Coastal Bend Climate Change Vulnerability Assessment

COASTAL BEND BAYS & ESTUARIES PROGRAM

The Nature Conservancy

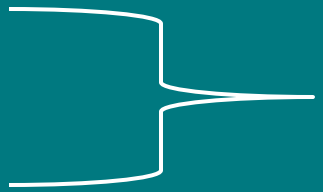
Protecting nature. Preserving life.™

Meagan Murdock
meagan.murdock@tnc.org
Marine GIS Manager

Vulnerability assessment

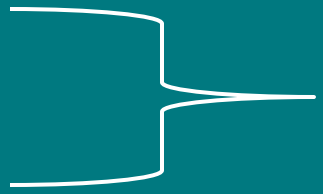
Goal: Identify sectors that may be *vulnerable* to climate change (stressors)

1. Stressors Identification
2. Stressors analysis
3. Scenario choice
4. Sectors identification
5. Sectors analysis



1st climate change

2nd future projections



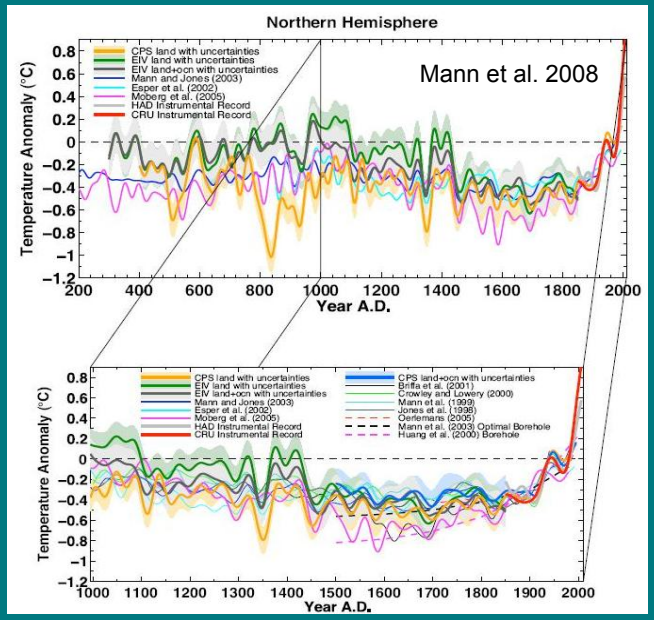
3rd social, economic, and natural

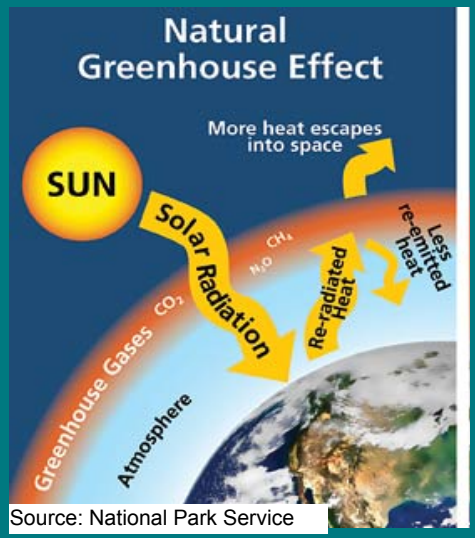
Vulnerability assessment- *Stressors identification*

- What is climate change?
- How is climate changing?
- How does climate change effect me?

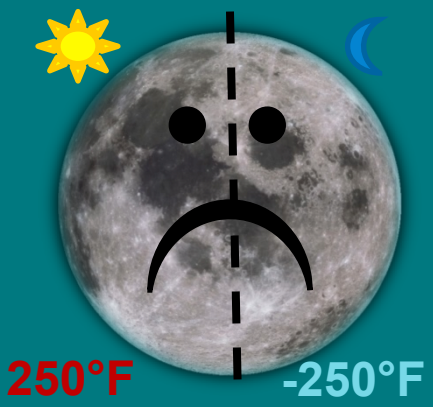
Stressors identification

- **Climate?**
  - measured over long spans of time
  - naturally variable
  - effected by abiotic and biotic factors
  - Earth's climate is hospitable due to it's atmosphere & the associated greenhouse gases (GHG)



