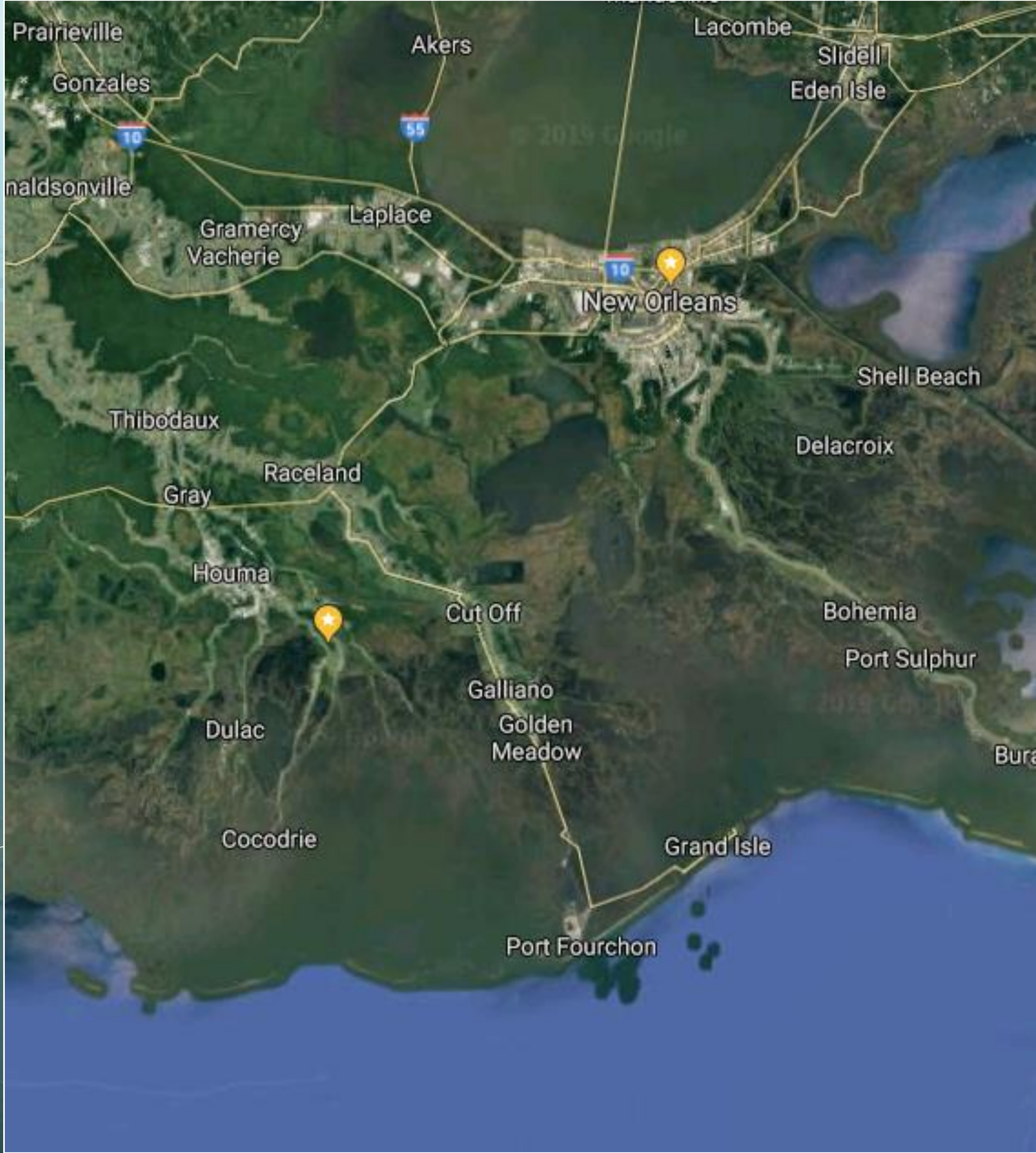


# RESILIENCE AND ADAPTABILITY IN RESPONSE TO THE IMPACTS OF COASTAL LAND LOSS AND FLOODING

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LOUISIANA UNIVERSITIES MARINE  
CONSORTIUM







CLIMATE

**This is not a  
future scenario.**

CHANGING  
COASTAL

**This is a  
now scenario**

LOSS

**Current**

# **Flooding**

**In 2017,**

flooded 23 days

closed due to flooding 7 days

**In 2018,**

flooded 21 days

closed due to flooding 3.5 days

**In 2019,**

flooded 5 days

closed due to flooding 2 hours



Current

# Flooding

7.4 ft



Current

# Flooding

8.0 ft



Current

# Flooding

8.25 ft





Current

