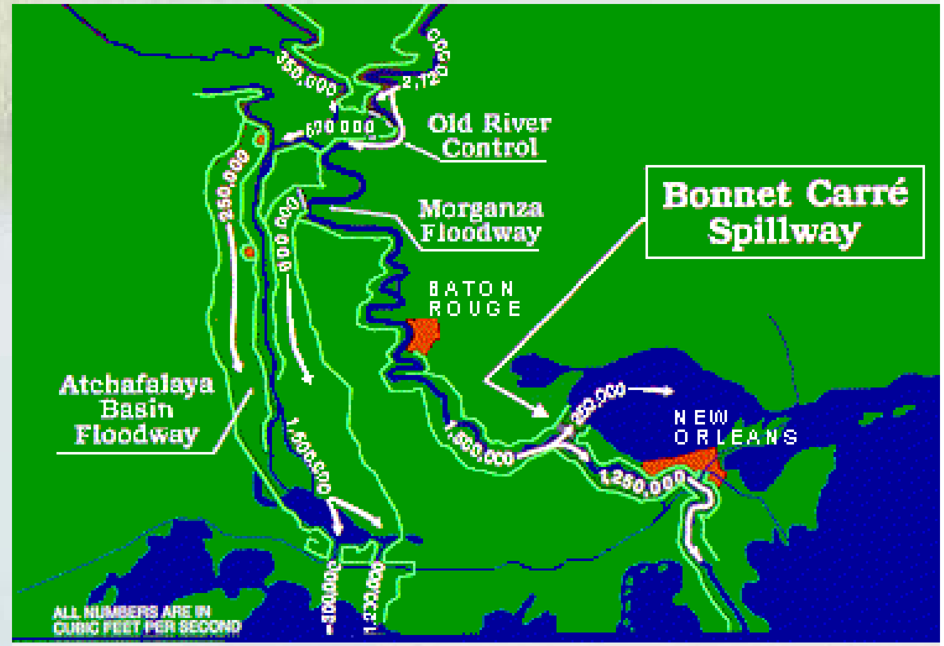


- Historic distributaries before the flood protection levees of the MR&T delivered freshwater and sediment to the wetlands.

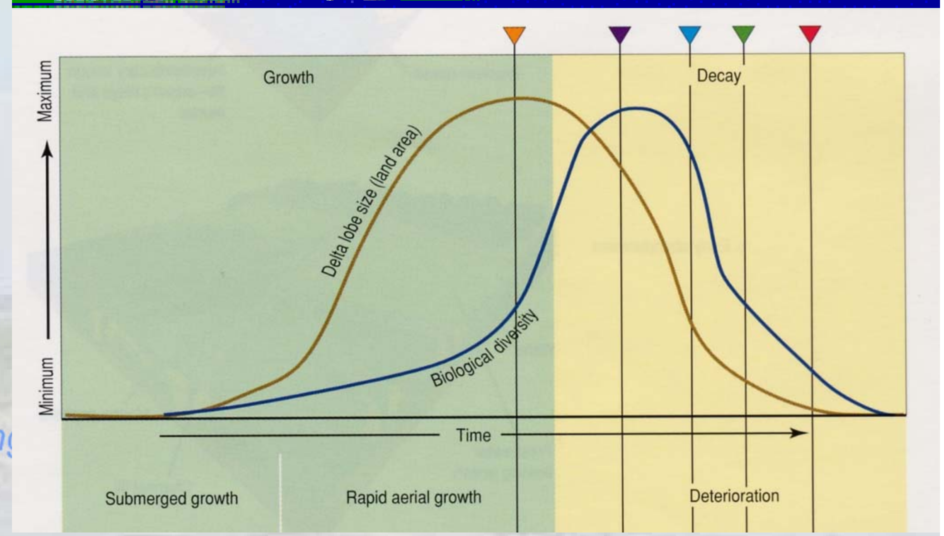


River Management

- Post-1927 flood, the MR&T disconnected the river from the estuaries and has interrupted the deltaic cycle that sustained our coastal wetlands.

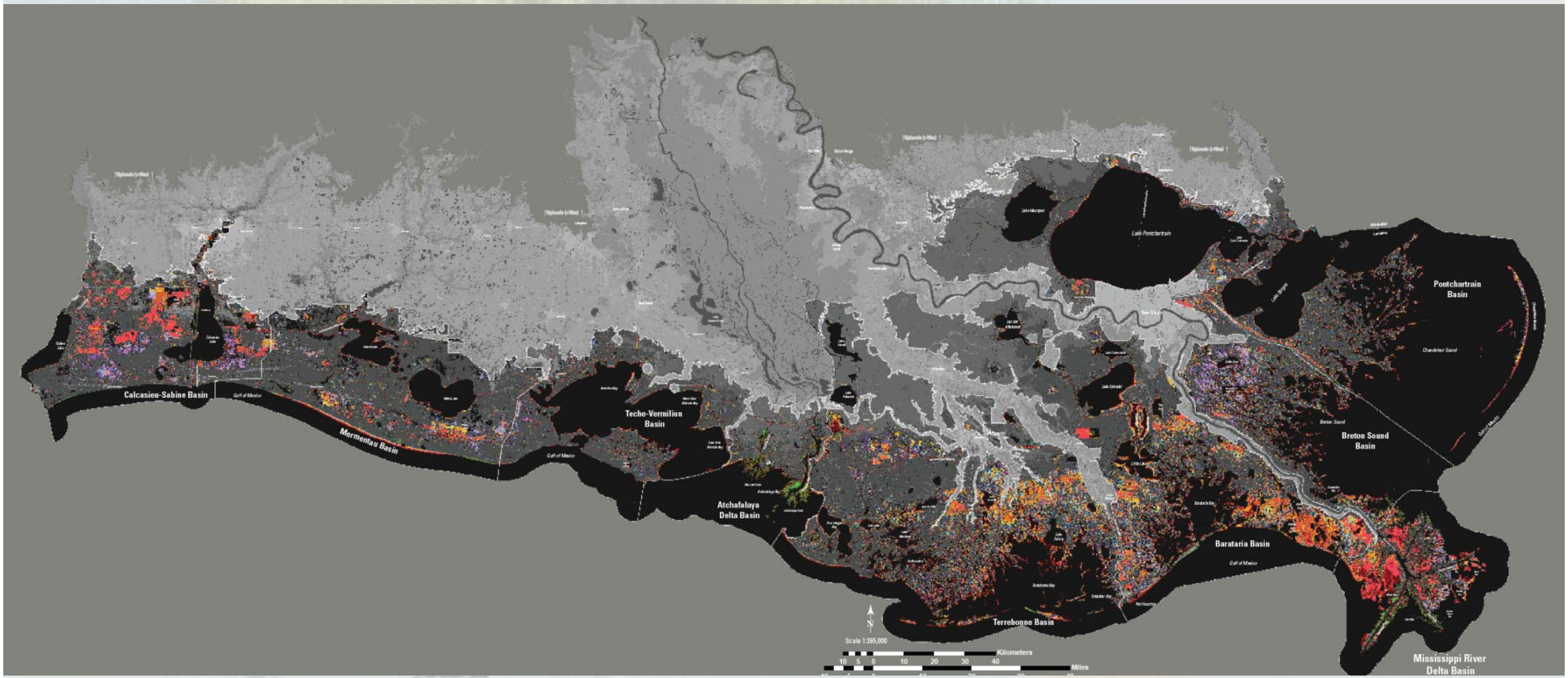


- Re-establishing this connection of the delta with the river is critical for continued sustainability



2011 Mississippi River High Water Event

Historical Coastal Land Loss

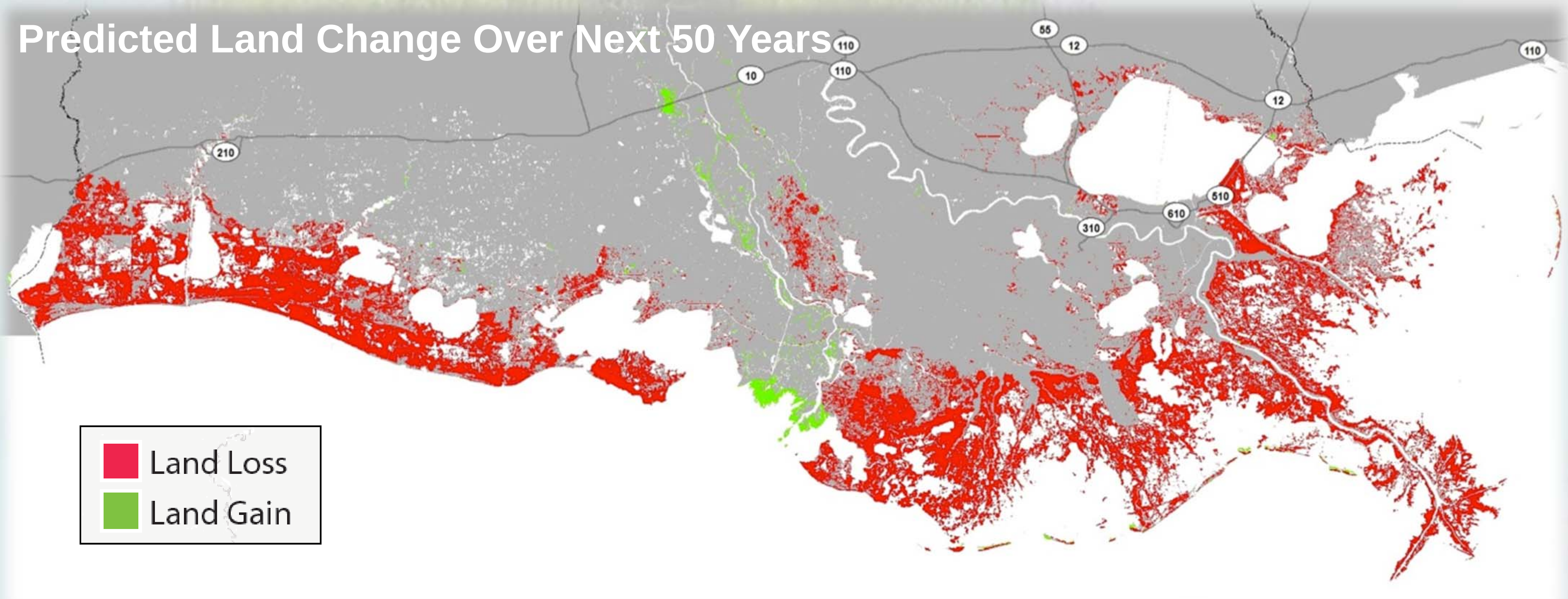


Couvillion et al. 2011 USGS SIM 3164

- 4,877 km^2 (1,883 square miles) lost since the 1930s
- Currently losing over 41 km^2 (16 square miles) per year

restoring and protecting Louisiana's coast

Louisiana is Experiencing a Coastal Crisis



Potential to lose an additional 2,000-4,500 km^2 of land over the next 50 years

National Perspective

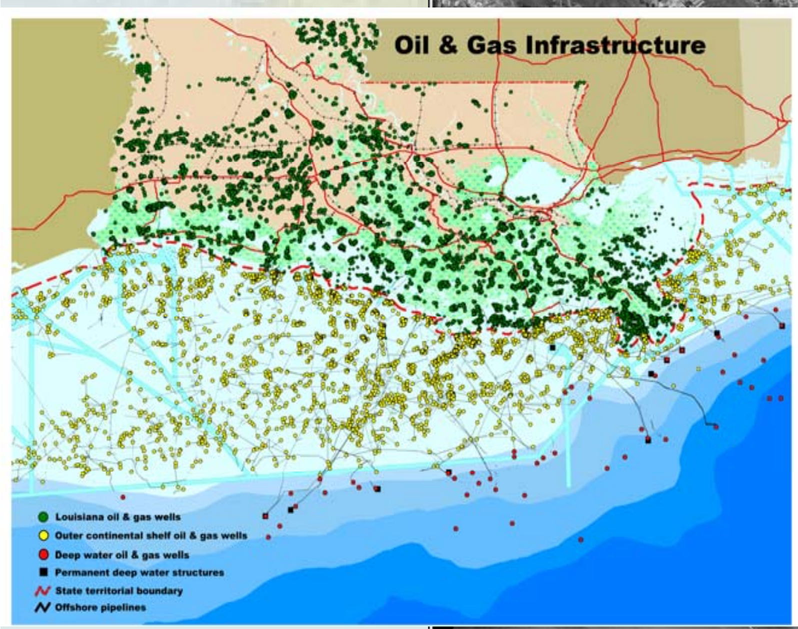
- **Ports**
  - **Port of Louisiana is the top tonnage port in the nation**