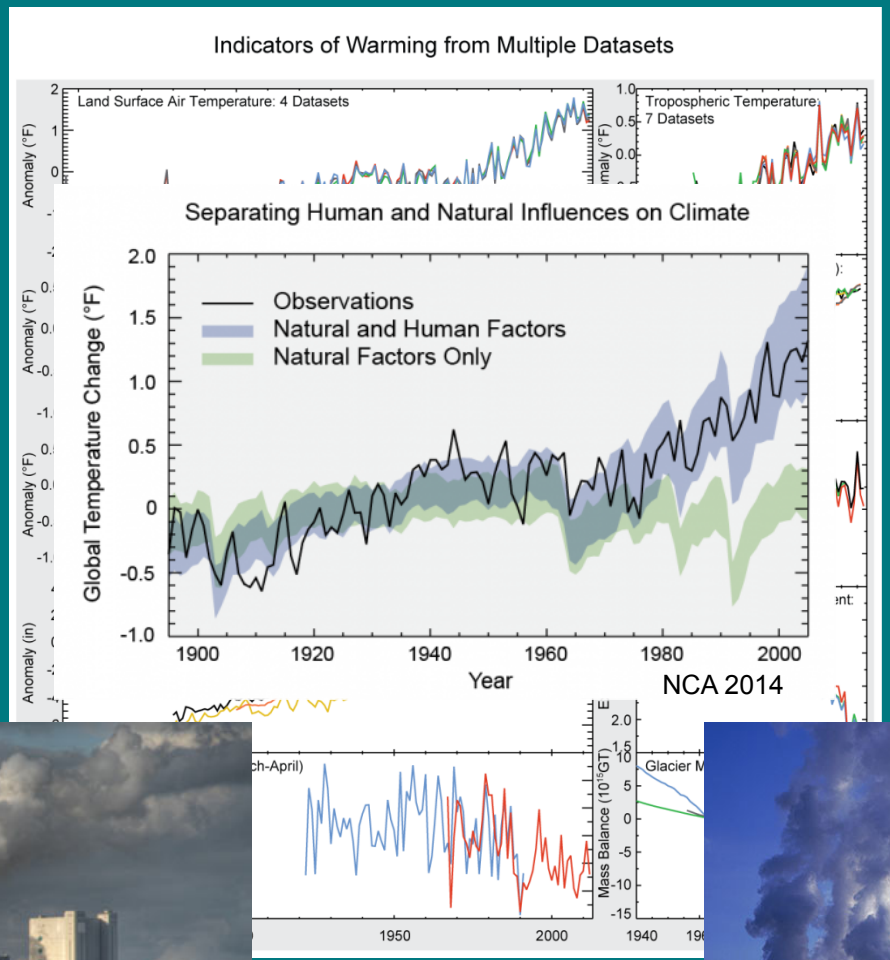


Source: National Park Service

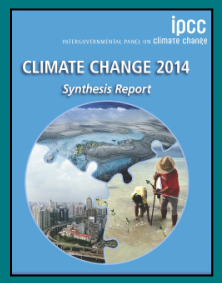


Stressors identification

- Climate change? Global warming

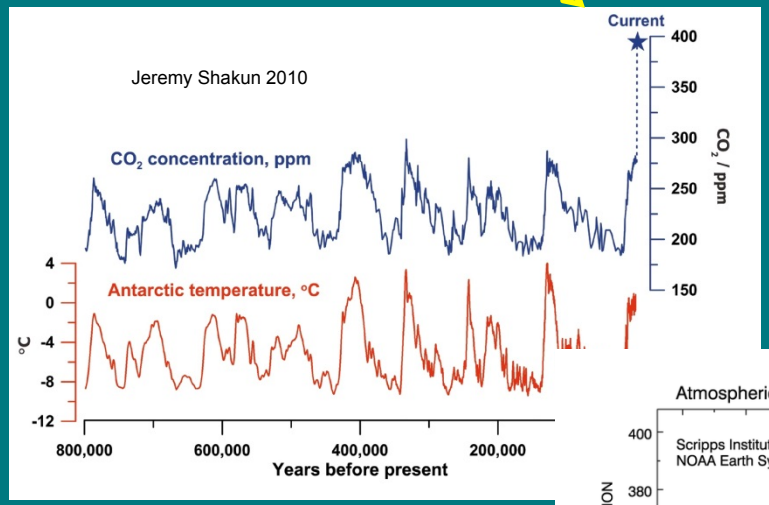


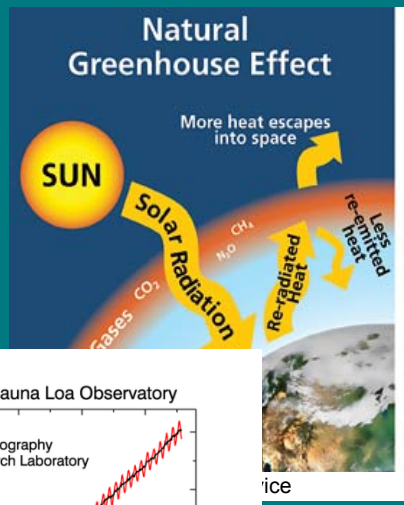
Stressors identification: carbon bust

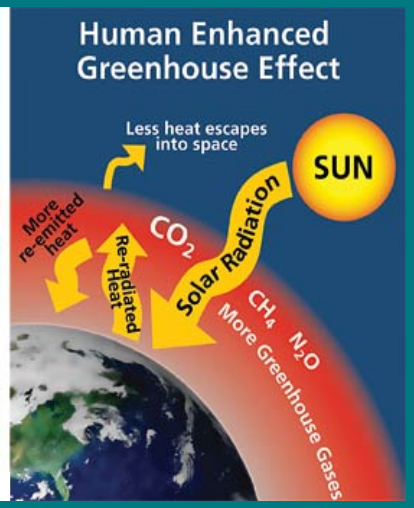


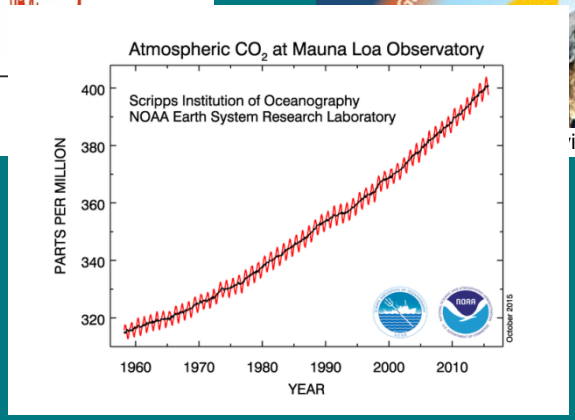
Human influence on the climate system is clear, and recent anthropogenic emissions of **greenhouse gases** are the **highest in history**. Recent climate changes have had widespread **impacts on human and natural systems**.