# Flooding

Days of High Water at LUMCON's Marine Center

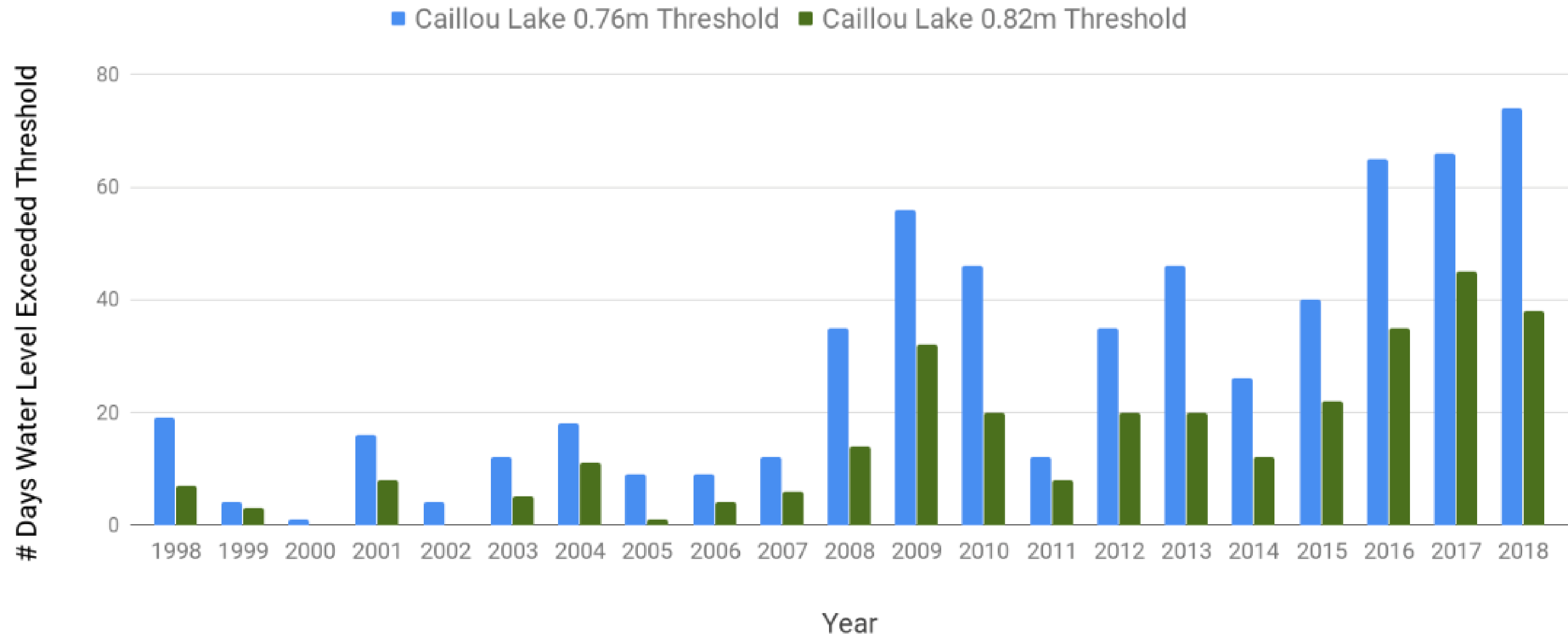


Fig. 9. Number of days of high water in south Terrebonne Parish, as determined by the long-running USGS Caillou Lake gauge.

CLIMATE

CHANGE

**How did we**

**get here?**

COASTAL

LOSS

# Causes of Flooding

## Climate Change and Sea Rise

Hurricanes and Tropical Storms

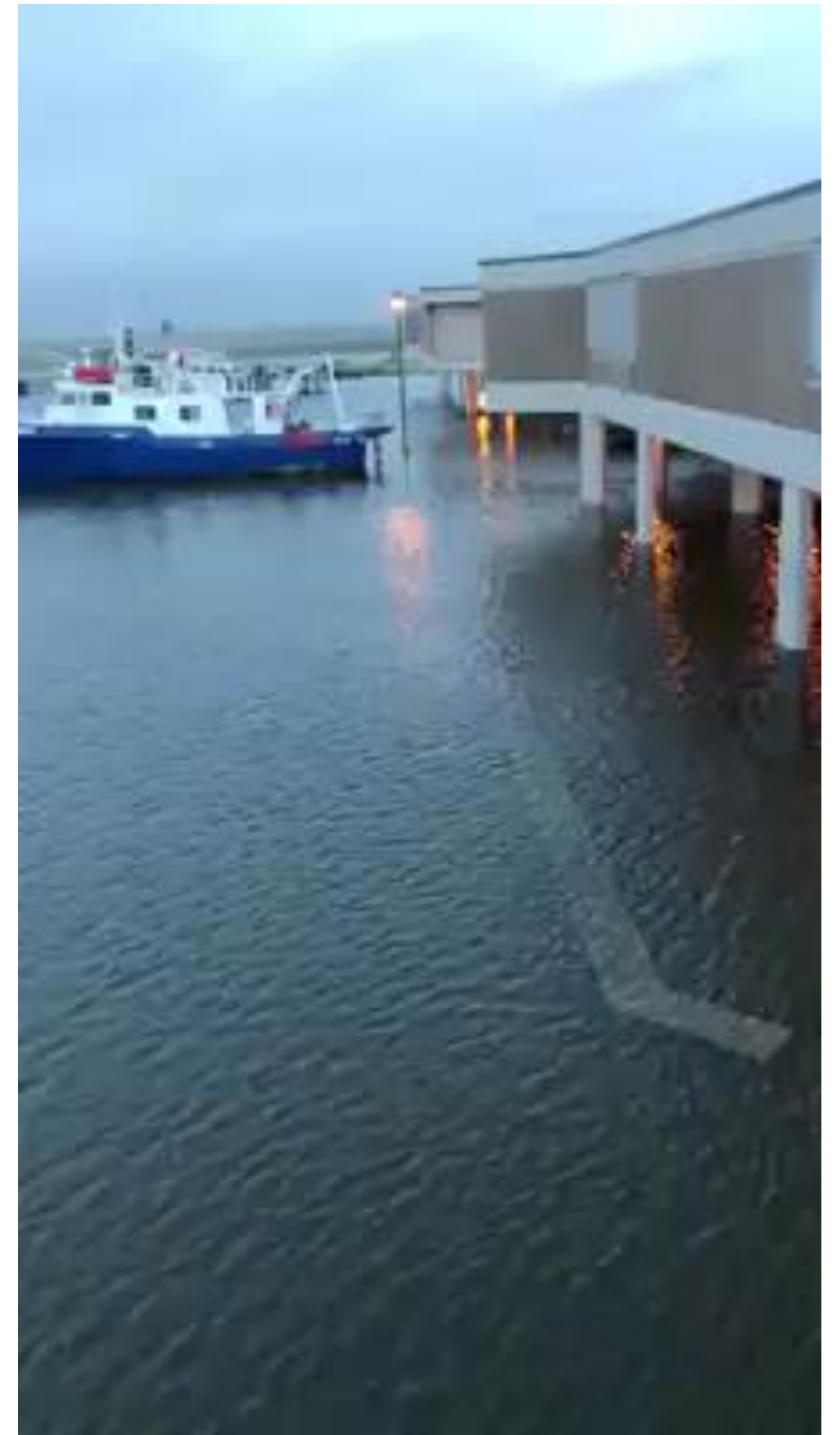
Southerly Winds and Cold Front Cycle

Land Loss

Subsidence

Morganza to the Gulf Levee System

Sea-level rise rates are likely to accelerate this century, impacting coastal systems worldwide, compounding flood risks that have been increasing in many areas for decades. (Sweet et al., 2017)