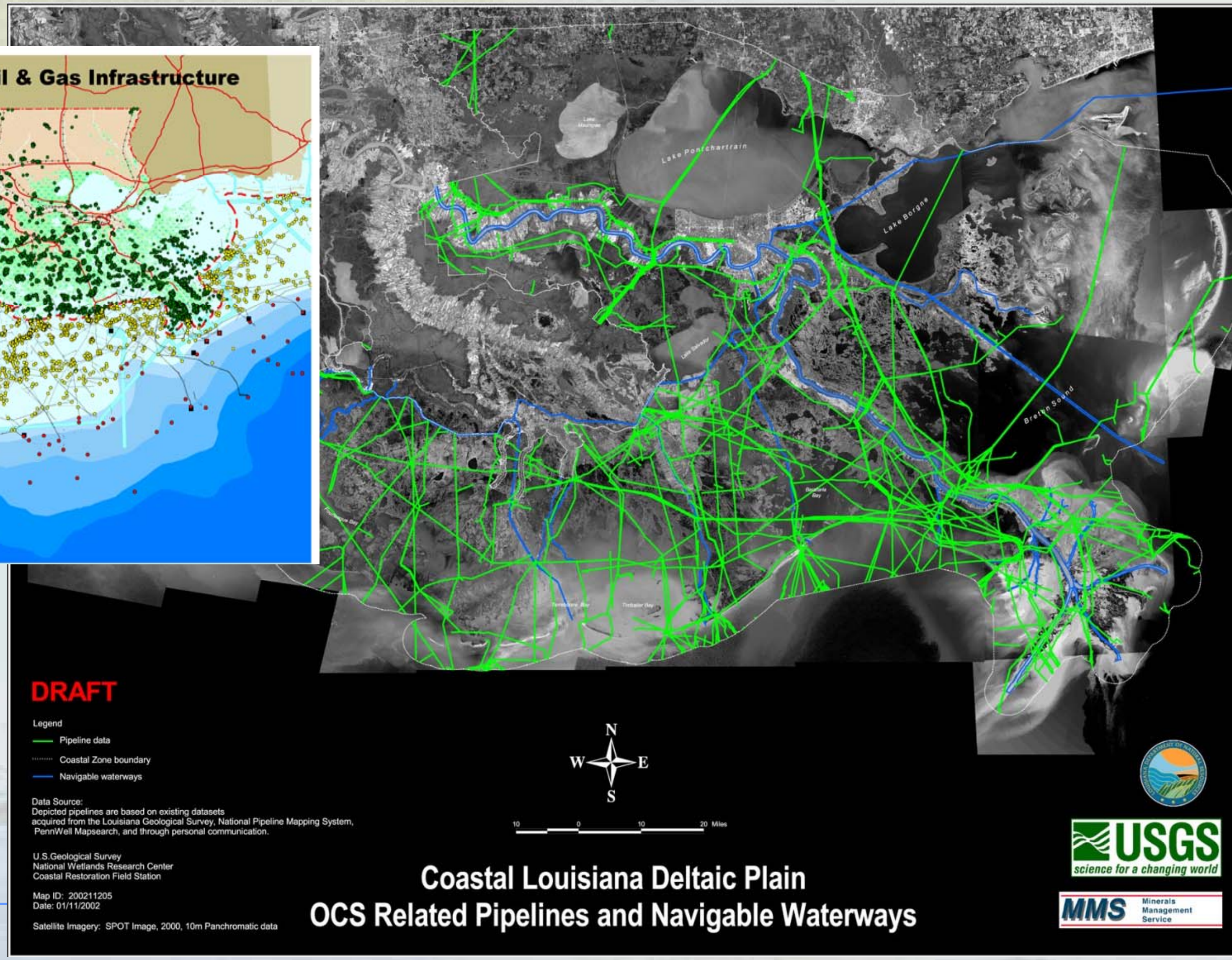
- **Seafood**
  - **By weight 24% of all commercial species caught in the lower 48 States are caught in Louisiana waters**

- **Energy**
  - **Top producer of domestic oil, offshore gas, and offshore revenues for the US Treasury**

photo LA DOTD

America's Wetland Protect
Nationally Significant OCS Infrastructure



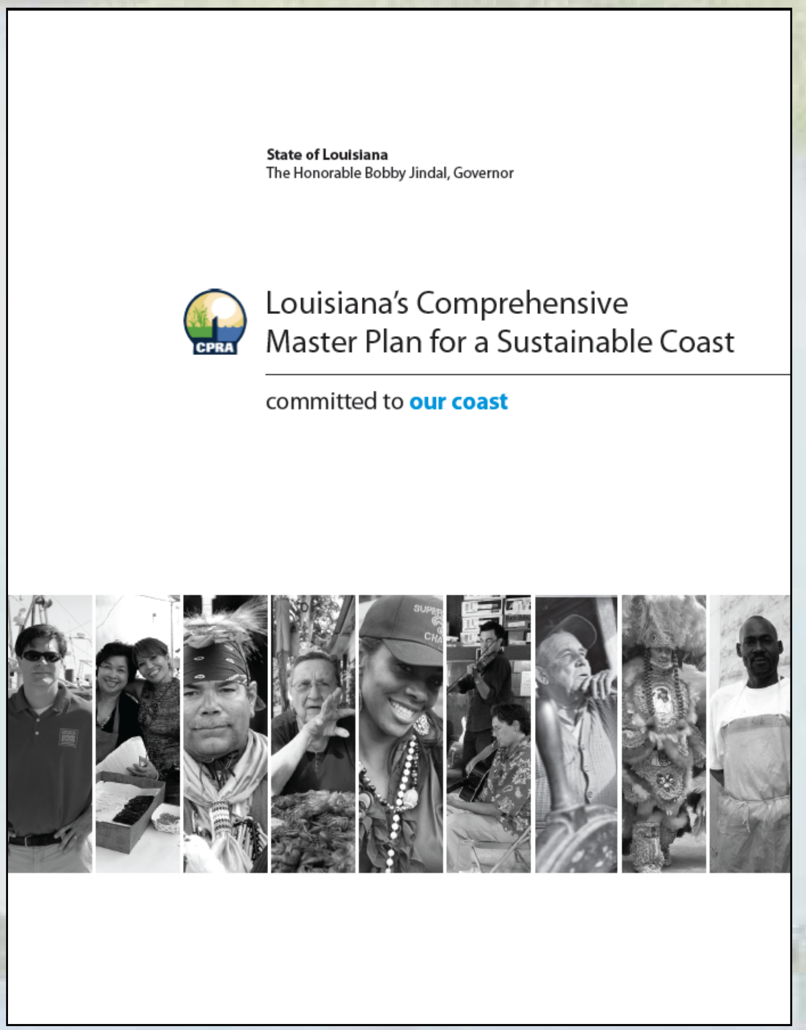


Coastal Protection and Restoration Authority (CPRA) Members

- Governor's Office for Coastal Activities - Chair
- Governor's Advisory Commission on Coastal Protection, Restoration and Conservation
- Governor's Office of Homeland Security and Emergency Preparedness
- Louisiana Department of Agriculture and Forestry
- Louisiana Department of Economic Development
- Louisiana Department of Environmental Quality
- Louisiana Department of Insurance
- Louisiana Department of Natural Resources
- Louisiana Department of Transportation and Development
- Louisiana Department of Wildlife and Fisheries
- Louisiana Division of Administration
- Louisiana Levee Districts – 4 Regions
- Louisiana Non-Levee Parishes - East and West

We Continue to Make Progress

Revised 2012 Master Plan

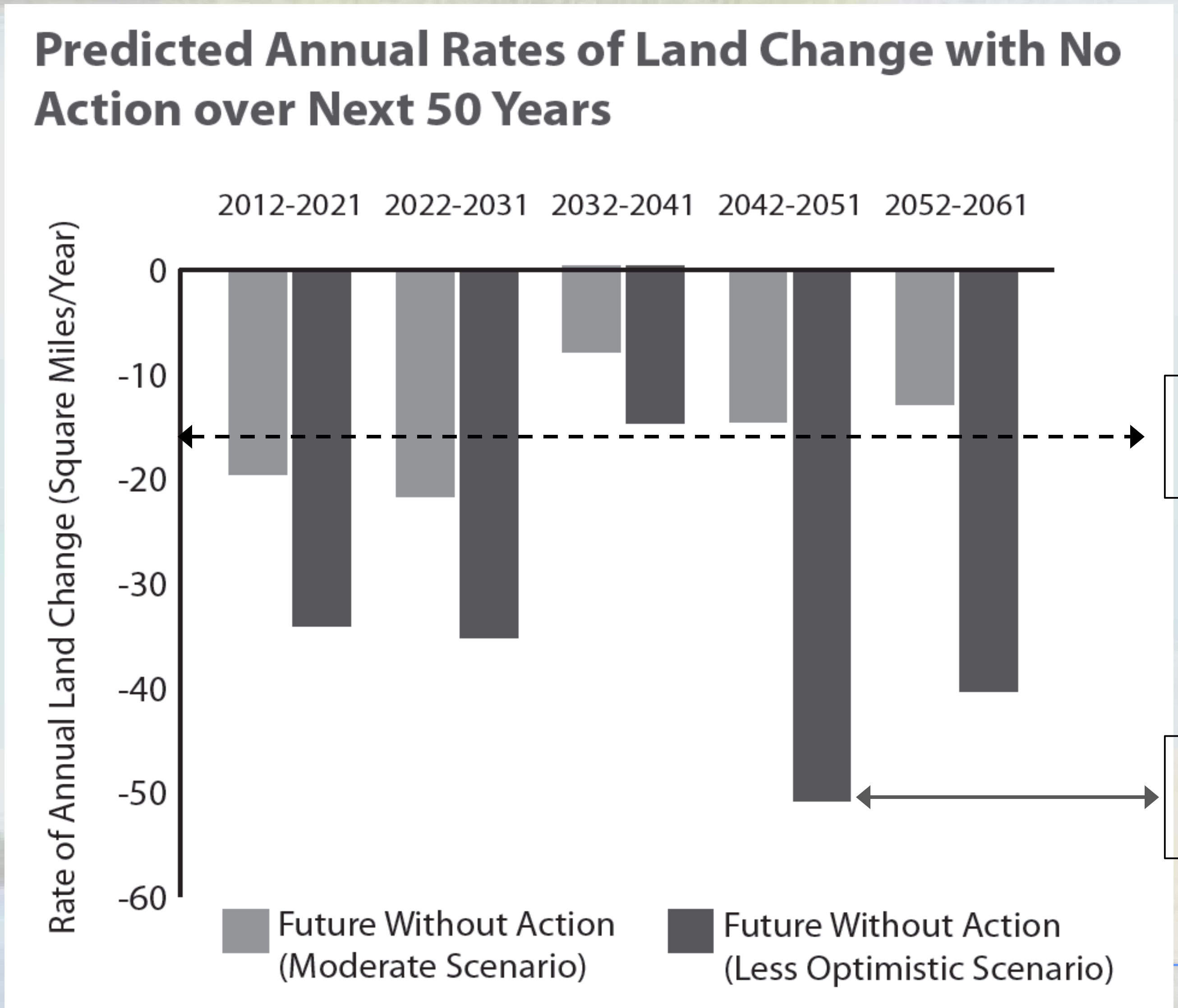

State of Louisiana
The Honorable Bobby Jindal, Governor

Louisiana's Comprehensive
Master Plan for a Sustainable Coast

committed to **our coast**

- Adopted unanimously by the CPRA Board on 21 March 2012
- Presented to the Legislature for approval earlier this week