IPCC AR5

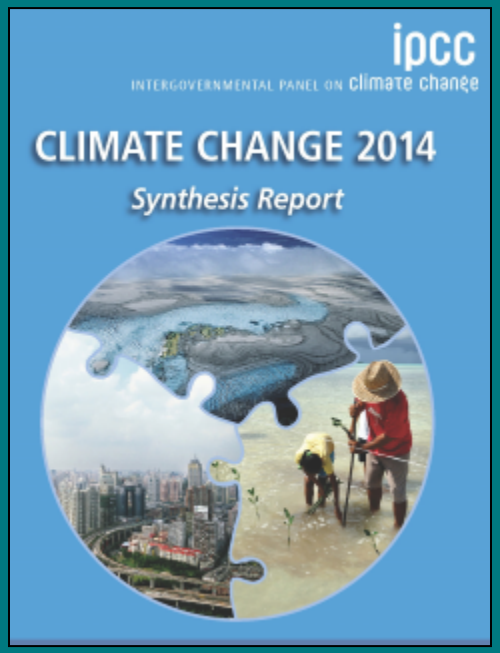


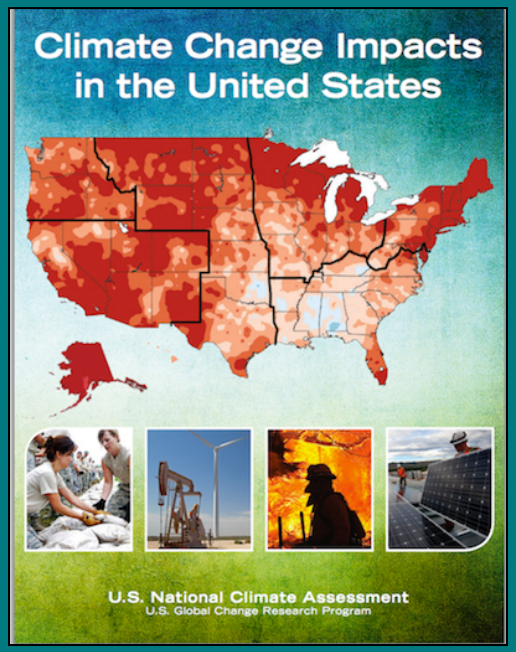


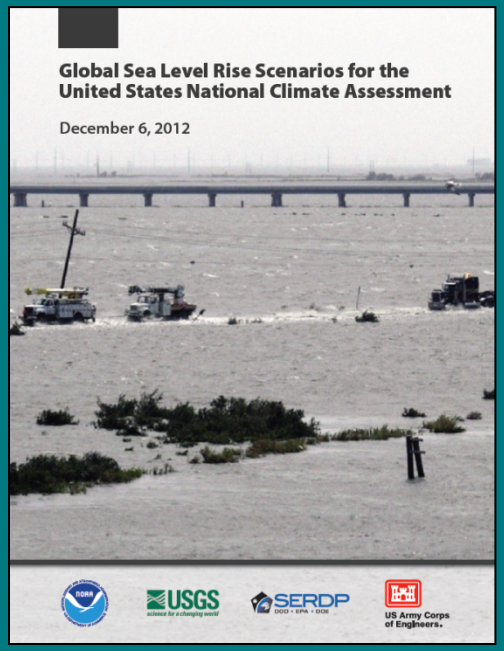




Stressors Identification







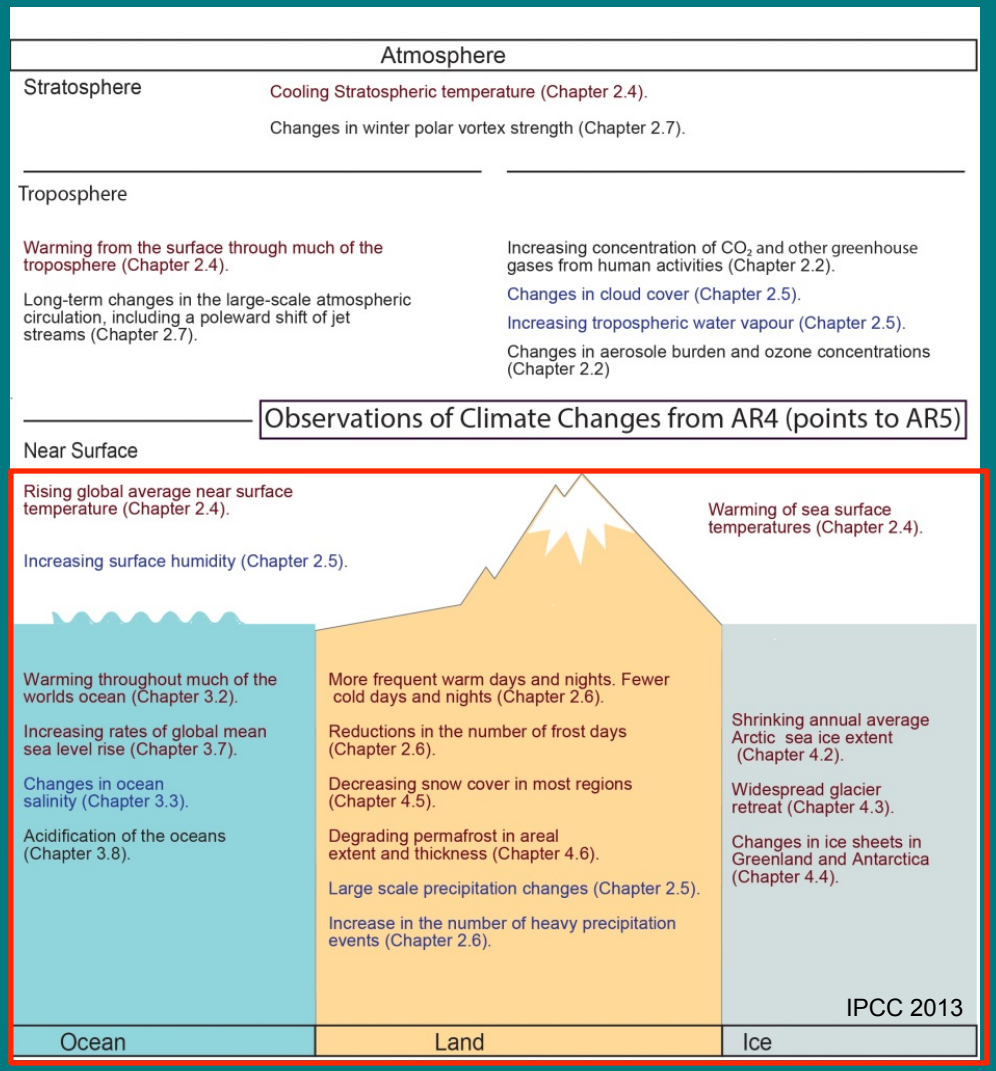
Stressors identification

↑ temperatures (air, water, oceans)