Causes of

# Flooding

Climate Change and Sea Rise

**Hurricanes and Tropical Storms**

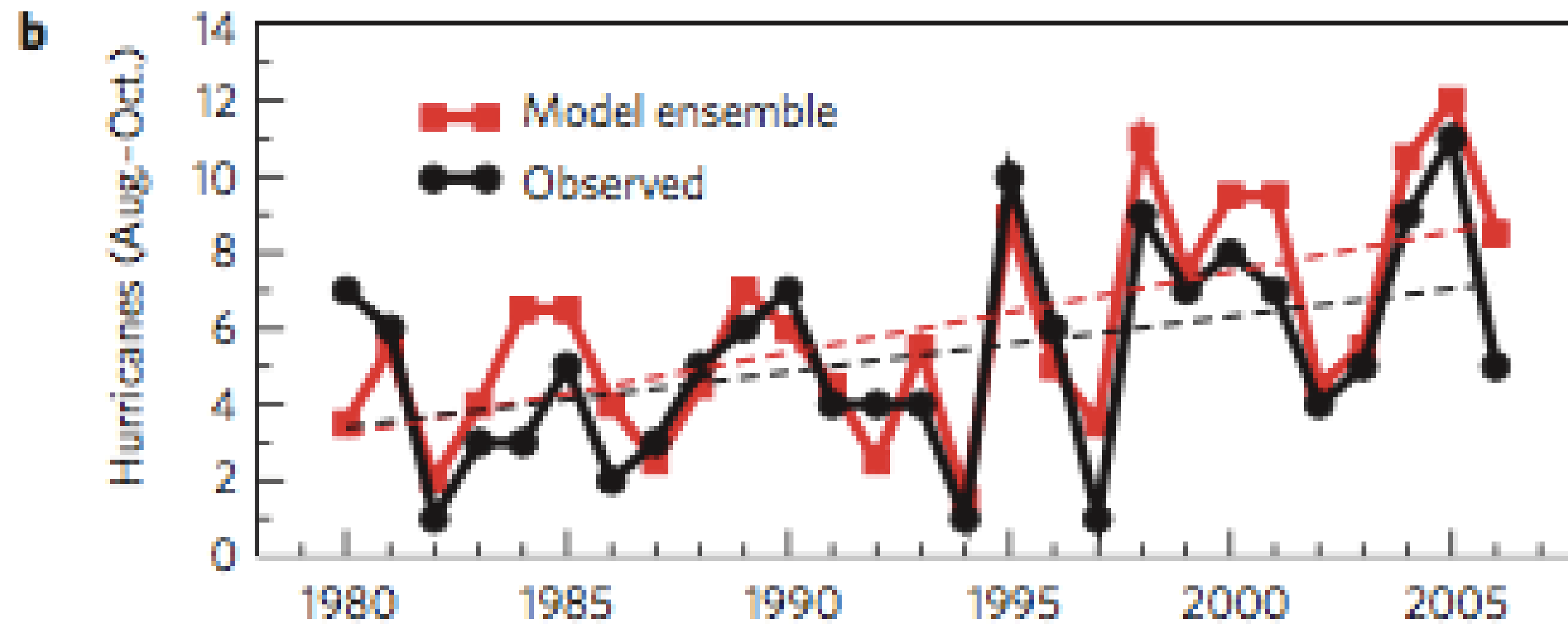
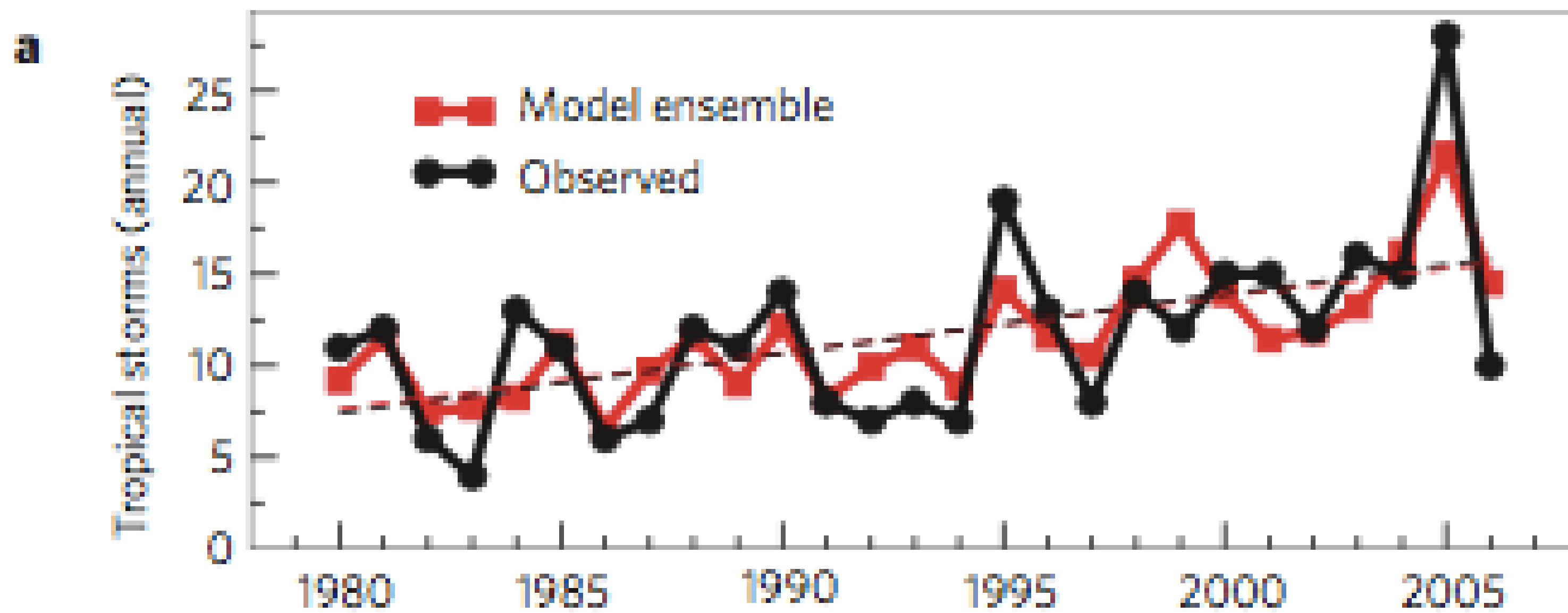
Southerly Winds and Cold Front Cycle