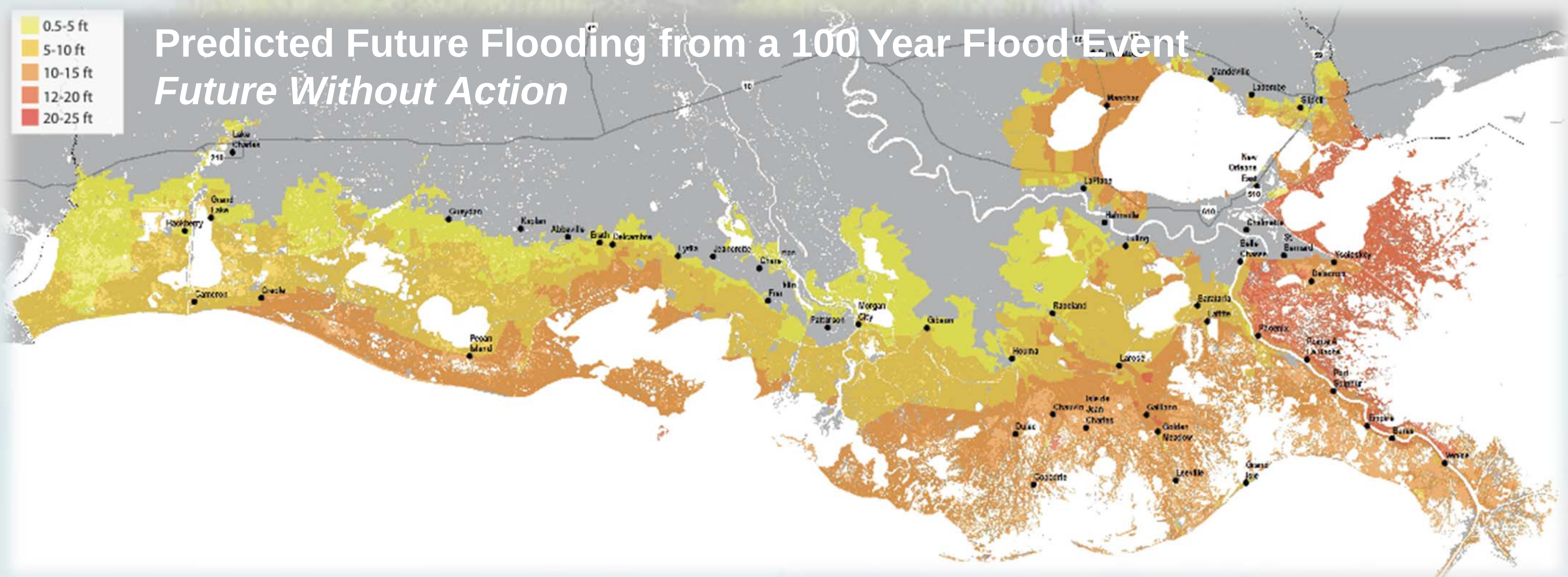
Louisiana is Experiencing a Coastal Crisis



Currently experiencing -41 km^2/year

Future could reach -132 km^2/year

Our Communities and Livelihoods at Risk



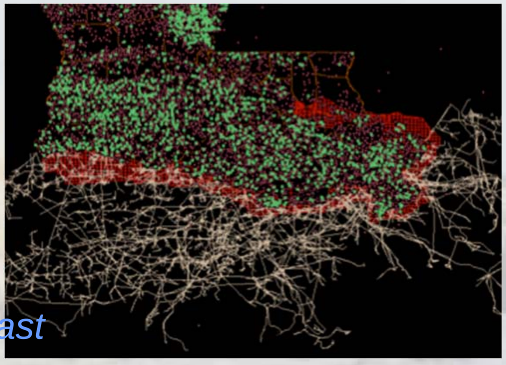
- **Potential for damages to reach $7.7 to $23.4 billion annually**
- **Increasing threats to lives, jobs and communities**

2012 Master Plan Objectives

Flood Protection	Reduce economic losses from storm-based flooding
Natural Processes	Promote a sustainable coastal ecosystem by harnessing the processes of the natural system
Coastal Habitats	Provide habitats suitable to support an array of commercial and recreational activities coast wide
Cultural Heritage	Sustain Louisiana's unique heritage and culture
Working Coast	Provide a viable working coast to support industry

Focus Groups

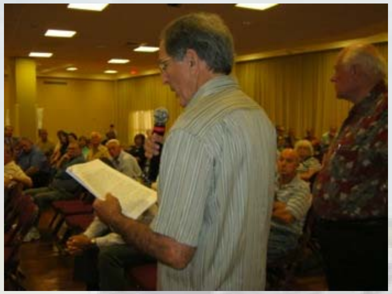
- Key industries are impacted by land loss and large scale protection and restoration efforts
- Created three focus groups:
  - Navigation
  - Fisheries
  - Oil and Gas
- Framework Development Team:
  - Over 30 Federal, State, NGO, Academic, Community, and Industry Organizations



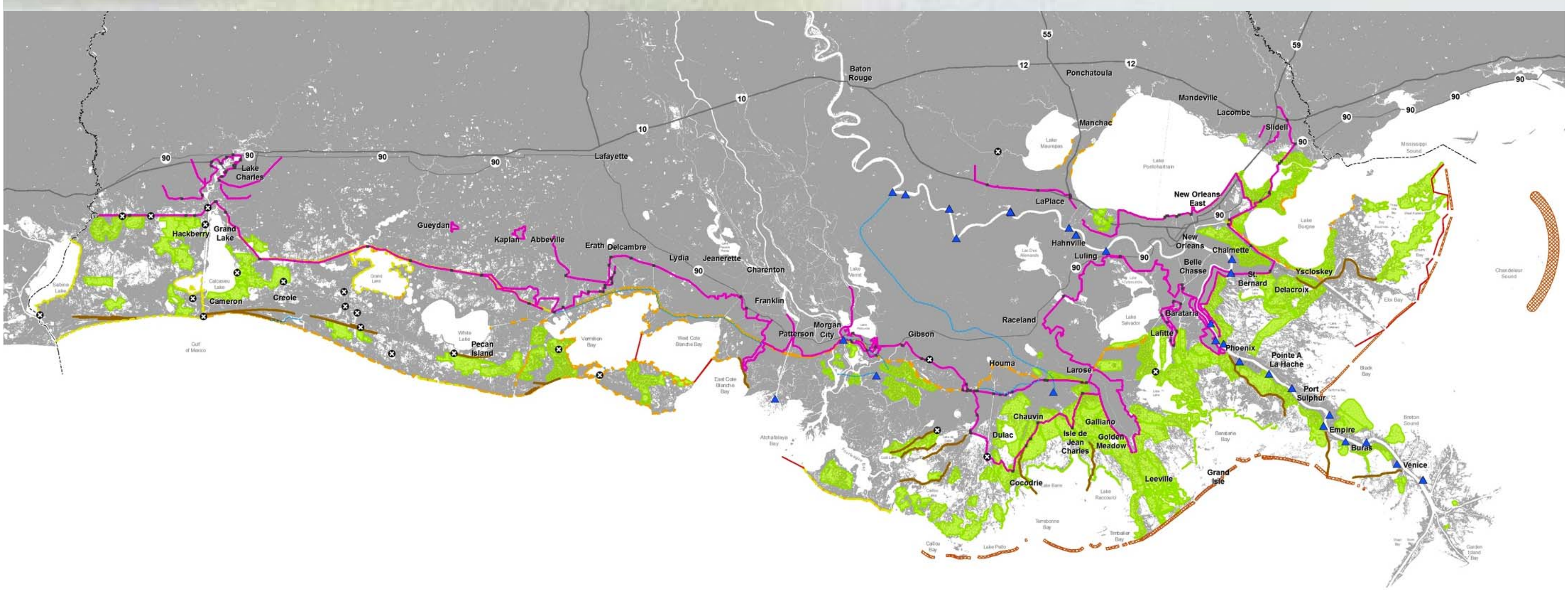
Extensive Public Review and Input

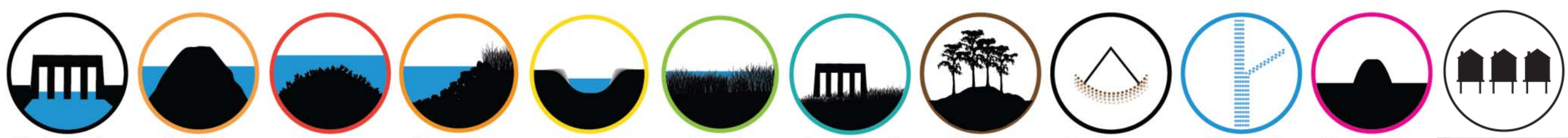
120+ Meetings with Citizens, Focus Groups, Elected Officials, Stakeholders & Review Teams

- **Parish Official Group Briefings**
- **CPRA and Governor’s Advisory Commission**
- **Regional Community Meetings**
- **Focus Group Meetings**
- **Framework Development Team Participants**
- **Civic or Professional Groups**
- **Regional Community Meetings**



Evaluation of Hundreds of Existing Projects





Hydrologic Restoration | Barrier Island Restoration | Oyster Barrier Reef | Shoreline Protection | Bank Stabilization | Marsh Creation | Combined Project | Ridge Restoration | Sediment Diversion | Channel Realignment | Protective Levee | Nonstructural Measure

Nearly 400 Projects Evaluated Across the Coast

Protection: Structural Projects

Earthen Levee

The principal component of structural projects is the earthen levee. These structures consist of pyramidal banks of compacted earth that provide a barrier against storm surge for coastal communities and other assets. Levees can either be linear in shape or ringed. Ring levees form a closed risk reduction system that encircles a protected area, and the protected area is referred to as a polder. Linear levees create a closed system by tying into other linear levees or by extending inland to high ground.

Concrete Wall

These are typically located at points along an earthen levee that have a high potential for erosion or insufficient space for the wide slopes of an earthen levee. Concrete walls were specified at junctions with water crossings, railroads, and major roadways (e.g., interstates and state highways).

Floodgate

Floodgates are needed where levees or concrete walls cross a road or railroad or where they intersect waterways. Floodgates were established for each of these crossings for the structural projects in the master plan.

Pumps

Pumps are needed in enclosed risk reduction systems to allow water that enters a polder to be pumped out. Pumps were included as features of most of our structural protection features.