↑ sea levels

Δ salinity

↓ pH



↑ humidity

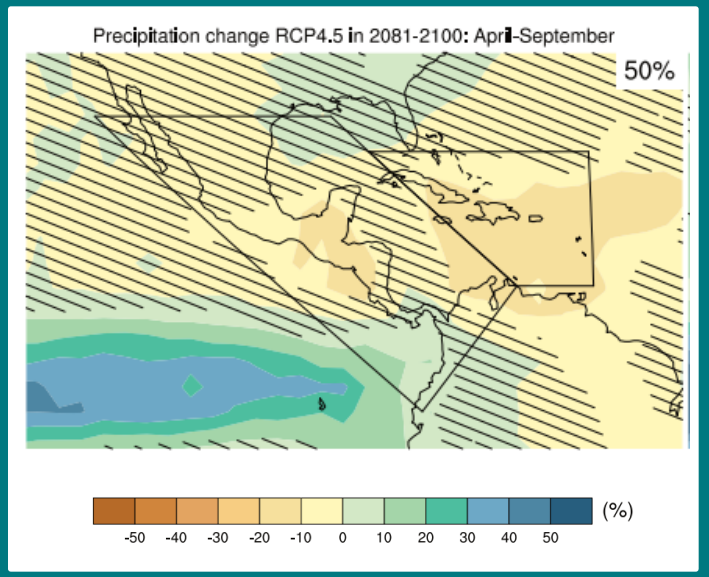
Δ precipitation

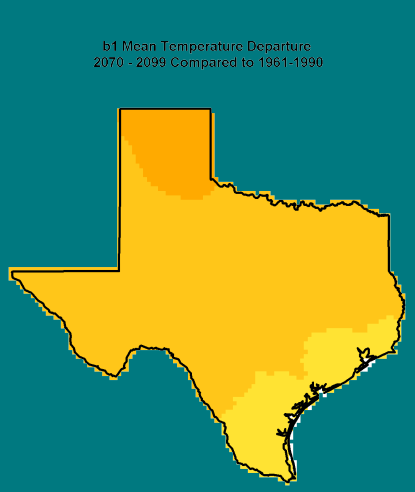
↑ drought

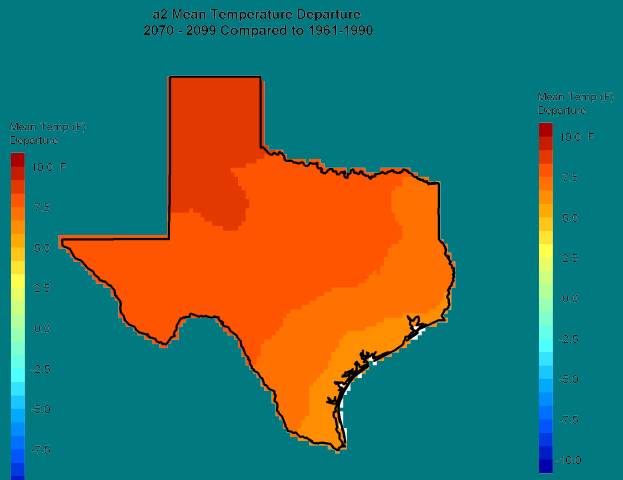
↑ storminess

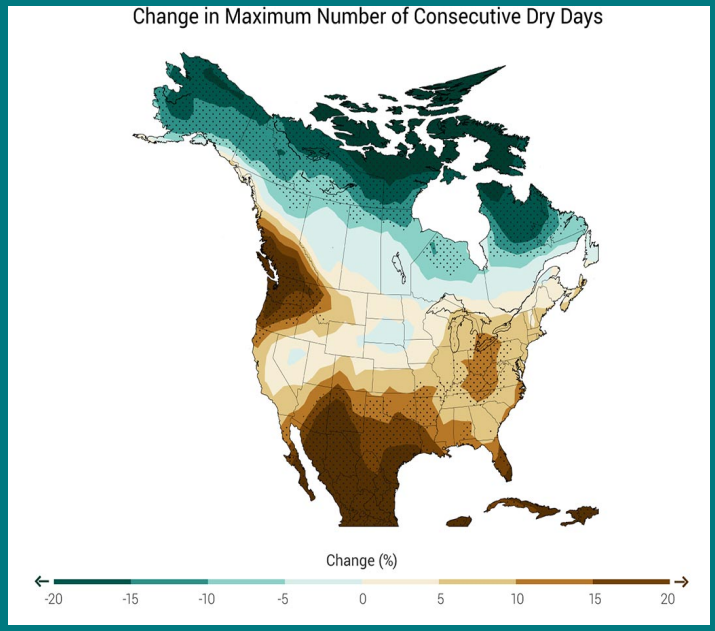
Stressors identification: future risk

- Increases in CO2 emissions
- Increase in extreme weather events of all kinds
  - Rain
  - Flooding
  - Drought
  - Hurricanes
- Increases in air and water temperature
- Sea level rise
- Changes in ocean chemistry









Vulnerability assessment

Goal: Identify sectors that may be impacted by climate change (stressors)

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2. **Stressors analysis**
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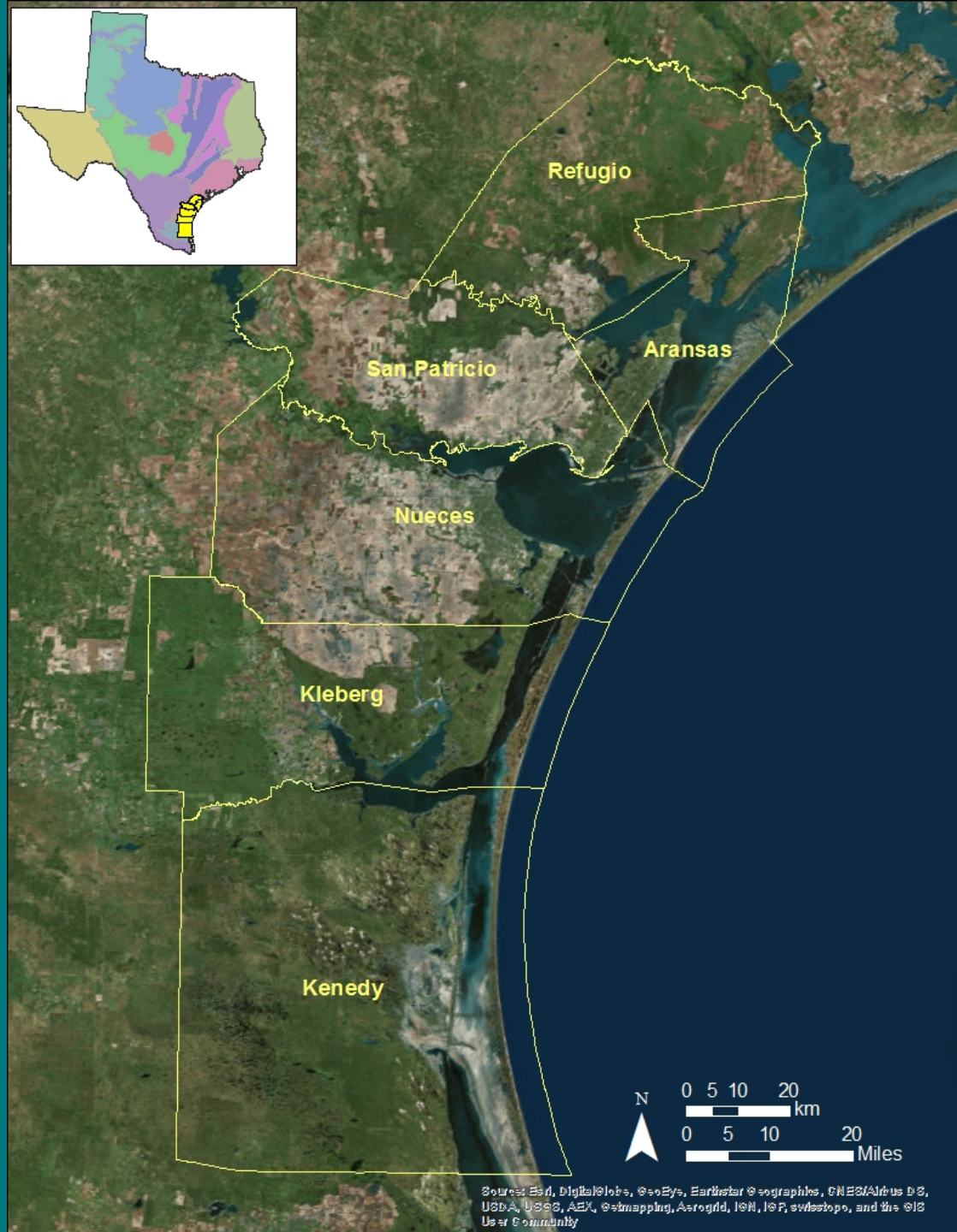
Stressors analysis