Land Loss

Subsidence

Morganza to the Gulf Levee System

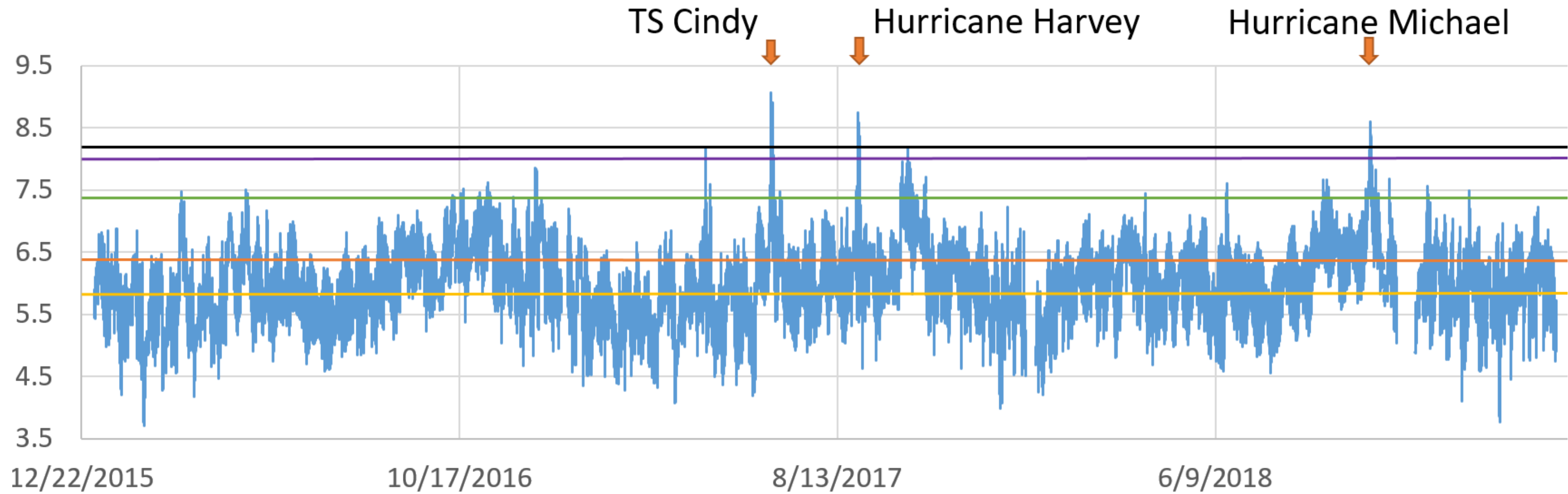
Surges from hurricanes such as Andrew, Katrina, Rita and Gustav raised water levels at LUMCON's Marine Center by 4-9 feet. Data developed for Louisiana's Coastal Master Plan predict that under current conditions, a storm with a 1% chance of occurring in any given year will lead to a storm surge between 3 to 4.5 meters (10 to 15 feet) in many areas near Cocodrie, with some areas experiencing over 4.8 meters (16 feet) of flooding (LACPRA 2017).



**Tropical cyclones and climate change.**  
 Knutson, Thomas R., et al.  
*Nature Geoscience* 3.3 (2010): 157.

Current

# Flooding

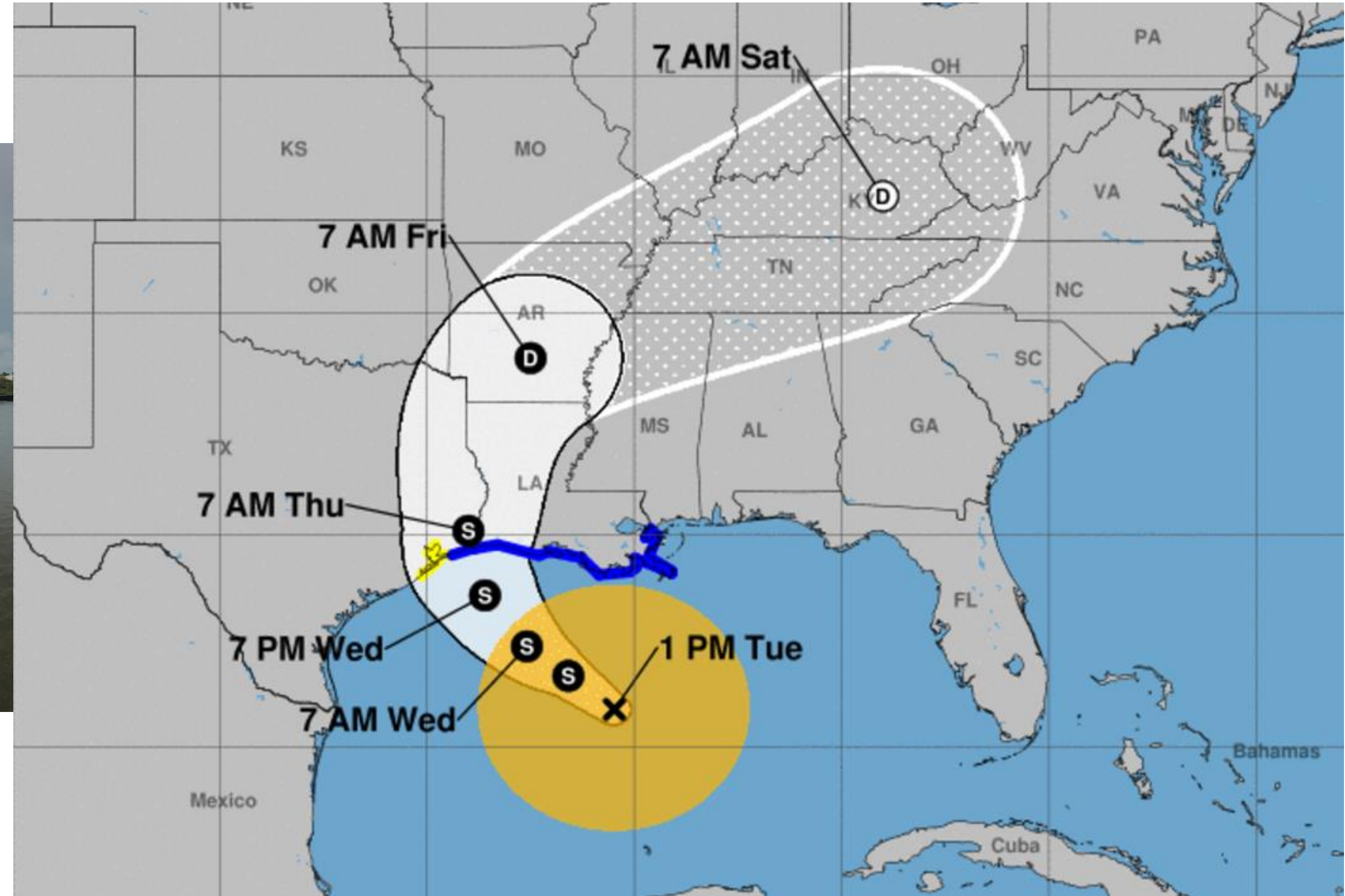


- 5.9 ft – Water on the marsh
- 6.4 ft – Water on our property through the boat ramp
- 7.4 ft – Marine Center parking lot floods
- 8.0 ft – Highway 56 to the Marine Center floods
- 8.2 ft – R/V *Acadiana* and pump house docks are underwater