Protection: Non-Structural Projects

Nonstructural Project Types and Flood Depths

Floodproofing	Elevation	Voluntary Acquisition
RESIDENTIAL & COMMERCIAL	RESIDENTIAL	RESIDENTIAL

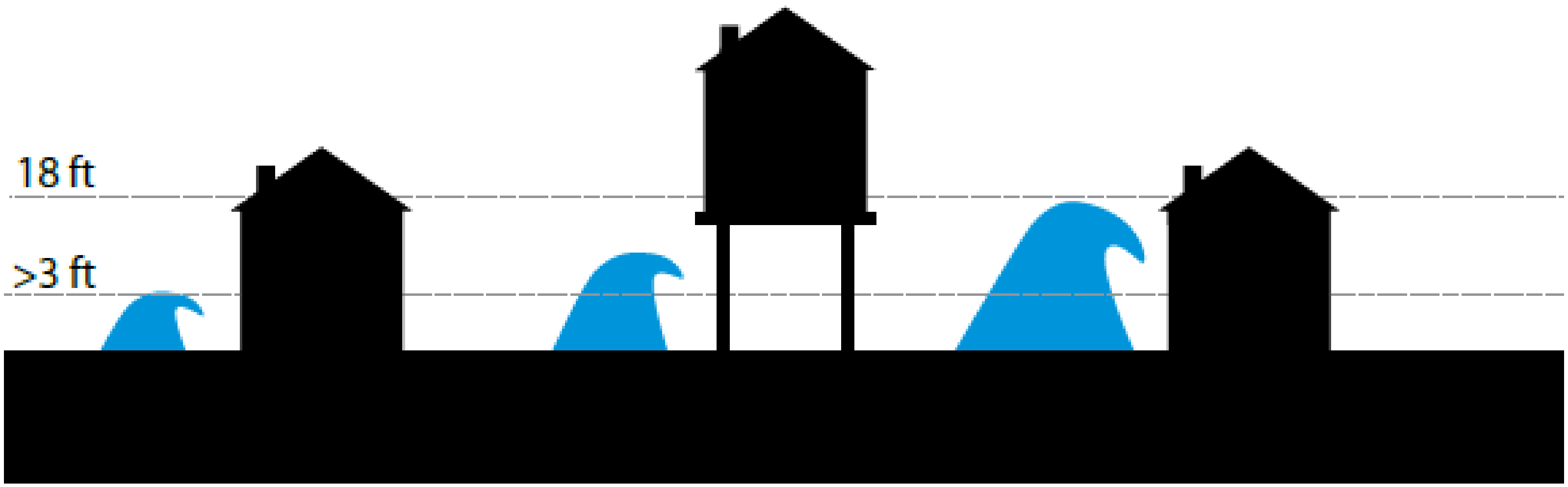


Figure 2.2 Three types of nonstructural measures are proposed in the master plan. A measure is selected based on flood depth.

Communicating Risk

What Do 50-100-500 Year Protection Levels Mean?

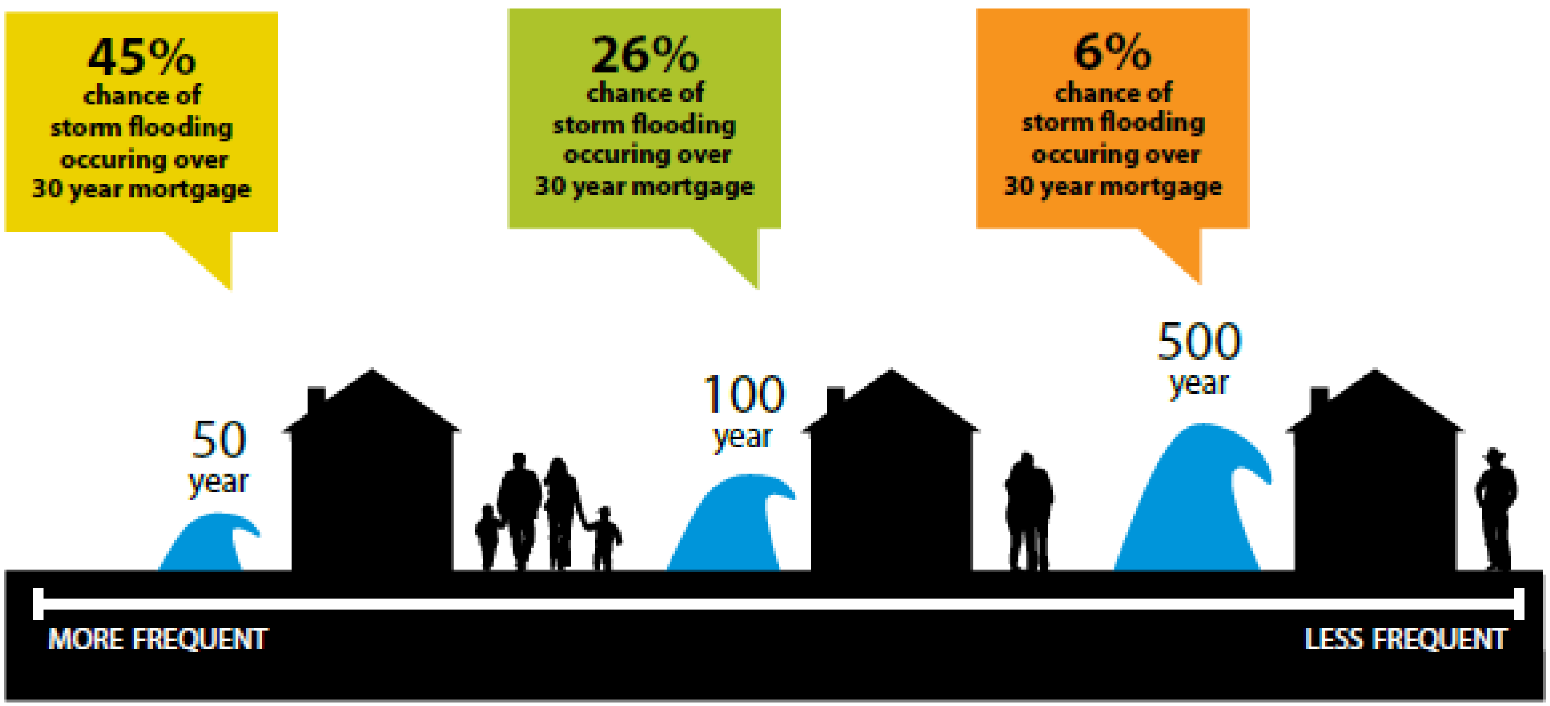


Figure 2.3 Protection levels still include the chance of 50, 100, and 500 year flood events affecting a home over the life of a 30 year mortgage.

Model Uncertainties

Climate drivers included in modeling effort

- Sea-level Rise
- Subsidence
- Storm Intensity
- Storm Frequency
- River Discharge
- Rainfall
- Evapotranspiration
- Marsh Collapse Threshold

Moderate scenario-

assumed limited changes in the factors on the facing page over the next 50 years.

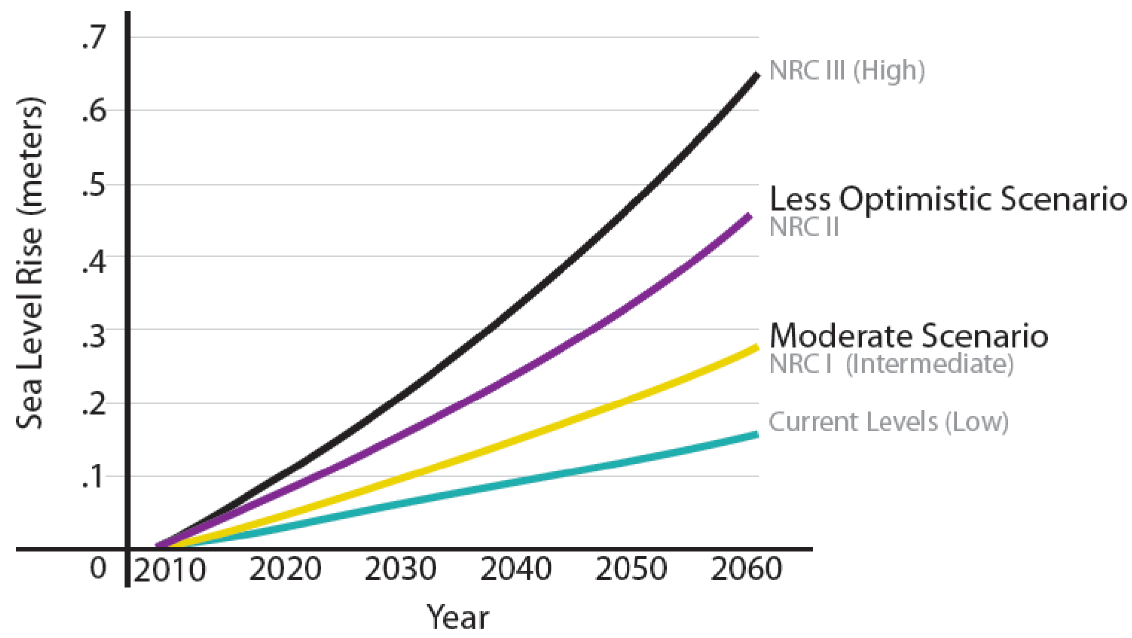
Less optimistic scenario-

assumed more dramatic changes in these factors over the next 50 years.

Uncertainty: Sea-level Rise

Estimates of Sea Level Rise over Next 50 Years

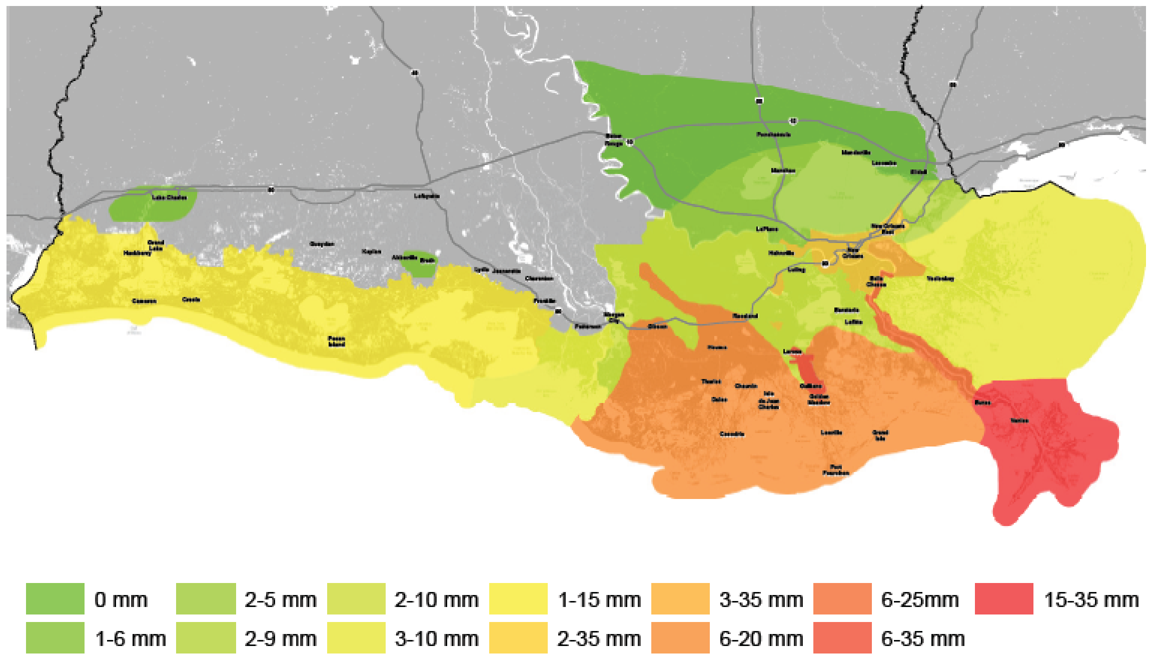
Figure 3.4 Scenarios of future eustatic sea level rise based on National Research Council (NRC) and Corps guidance (2011) were used to inform the moderate and less optimistic sea level rise rates over the next 50 years.