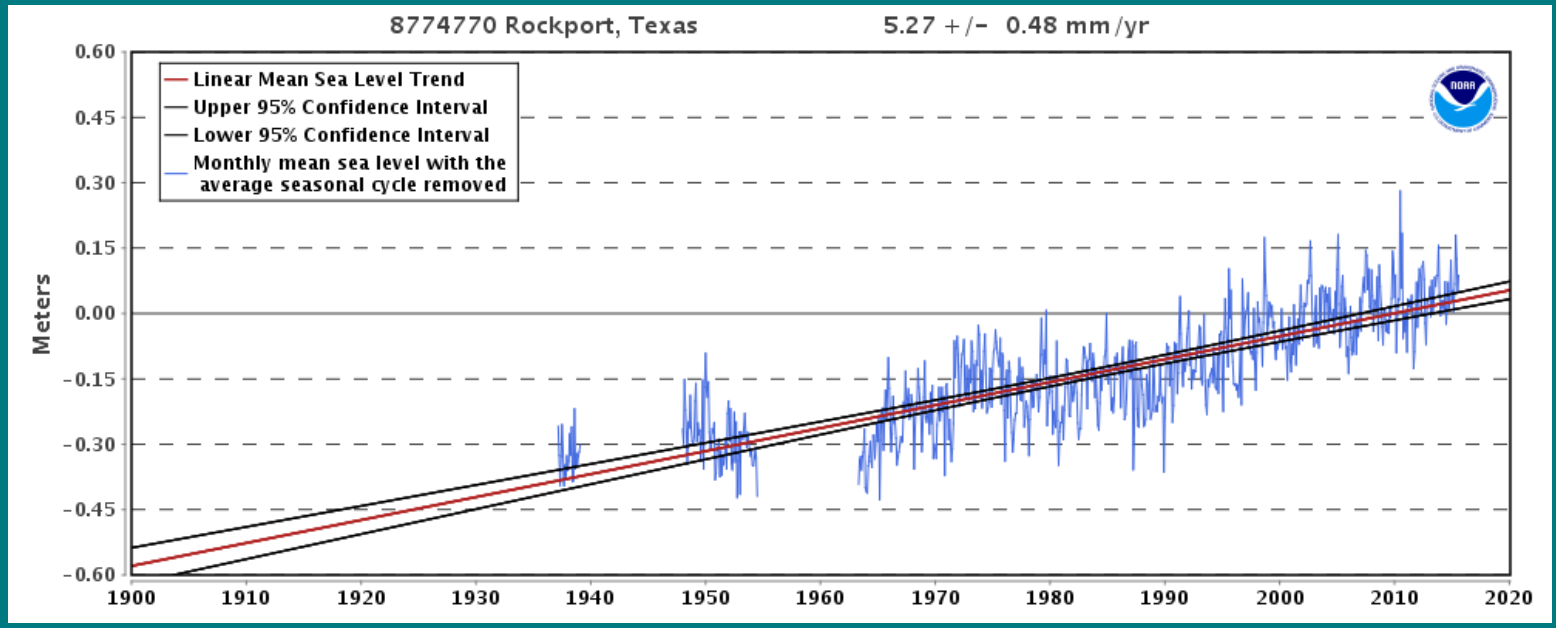
- What is the study area?
- What are the historical trends in that area?
- What stressors are applicable to the region?

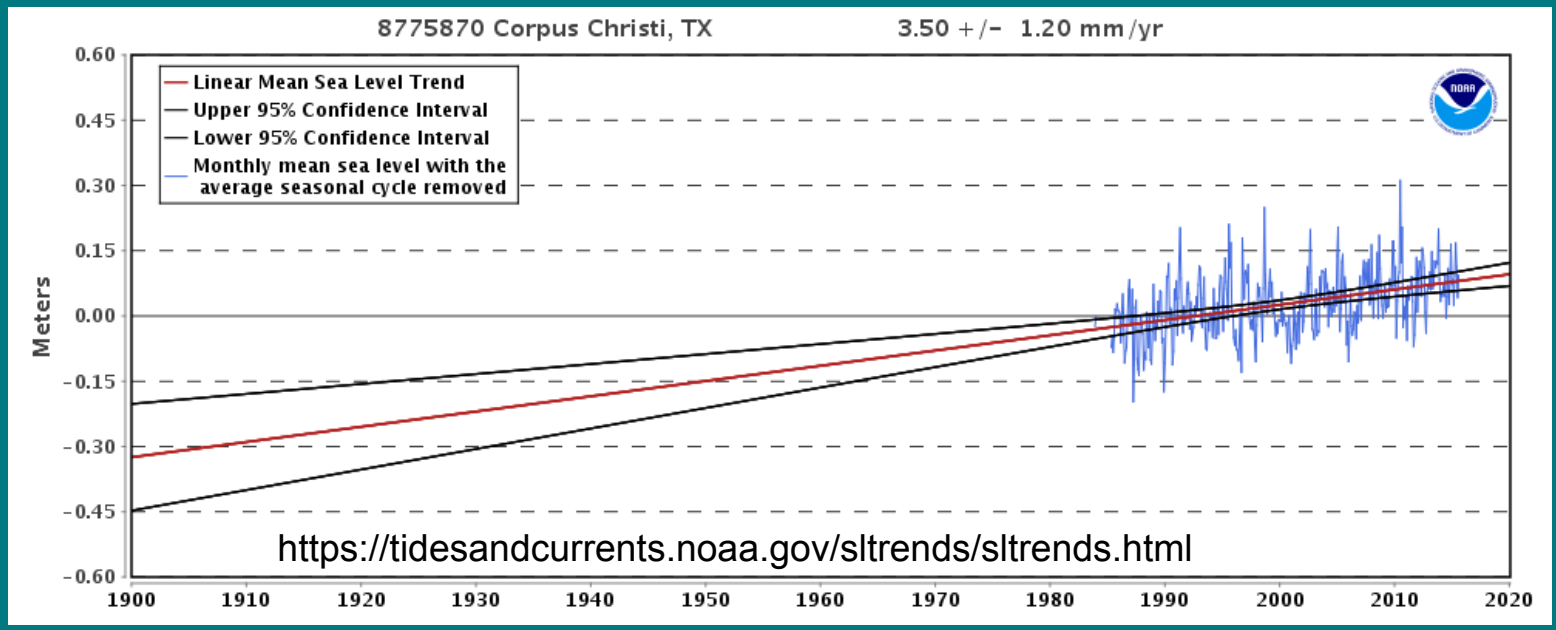
Study area

- Coastal counties of Texas Coastal Bend
- 3 of 7 major estuaries in Texas
  - 25 bays and lakes
- 75 miles of shoreline
- 8th largest Port in US
- Universities, Naval air station, refineries