# Causes of Flooding



Tropical Storm Cindy  
Landfall: June 22, 2017





Tropical Storm Cindy  
June 21, 2017 22:31



# Causes of Flooding

Climate Change and Sea Rise

Hurricanes and Tropical Storms

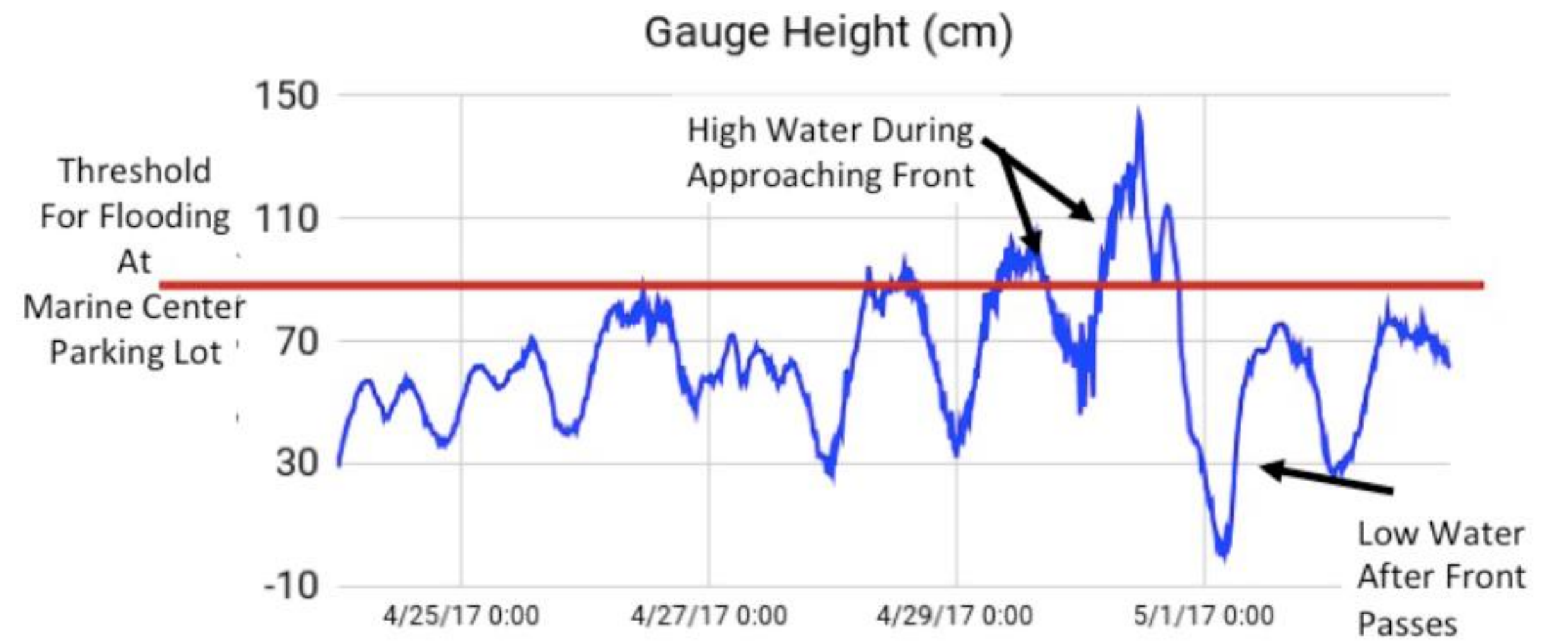
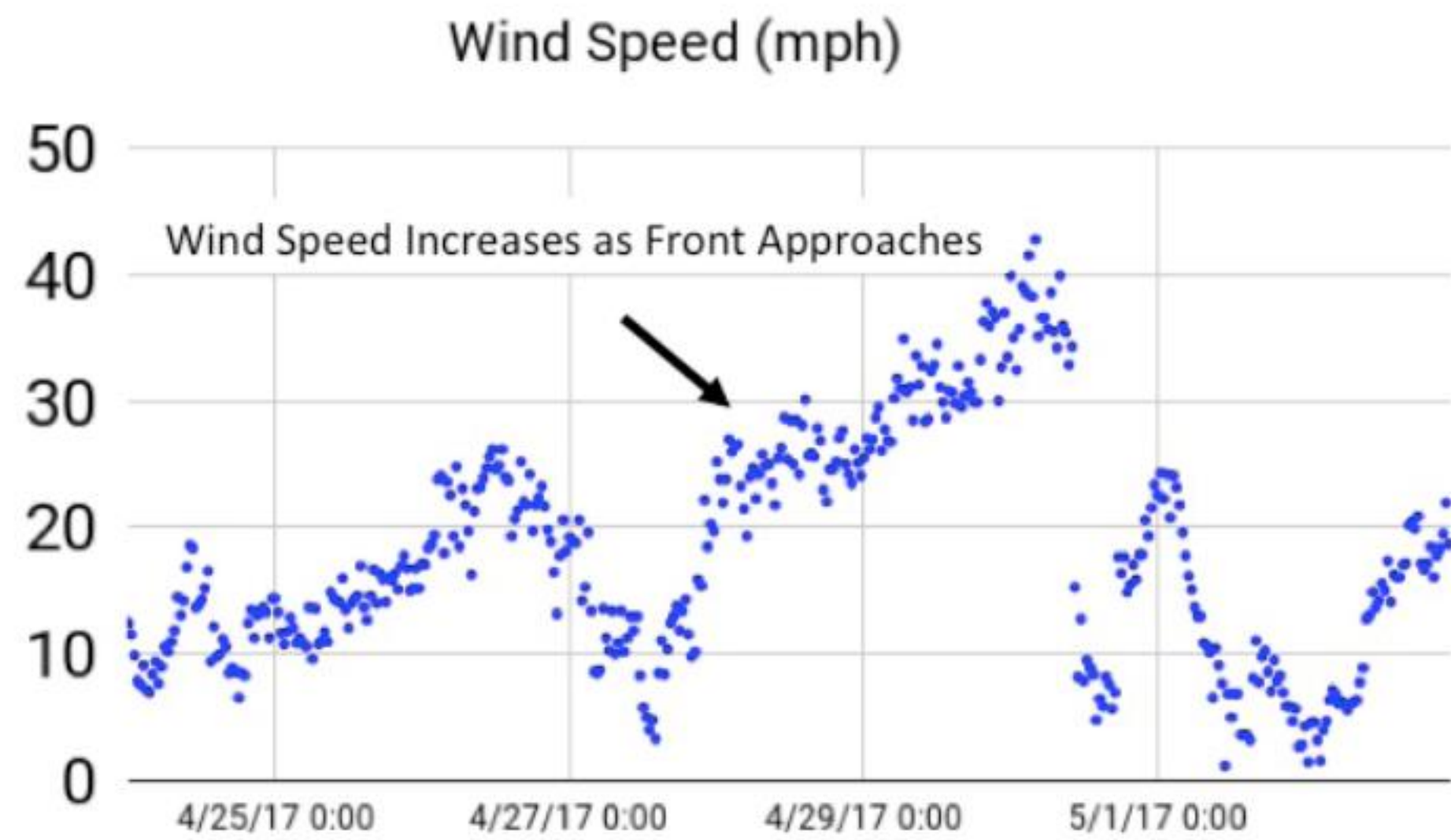
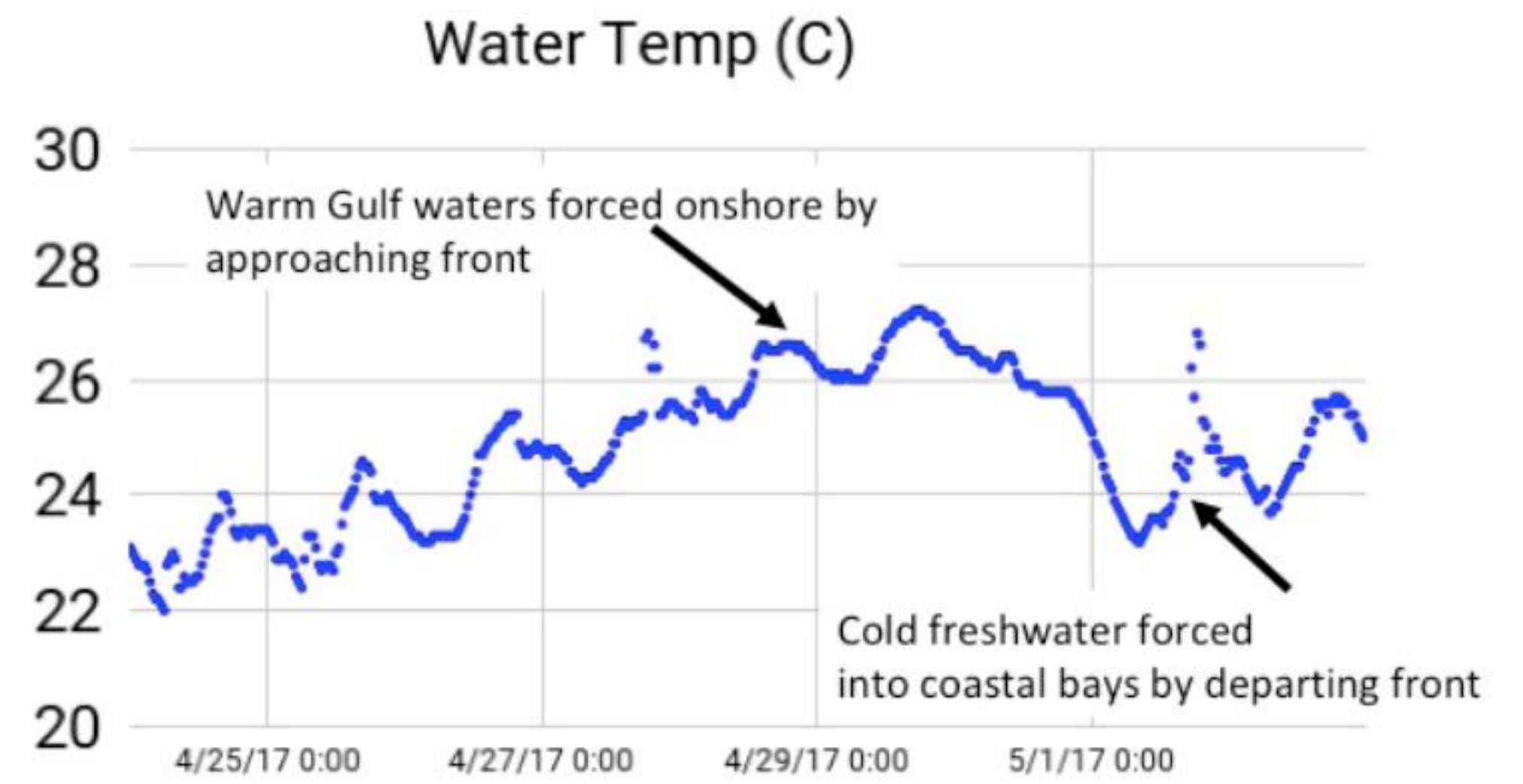
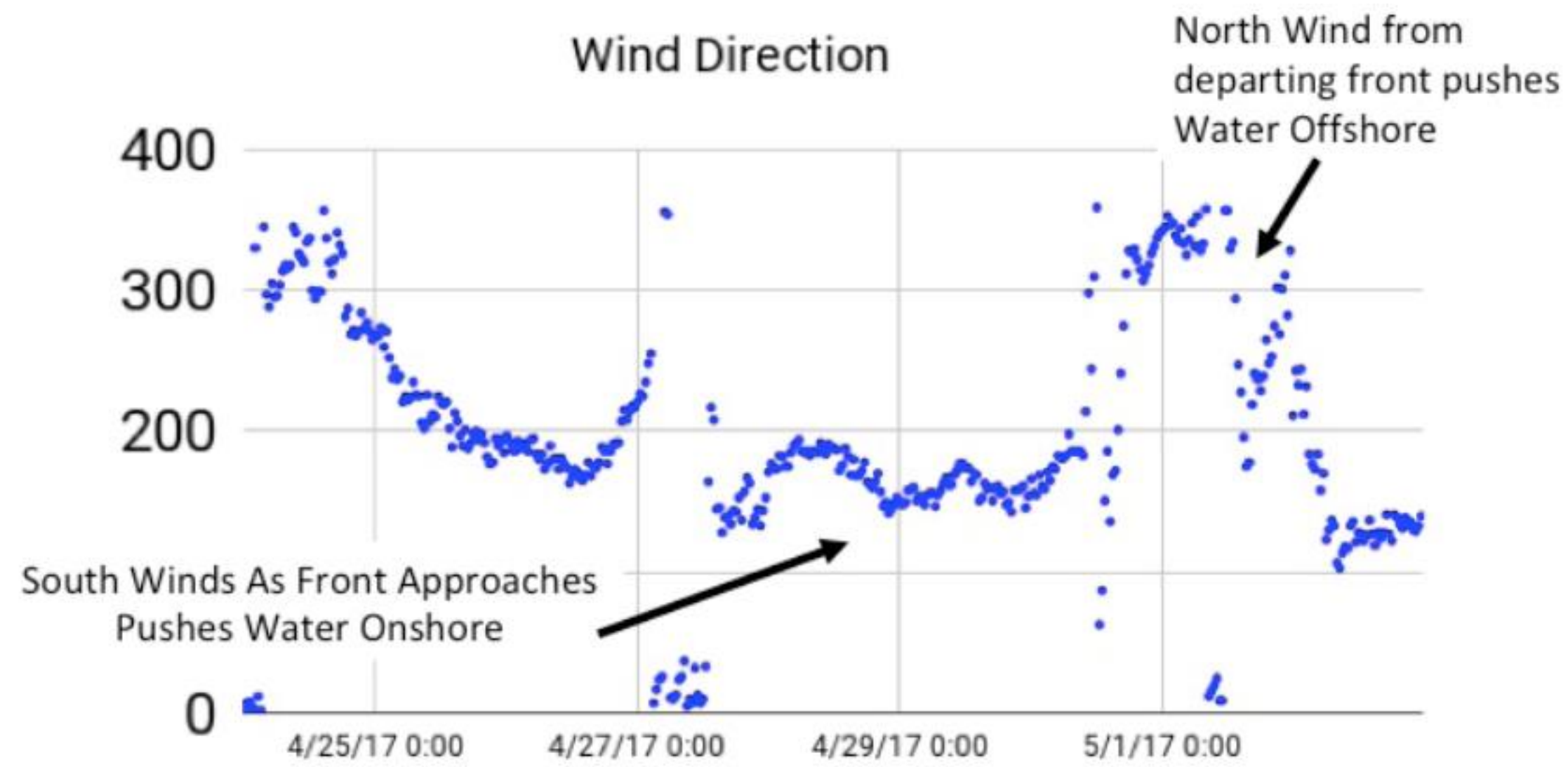
**Southerly Winds and Cold Front Cycle**