Uncertainty: Subsidence

Ranges of Coast Wide Annual Subsidence Rates

Figure 3.5 Regional ranges of subsidence rates in mm/yr were used as inputs to the modeling analysis. The ranges depict both current values and predicted future values over 50 years.



Moderate Scenario: 20% into range
Less Optimistic Scenario: 50% into range

Uncertainty: Storm Intensity and Frequency

INTENSITY

Moderate Scenario:

- 10% increase in intensity in 50 years

Less Optimistic Scenario:

- 20% increase in intensity in 50 years

FREQUENCY

Moderate Scenario:

- No change from current condition (approx. one Cat 3 every 19 years)

Less Optimistic Scenario:

- 2.5% increase from current condition (approx. one Cat 3 every 18 years)

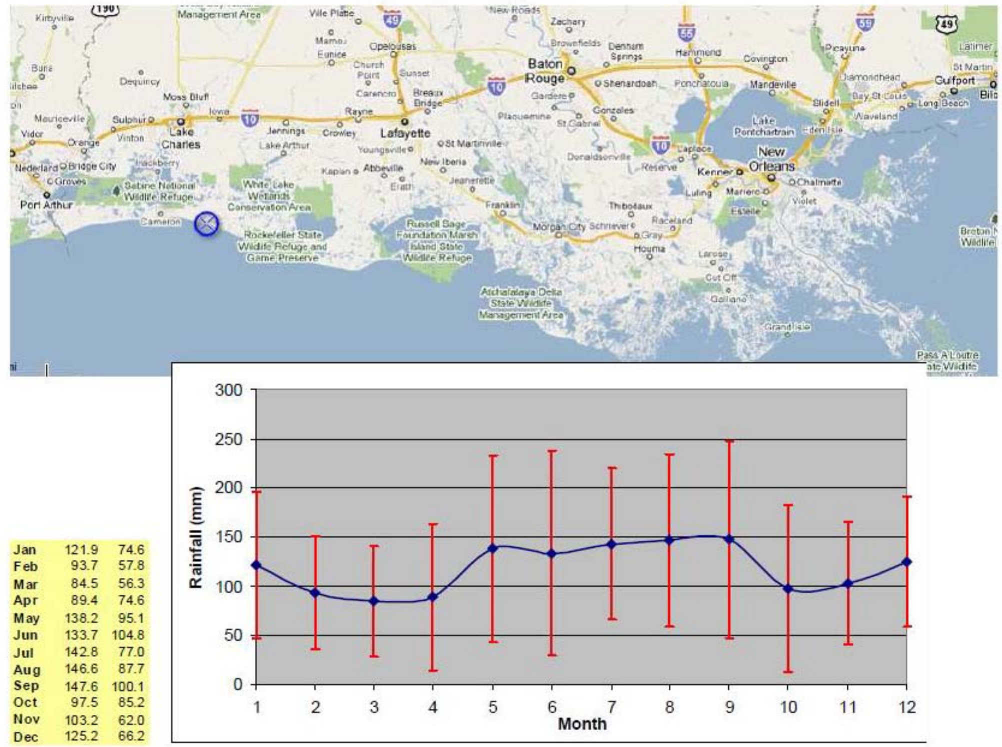
Uncertainty: Rainfall

Moderate Scenario:

- **Assumes future rainfall patterns equal to the average historical monthly value**

Less Optimistic Scenario:

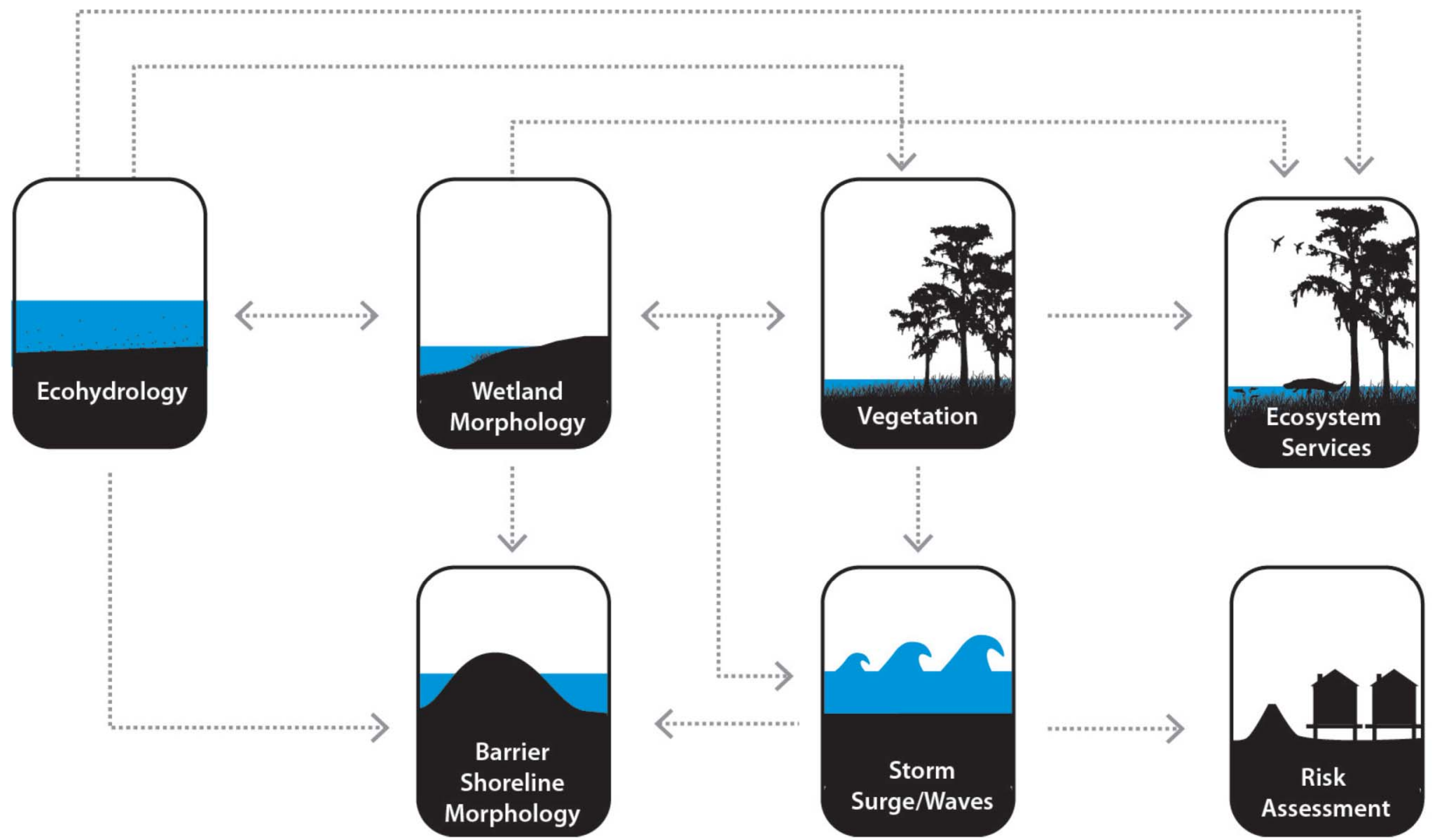
- **Assumes 0.4 SD decrease from average historical monthly values (drier)**



Jan	121.9	74.6
Feb	93.7	57.8
Mar	84.5	56.3
Apr	89.4	74.6
May	138.2	95.1
Jun	133.7	104.8
Jul	142.8	77.0
Aug	146.6	87.7
Sep	147.6	100.1
Oct	97.5	85.2
Nov	103.2	62.0
Dec	125.2	66.2

Figure 8. Precipitation station 2 and monthly averages +/- 1 SD.

Using New Tools, Breaking New Ground: Integrated Modeling Framework

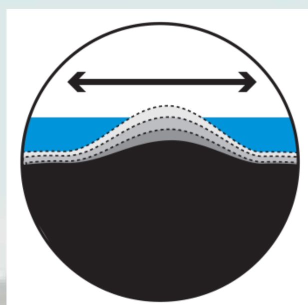


Factors in Making Decision

Risk Reduction

Expected Annual Damages

Restoration



Land Area

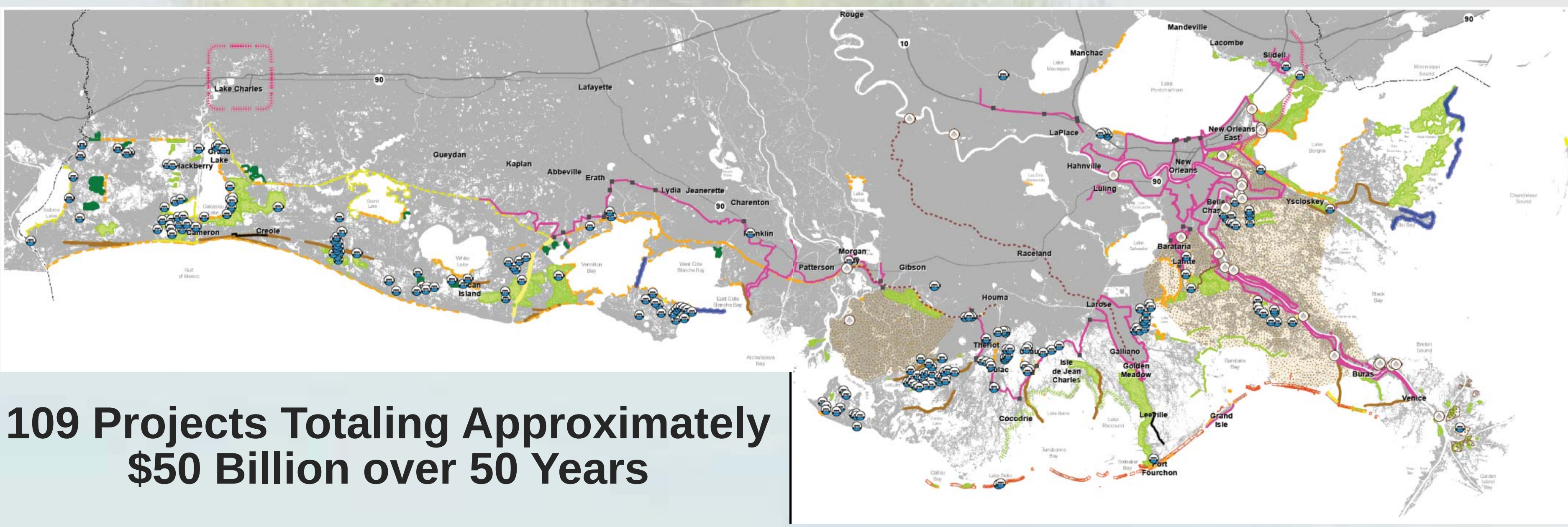
Decision Criteria and Ecosystem Services

- Distribution of flood risk across socioeconomic groups
- Flood protection of historic properties
- Flood protection of strategic assets
- Operation and maintenance costs
- Sustainability
- Support for navigation
- Use of natural processes
- Support for cultural heritage
- Support for oil & gas

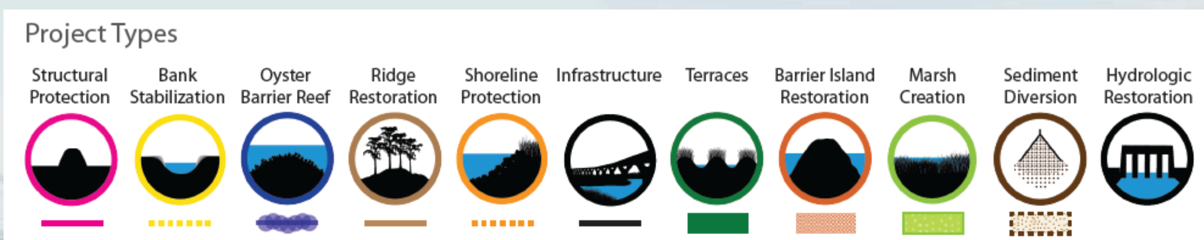
- Oyster
- Shrimp
- Freshwater Availability
- Alligator
- Waterfowl
- Saltwater Fisheries
- Freshwater Fisheries
- Carbon Sequestration
- Nitrogen Removal
- Agriculture/Aquaculture
- Other Coastal Wildlife
- Nature-Based Tourism