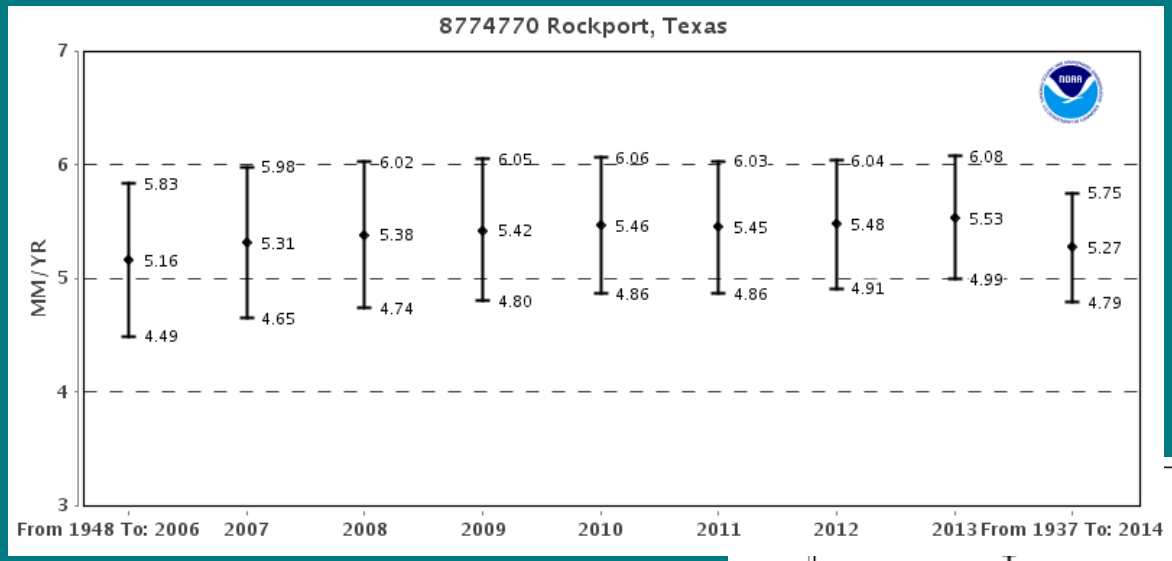


Historical trends

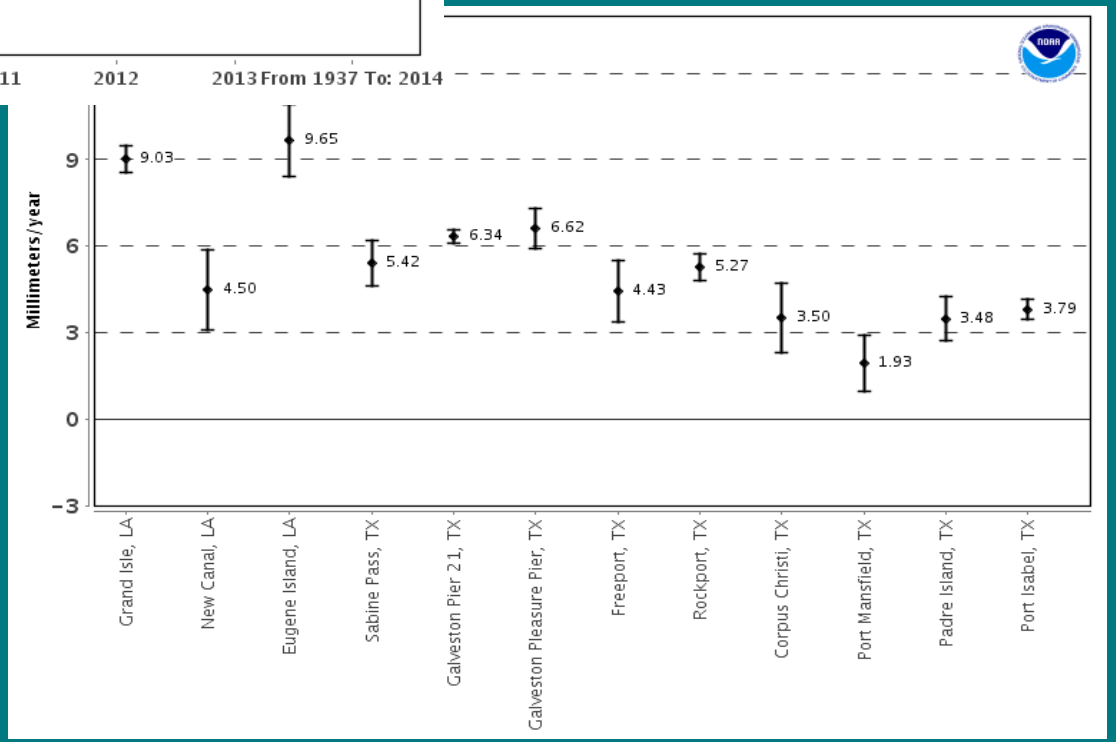




Historical trends



0.44 m SLR by 2100



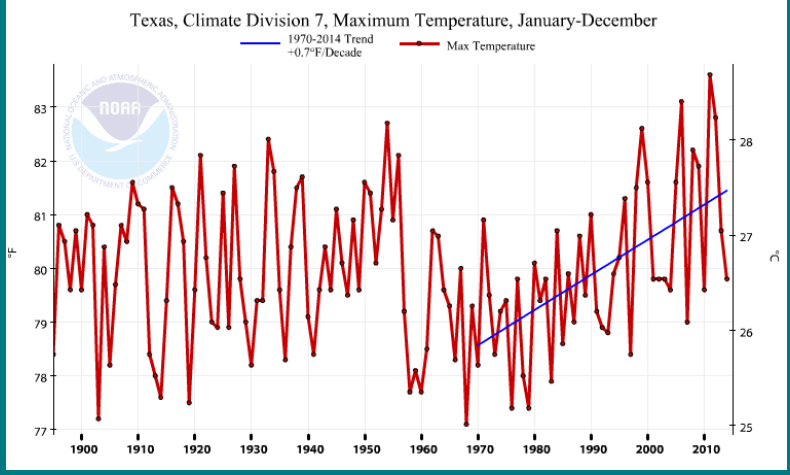
Historical trends

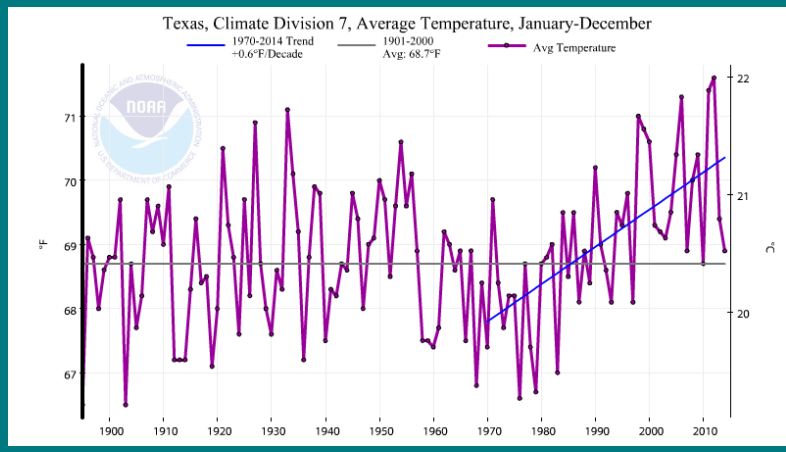
http://www.ncdc.noaa.gov/cag/

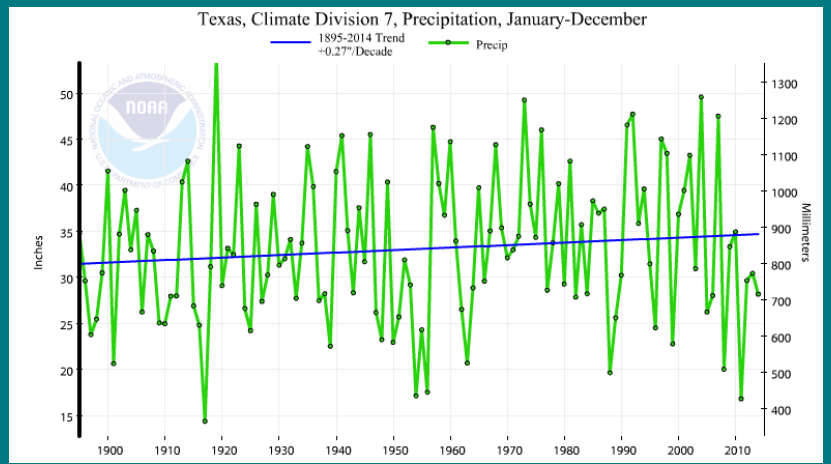
- Increases in air temperature