Land Loss

Subsidence

Morganza to the Gulf Levee System

Winds out of the southeast present one of the most common driver of nuisance flooding at LUMCON. Often these floods are associated with approaching cold fronts, in which water is forced onshore during the approaching phase of the front and onshore during the post-frontal phase (Roberts et al. 1989; Kineke et al. 2006). Preliminary analyses of data from recent years indicate that there will be at least a small amount of water in the Marine Center's parking lot when there are onshore winds of about 9 meters per second (20 miles per hour) and a normal or spring tide.



Causes of

# Flooding

Climate Change and Sea Rise

Hurricanes and Tropical Storms

Southerly Winds and Cold Front Cycle

## Land Loss

Subsidence

Morganza to the Gulf Levee System

Coastal Louisiana has experienced nearly 4,800 square kilometers (1,853 square miles) of land loss since 1932, during which the Terrebonne Basin has lost nearly 1302 square kilometers (504 square miles) - amounting to 29% of the total land area of the basin (Couvillion et al. 2017). This land loss results in a decreased coastal buffer that increases flood stress on Cocodrie, and raises water levels more broadly across the region (LACPRA 2017).

# Causes of Flooding

Climate Change and Sea Rise

6 mm/yr (Blum and Roberts 2012)

Hurricanes and Tropical Storms

8.8 mm/yr (LUMCON Bencharks)

Southerly Winds and Cold Front Cycle

9.8 mm/yr and 15.5 mm/yr (LA Coastal Master Plan)

Land Loss

2.02 cm/yr (US Army Corps of Engineers)

**Subsidence**

3 to 5 cm/yr (Woock et al. 2018)