2012 Coastal Master Plan

Current and Future Projects

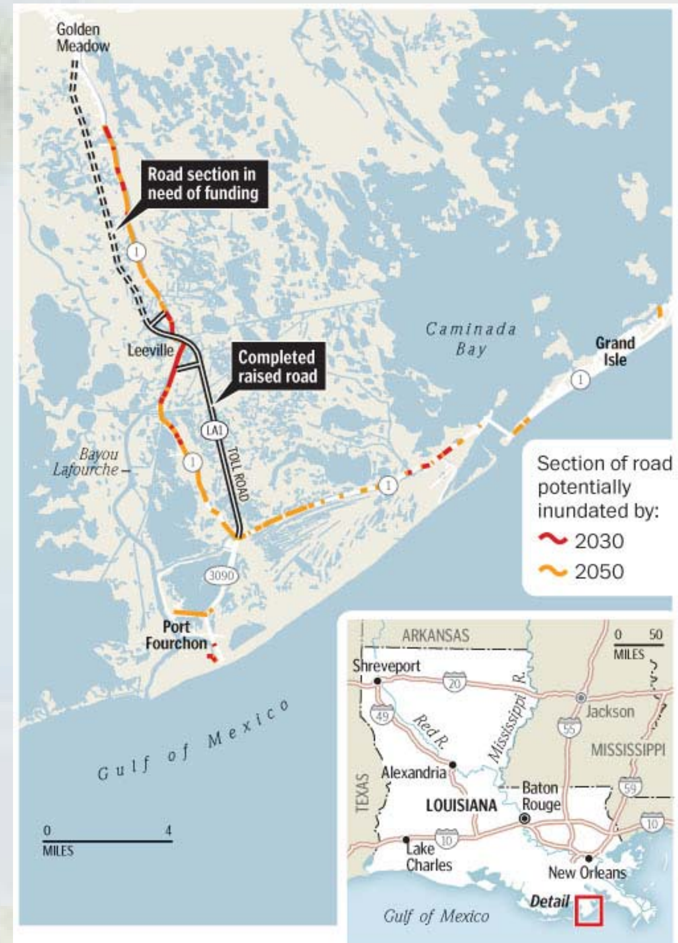


109 Projects Totaling Approximately $50 Billion over 50 Years



restoring and protecting Louisiana's coast

Louisiana Hwy 1
Support to Port Fourchon



- Currently services over 90% of the Gulf of Mexico's deepwater oil production.
- There are over 600 oil platforms within a 40-mile radius of Port Fourchon.
- This area furnishes 16 to 18 percent of the US oil supply

What the Master Plan Delivers

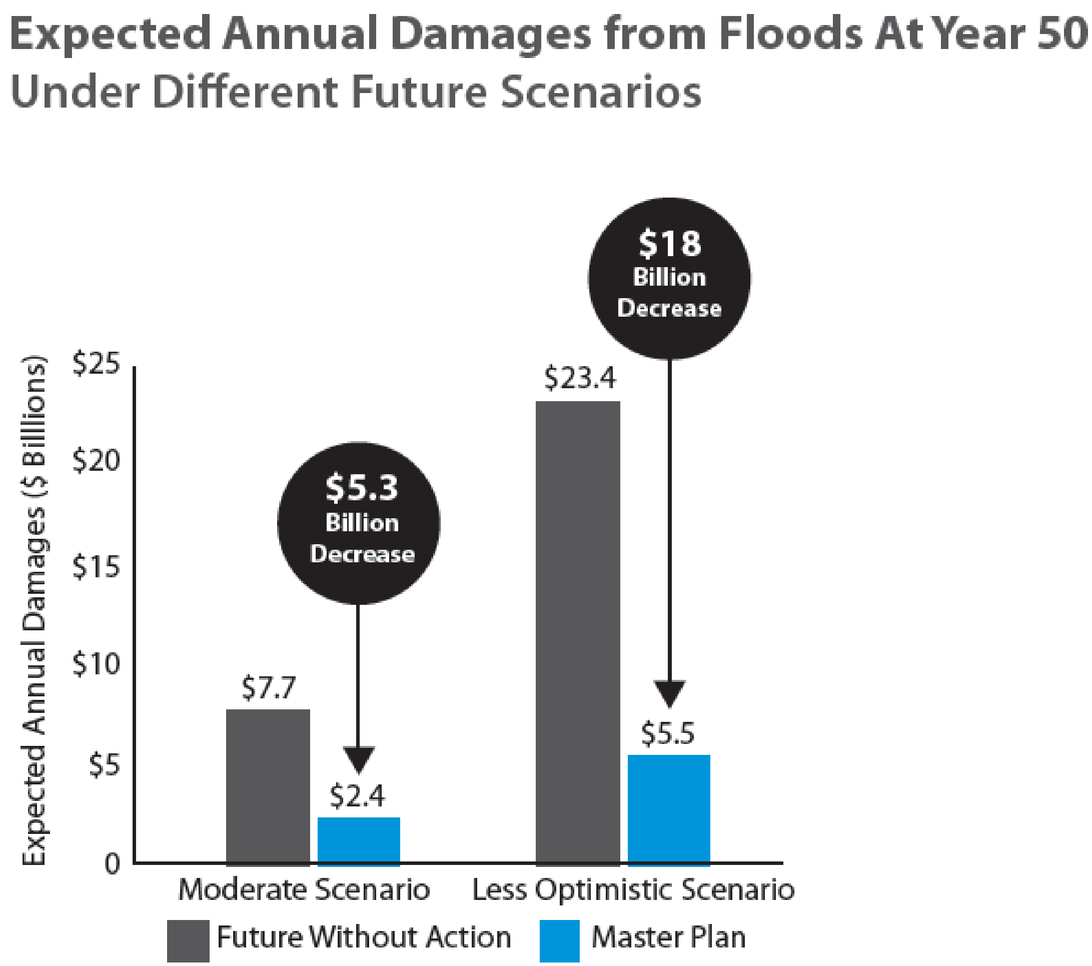
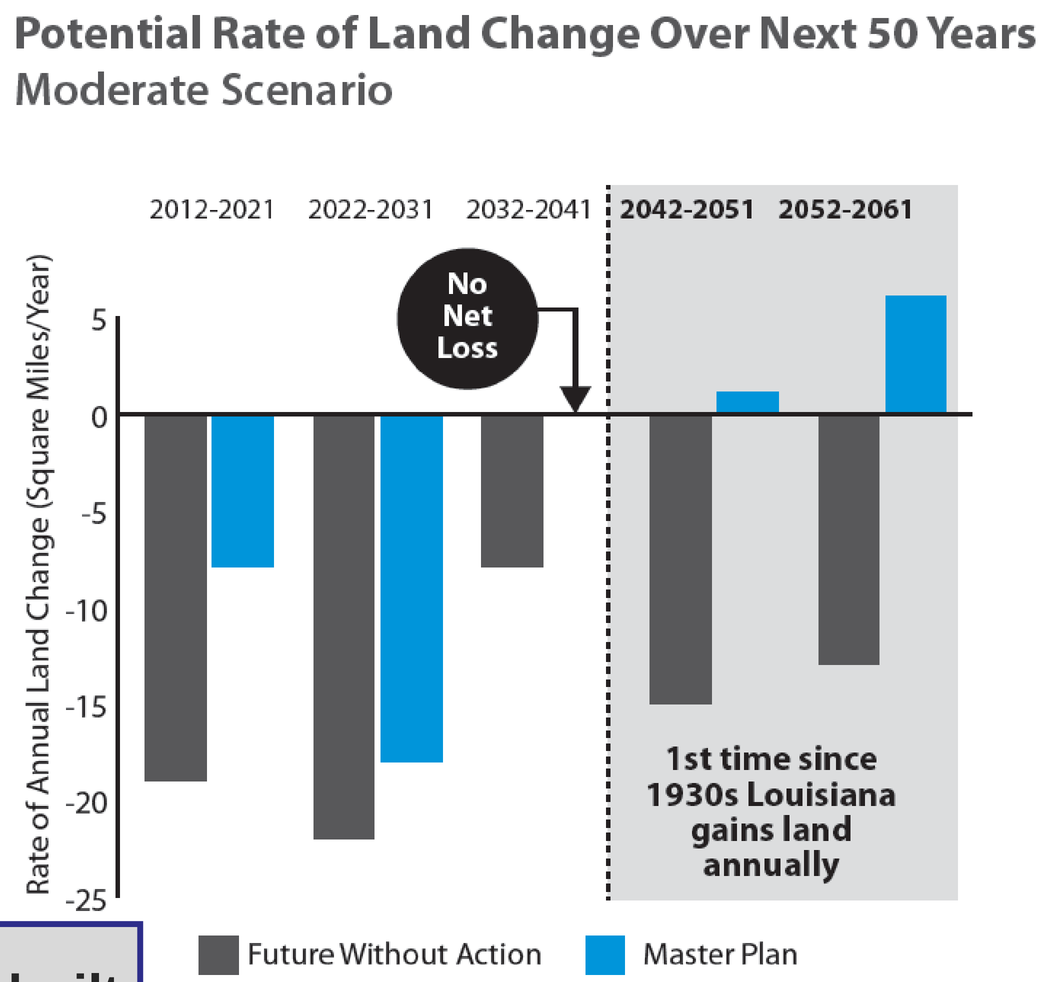


Figure 5.8
Potential change in risk, represented by expected annual damages in the Future Without Action and with the master plan at Year 50.

What the Master Plan Delivers

▶ **Figure 5.13**
Potential changes in the annual rate of land loss or land gain every 10 years based upon the moderate scenario. Implementation of projects in the master plan may result in no net loss after 20 years, and annual net land gain after 30 years.