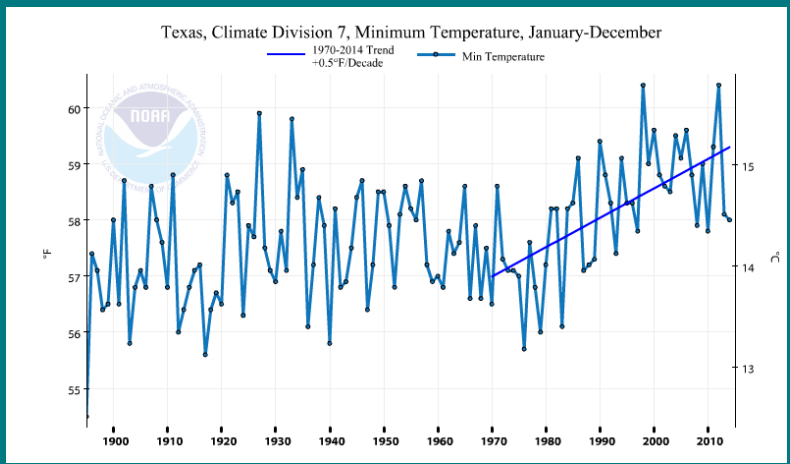
~.33°C/decade = 2.8°C increase by 2100

- Not much change in precipitation



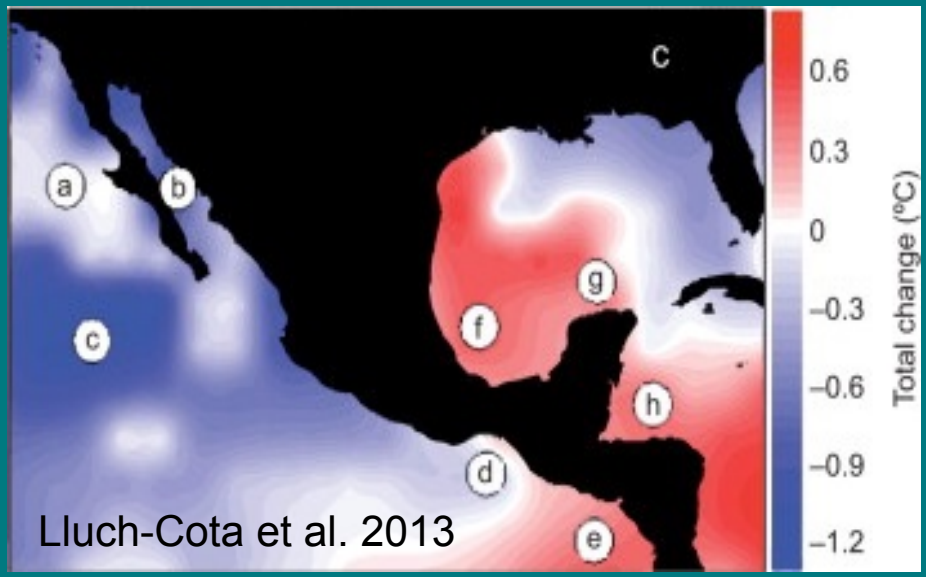


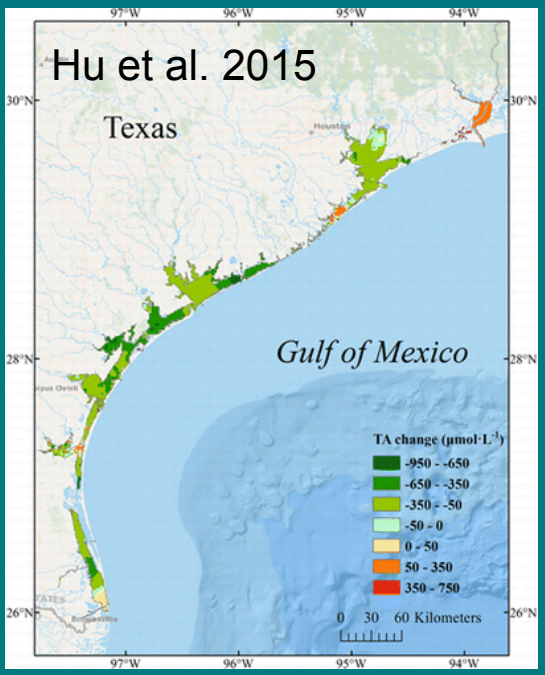




Historical trends

Water temperatures in the western GOM have been warming for the past 30 years

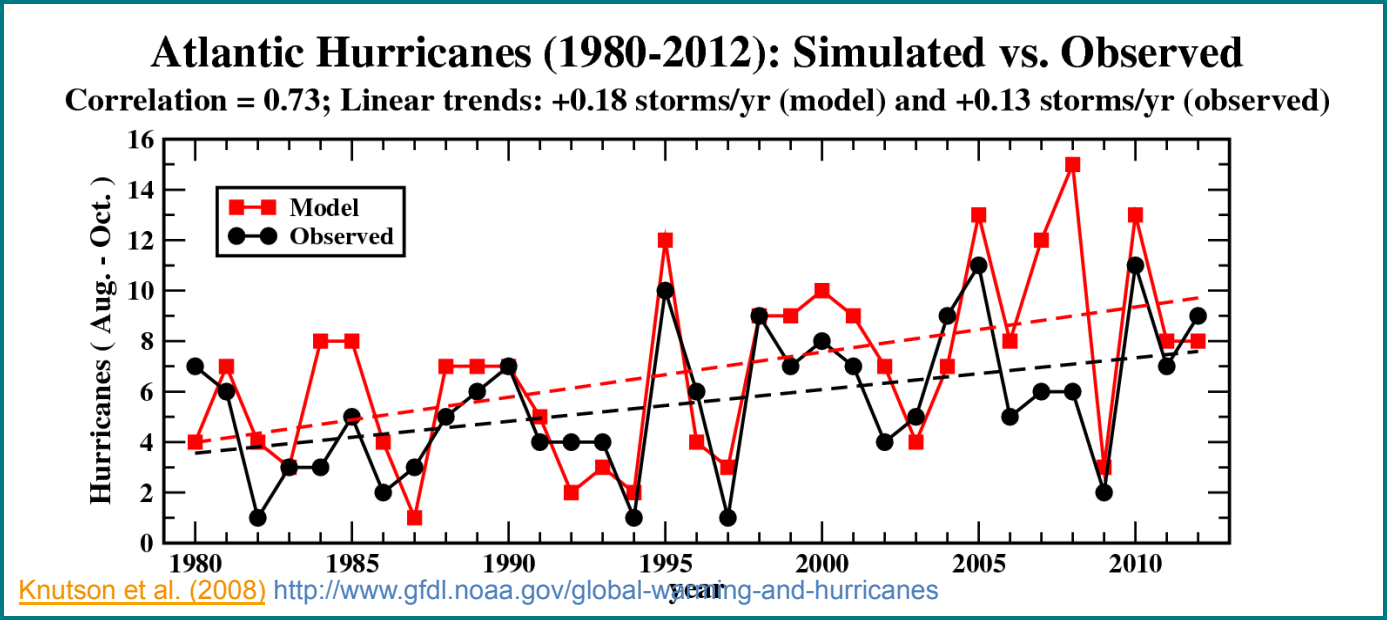