Morganza to the Gulf Levee System

# Causes of Flooding

Climate Change and Sea Rise

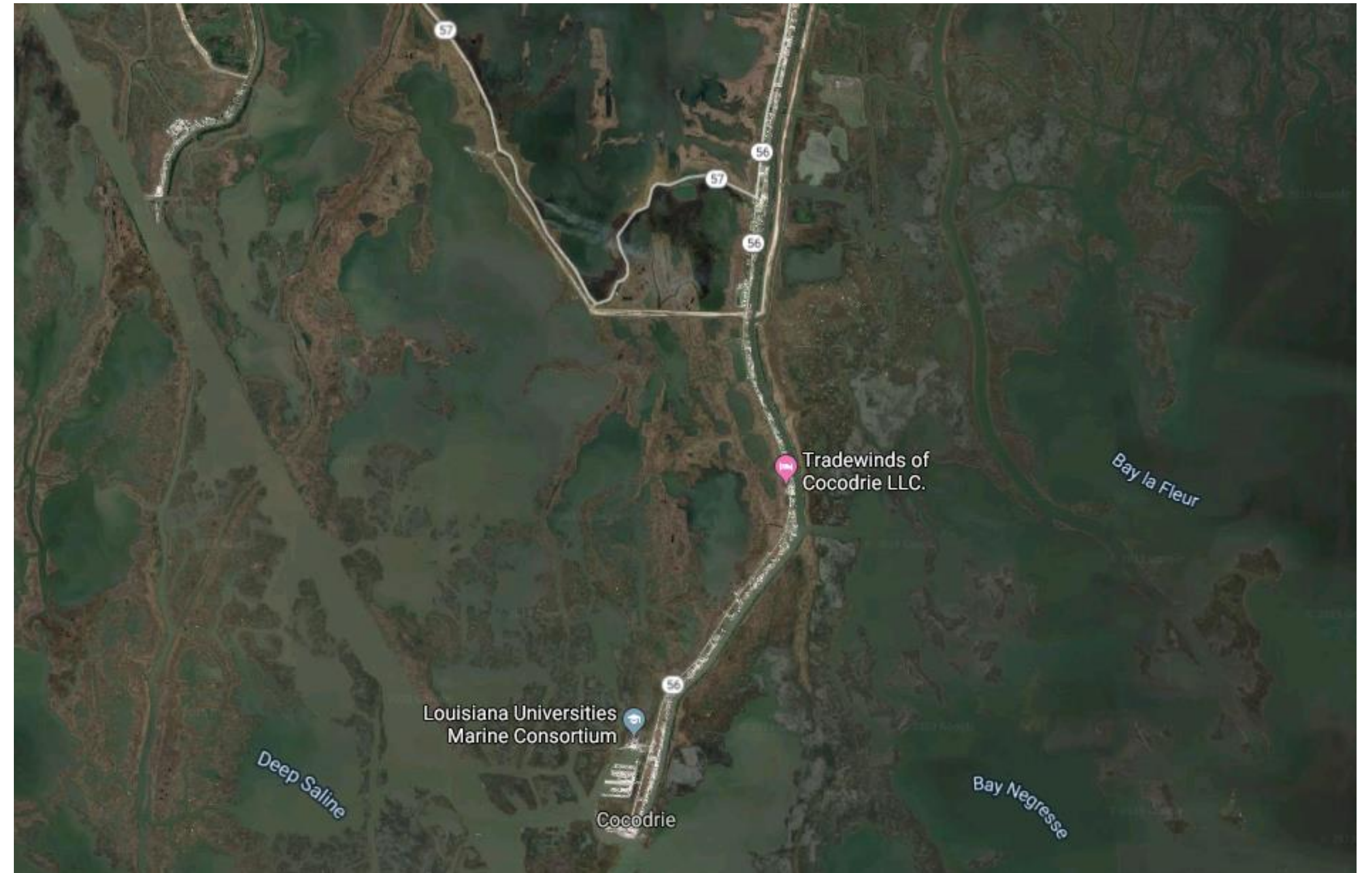
Hurricanes and Tropical Storms

Southerly Winds and Cold Front Cycle

Land Loss

Subsidence

**Morganza to the Gulf Levee System**



RESILIENCE  
**The Future of**  
**LUMCON**  
ADAPTATION

# Future of Flooding

	2020	2025	2030
Current Trends			
Low	2.8 (1.1)	7.4 (2.9)	12.0 (4.7)
Medium	3.6 (1.4)	9.6 (3.8)	15.2 (6.0)
High	6.9 (2.7)	18.4 (7.2)	29.9 (11.8)
With Accelerated SLR			
Low	4.6 (1.8)	12.2 (4.8)	19.8 (7.8)
Medium	5.4 (2.1)	14.4 (5.7)	23.4 (9.2)
High	8.7 (3.4)	23.2 (9.1)	37.7 (14.8)

Near- to medium-term relative sea-level rise projections for LUMCON's Marine Center. Total cm (Inches) by date.

Projections used in this analysis suggest that within about 10-15 years, regular tidal and frontal passage-induced flooding could lead to conditions that shut down LUMCON's Marine Center several dozen times a year if no action is taken

Difference between an inconvenient flood (one in which the parking lot has water, but does not immediately impact activities) and a problematic flood (one that shuts down most of LUMCON's daily operations) is about **15 cm (6 inches)**.

A Future of

# Resilience and Adaptation

To understand flood-related issues at LUMCON's Marine Center, a panel was convened to examine how LUMCON can both grow in a challenging environment, and plan for a changing future.

The panel's name, "**GRAPPLE**," stems from the need for GRowth And PLanning, and also emphasized the need to grapple with, and address, serious site concerns.

The purpose of this panel was

1. to identify current and future hazards, and
2. present a strategy to move forward.



**The Marine Center's Unique Location  
is an Opportunity to  
Study, Educate, and Inform  
About the Impacts and  
Solutions to Rising Waters**

**LUMCON Will Not Retreat and  
Embrace Flooding both  
Physically, Mentally,  
Emotionally, and Culturally**

**ADVERSITY  
STAGNANT  
CONSTRAINED  
REACTIVE**



**OPPORTUNITY  
INNOVATION  
UNRESTRICTED  
PROACTIVE**

A Future of

# Resilience and Adaptation

Research performed and lessons learned at LUMCON today can inform actions that are needed across the world tomorrow.

## Research

Increased flooding of lower Terrebonne Bay offers an unprecedented opportunity to study sea-level rise and its impacts to coastal systems and human infrastructure; LUMCON's Marine Center can serve as a "**living laboratory**" of coastal change moving forward.

## Education

By studying at LUMCON's Marine Center, students have a unique opportunity to learn about sea-level rise, climate change and coastal hazards First hand. LUMCON is ideally situated prepare a new generation of scholars, leaders, and educated citizens for these Twenty First Century challenges

LUMCON'S

# Adaptation Response & Resiliency

## **IMMEDIATE TERM (less than a year)**

- 1. Repair and fortify the Marine Center's utilities and make them more food resilient.**

LUMCON'S

# Adaptation **Response & Resiliency**

**NEAR TERM (less than 5 years)**

- 1. Rethinking parking**
- 2. Rethinking the elevators**
- 3. Expand the boardwalk network.**
- 4. Allow suitable areas of the property to return to marsh.**
- 5. Focus research on the opportunity to study sea-level rise first hand**
- 6. Enhance Sea Level Rise Education and Outreach (Flood Curriculum)**
- 7. Collaboration Opportunities (Marine Synthesis Center and Short-Term Visitor Program)**
- 8. Enhance documentation of flooding**
- 9. Safe Harbor and Engaging the New Houma Campus**
- 10. Vehicular Access**

LUMCON's

# Adaptation **Response & Resiliency**

## **LONG TERM (5-50 years)**

- 1. Develop alternative access route**
- 2. Increase Energy and Utility Independence**
- 3. Expand the list of activities that can be accomplished at LUMCON's Marine Center.**

2018-10-09



Thank You



IPC