1,420 -2200 km^2 of land built or maintained over 50 years

Associated Effort

RECOMMENDATIONS FOR ANTICIPATING SEA-LEVEL RISE IMPACTS ON LOUISIANA COASTAL RESOURCES DURING PROJECT PLANNING AND DESIGN

TECHNICAL REPORT

CPRA
Coastal Protection and Restoration Authority of Louisiana

Louisiana Applied Coastal Engineering & Science (LACES) Division

RECOMMENDATIONS FOR ANTICIPATING SEA-LEVEL RISE IMPACTS ON LOUISIANA COASTAL RESOURCES DURING PROJECT PLANNING AND DESIGN

SUMMARY OF THE TECHNICAL REPORT FOR COASTAL MANAGERS

CPRA
Coastal Protection and Restoration Authority of Louisiana

Louisiana Applied Coastal Engineering & Science (LACES) Division

24 January 2012

Need for Regional SLR Guidance

- **The Mississippi Delta is characterized by complex geology and processes that impose significant limitations when applying nationally consistent SLR guidelines.**
  - **Geology/Subsidence**
  - **Processes/Marsh Accretion**

- **Due to these complexities, we need an updated and more mechanistic process for accounting for sea-level rise in project planning and design**

LACES Recommendations explained by

- Simplified Relative Sea-level Rise (RSLR) Equation:

$$y = at + bt^2 + S$$

where

y is RSLR at a specific point,
t is time,
a is the rate of SLR (Step 1),
b is the acceleration/deceleration value (Step 2),
S is rate of subsidence (Step 3) and

- Vertical Accretion (VA) is a function of RSLR (y) specific to location and/or wetland type,

$$VA = f(y)$$

LACES Recommendations

1. Determine rate of regional water level change (mm/yr).

2. Utilize an acceleration value based on predictions of future sea-level rise.

3. Apply a local subsidence rate and incorporate into above to determine a relative SLR rate.

4. Apply RSLR rate to a habitat- or location-specific marsh accretion rate to predict marsh collapse.

LACES Recommendations
RSLR = at + bt² + St

1. **Determine rate of regional water level change (mm/yr).**

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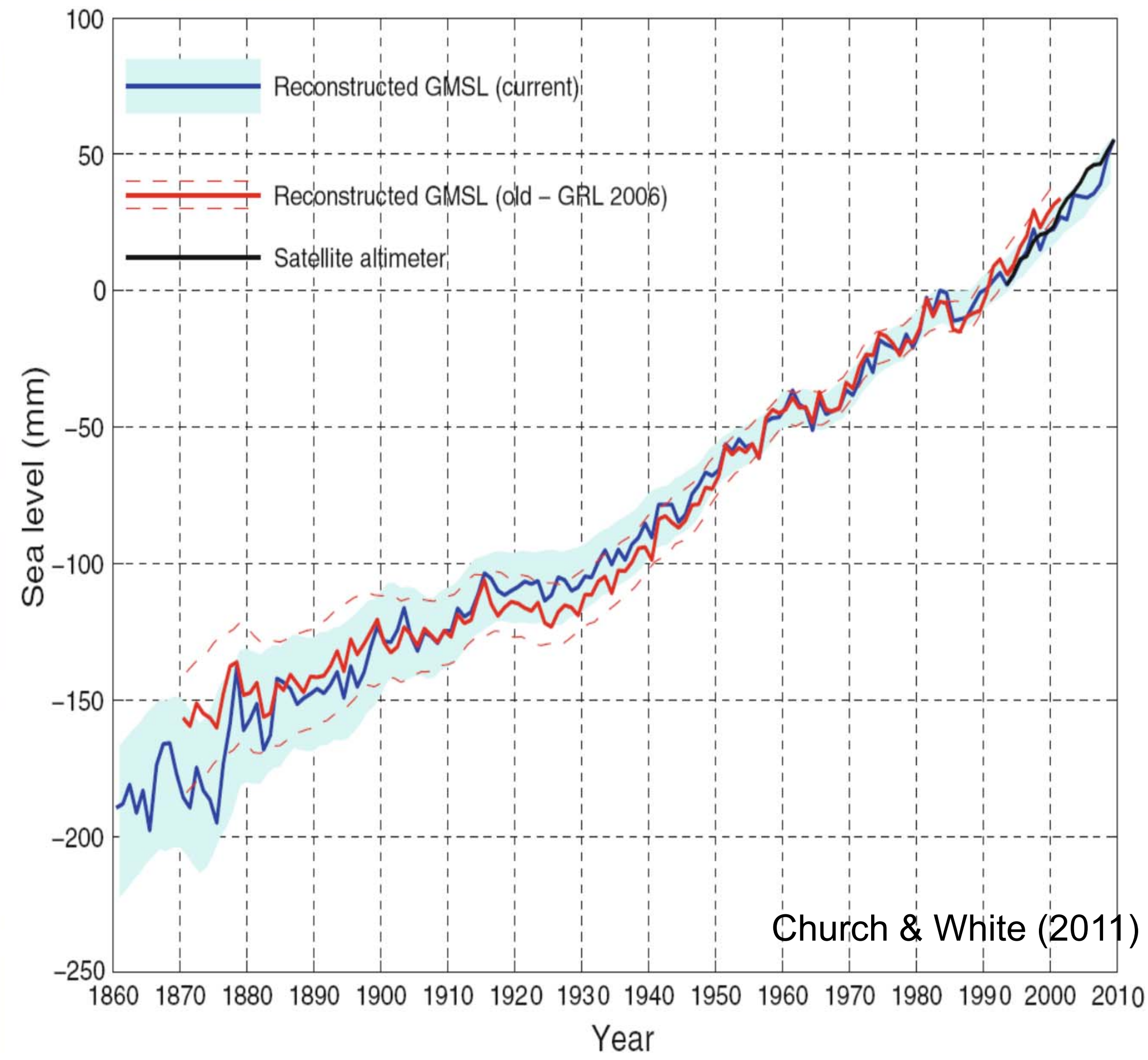
Future Mean Sea Level Trends

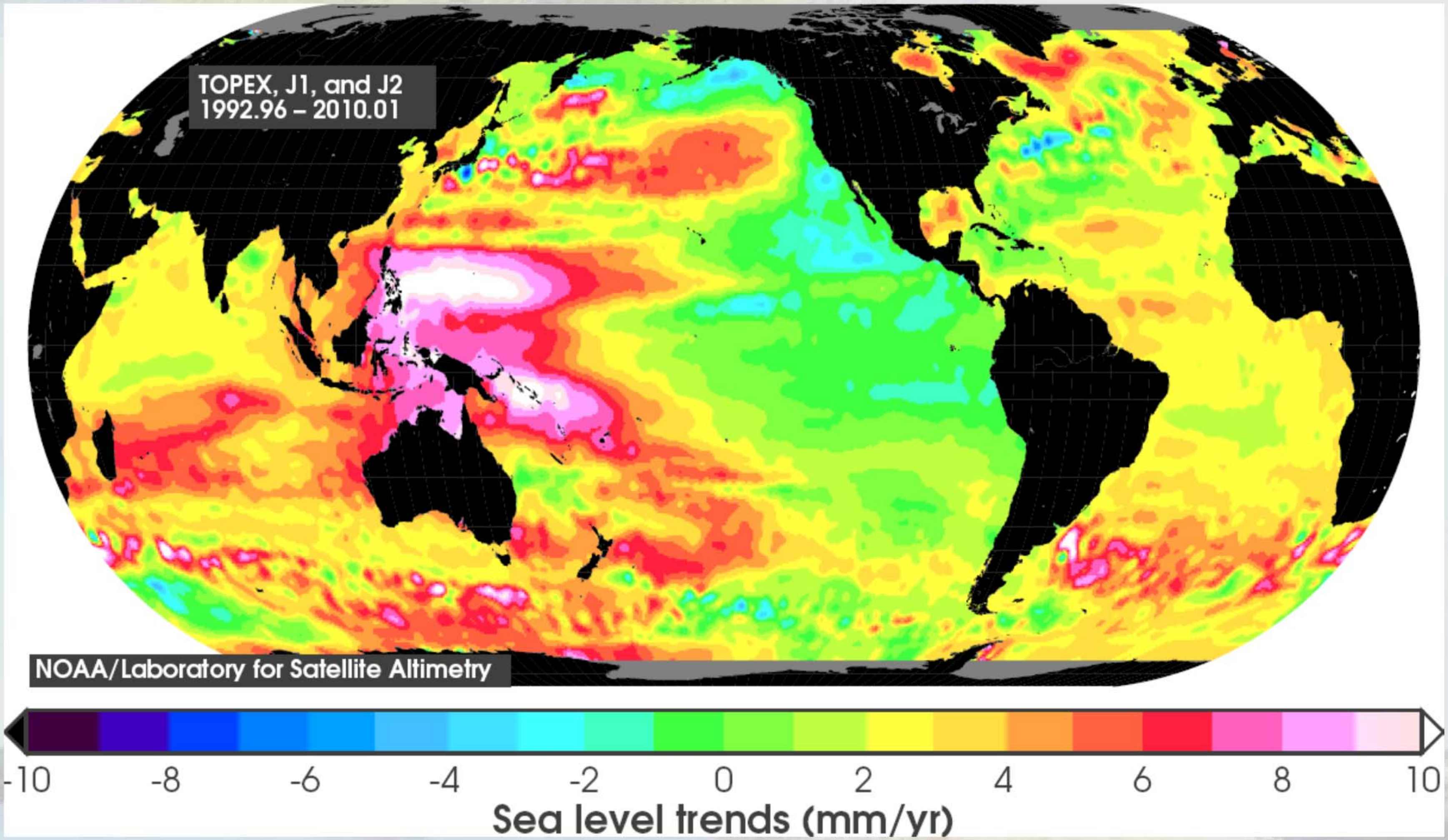
RSLR = at + bt^2 + St

- **Church & White (2011) and others demonstrate that satellite altimetry values are comparable to tide gauge record**



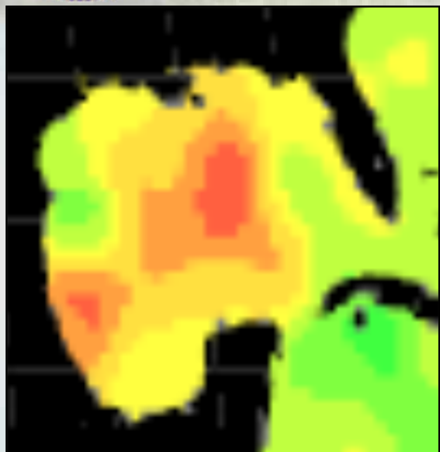
Church & White (2011)

Global Patterns in SLR Are Uneven

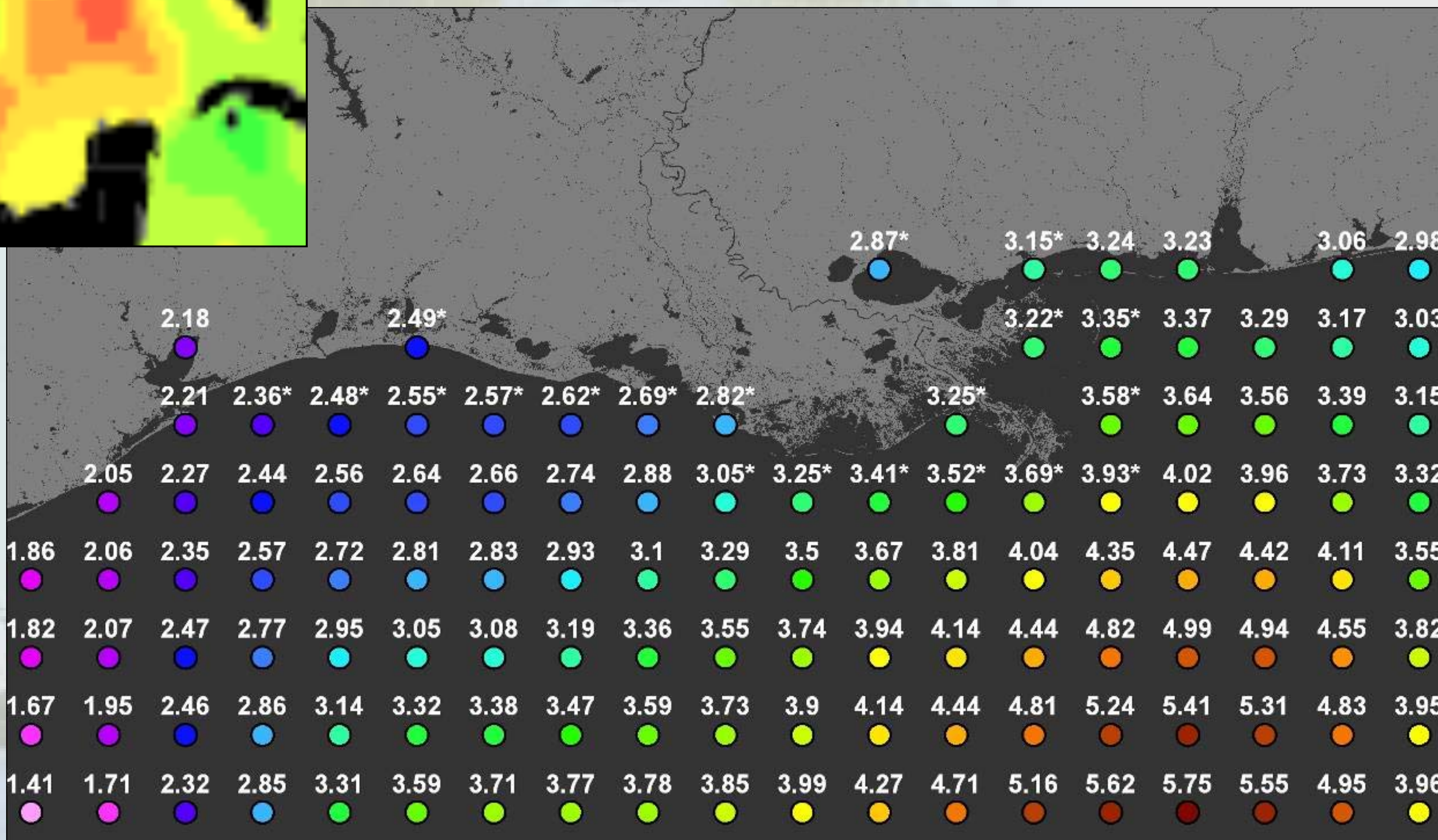


http://ibis.grdl.noaa.gov/SAT/SeaLevelRise/slr/slr_sla_gom_free_txj1j2_90.pdf

Discrete Point SLR trends from Satellite Altimetry



Range of values offshore coastal Louisiana (2.48-3.93 mm/yr) has high 58% greater than low



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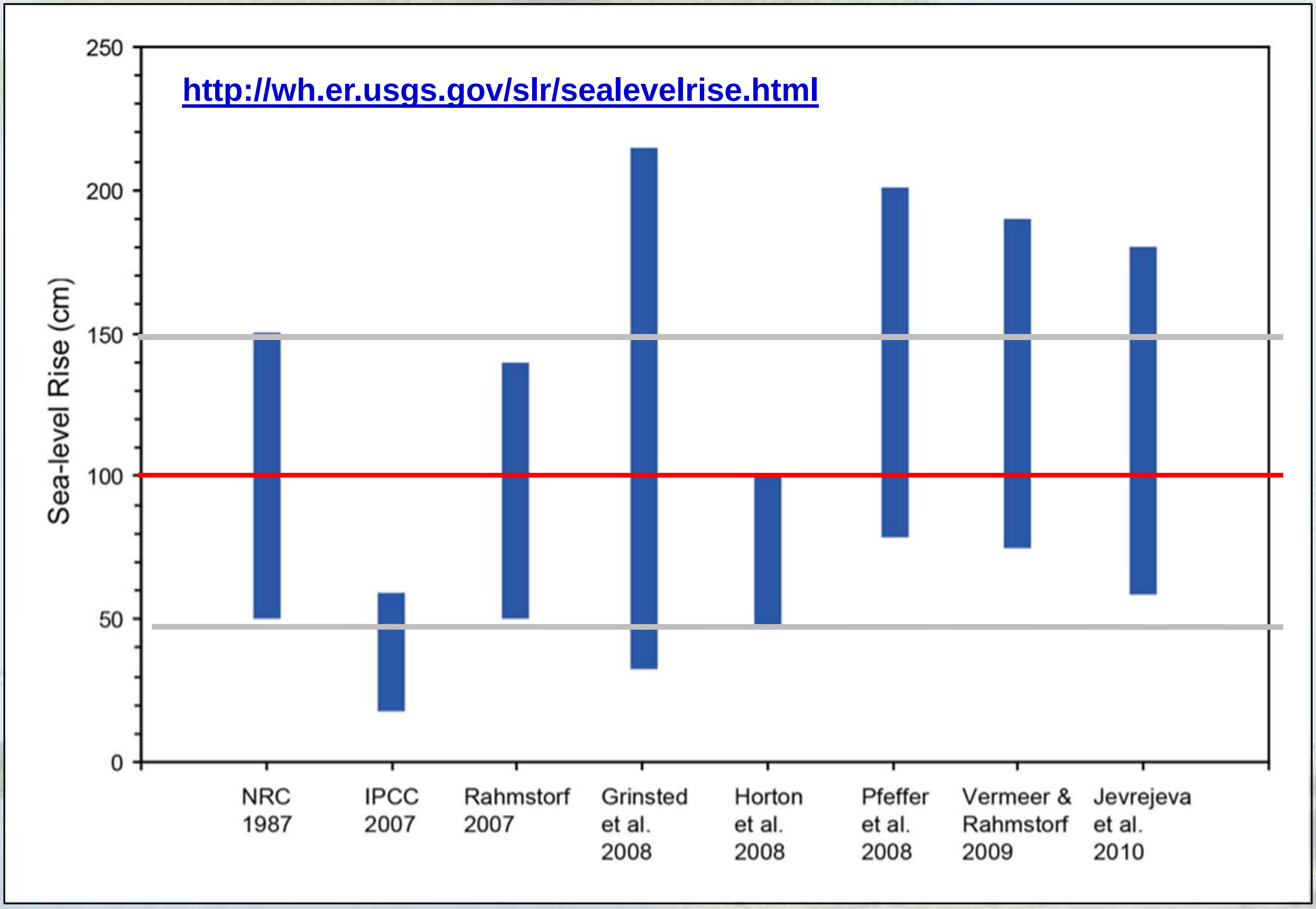

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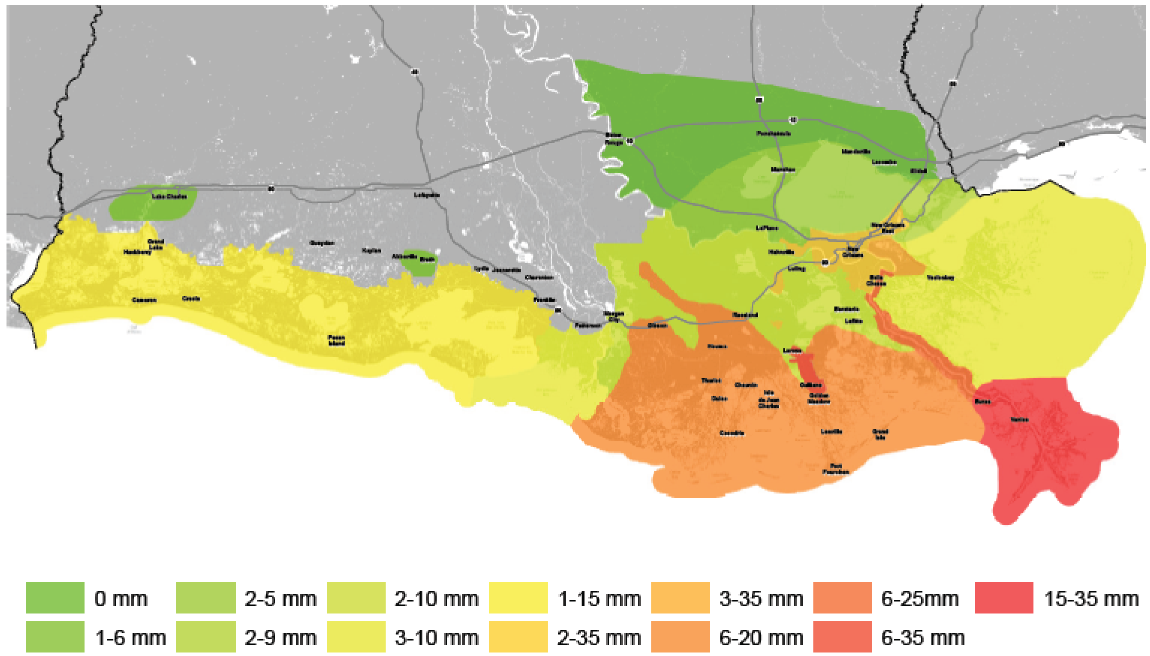

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restoring and protecting Louisiana's coast

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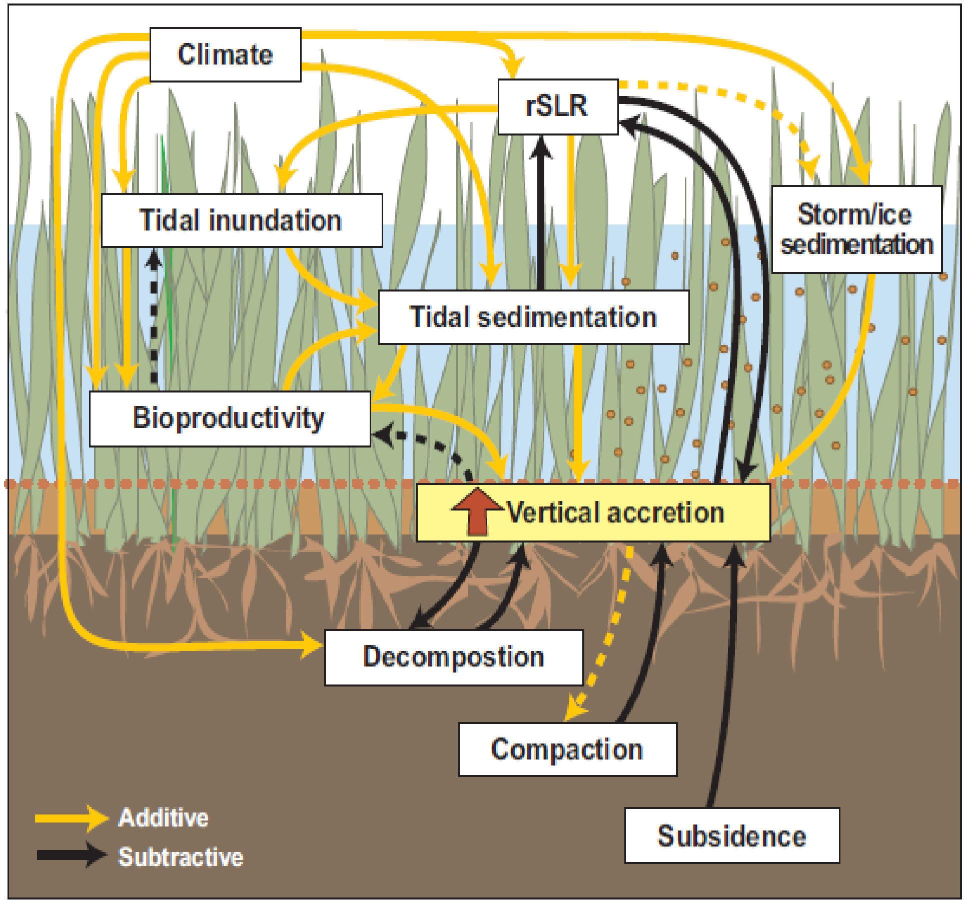
4. **Apply RSLR rate to a habitat or location specific marsh accretion rate to predict marsh collapse.**

Accretion

VA = f(RSLR)

- **Marsh vertical accretion is an extremely variable component to calculate, particularly in Louisiana.**

  - **Accretion rates are a function of relative sea-level rise**
  - Important to determine the "tipping point" or **marsh collapse threshold**



Accretion

VA = f(RSLR)

- **Recommendations**
  - **Site specific accretion measurements will be necessary to accurately predict response of wetland to RSLR.**
  - **Compare incremental RSLR function ($at + bt^2 + S$) to accretion rates to determine whether this will trigger marsh collapse.**
  - **Investigating models and elevation-based processes to predict collapse.**

Questions?

- CPRA website is coastal.louisiana.gov

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