Alkalinity and pH have been decreasing in CBBEP since the 1960s

Historical trends

- Storms



Knutson et al. (2008) http://www.gfdl.noaa.gov/global-warming-and-hurricanes

Vulnerability assessment

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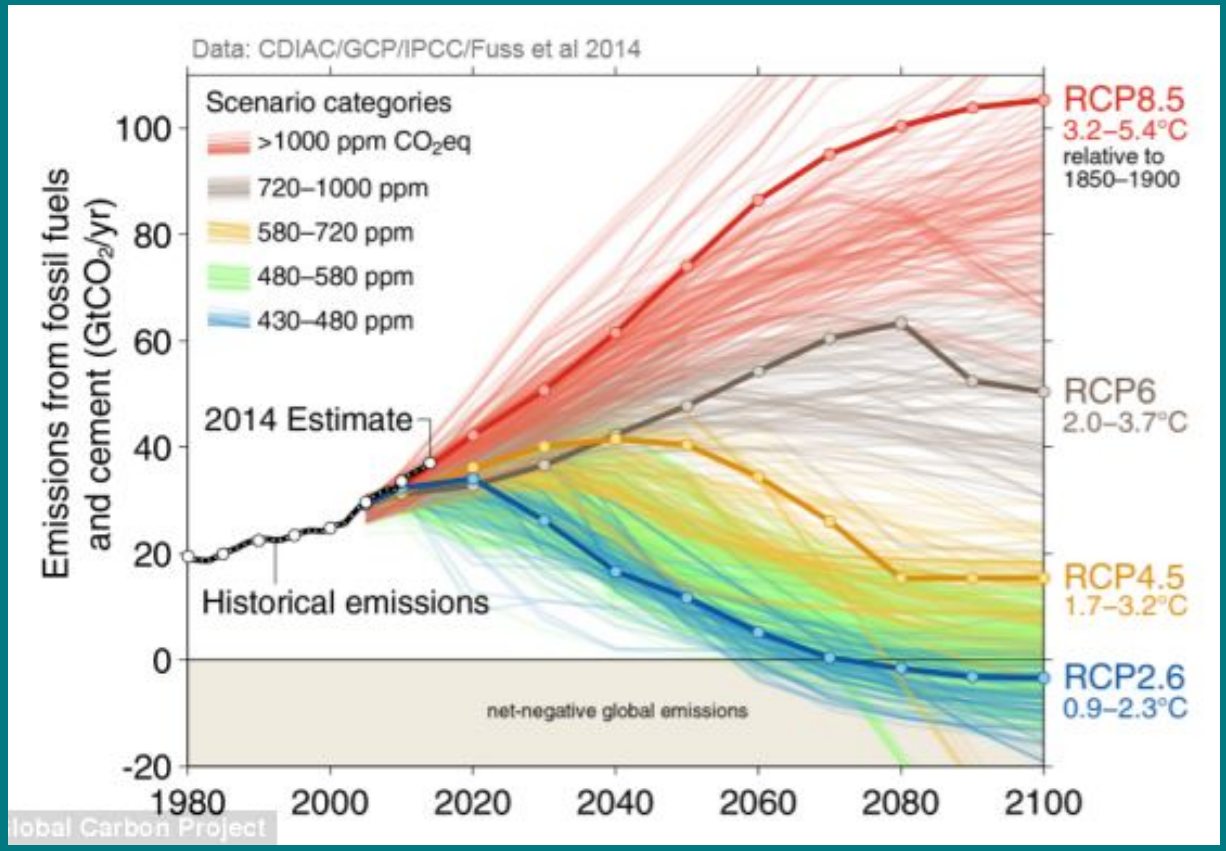
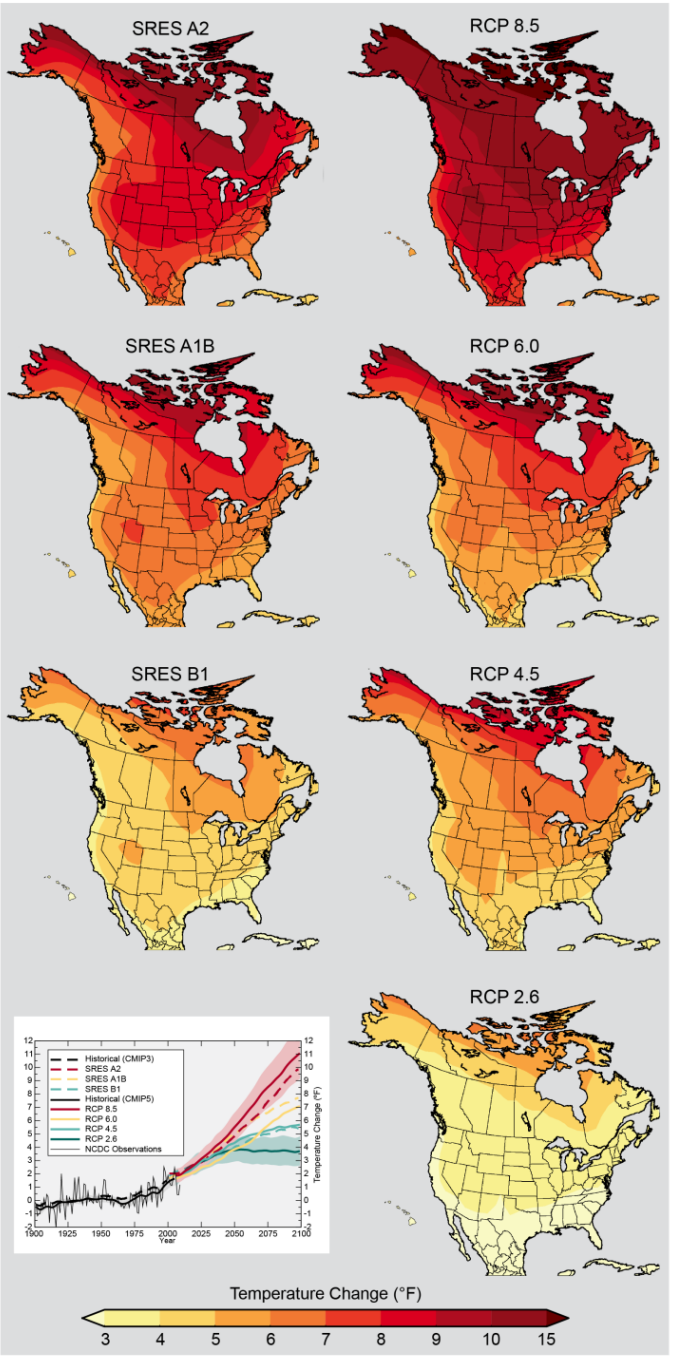
Scenario choice

IPCC adopted new scenarios in AR5 (2014)

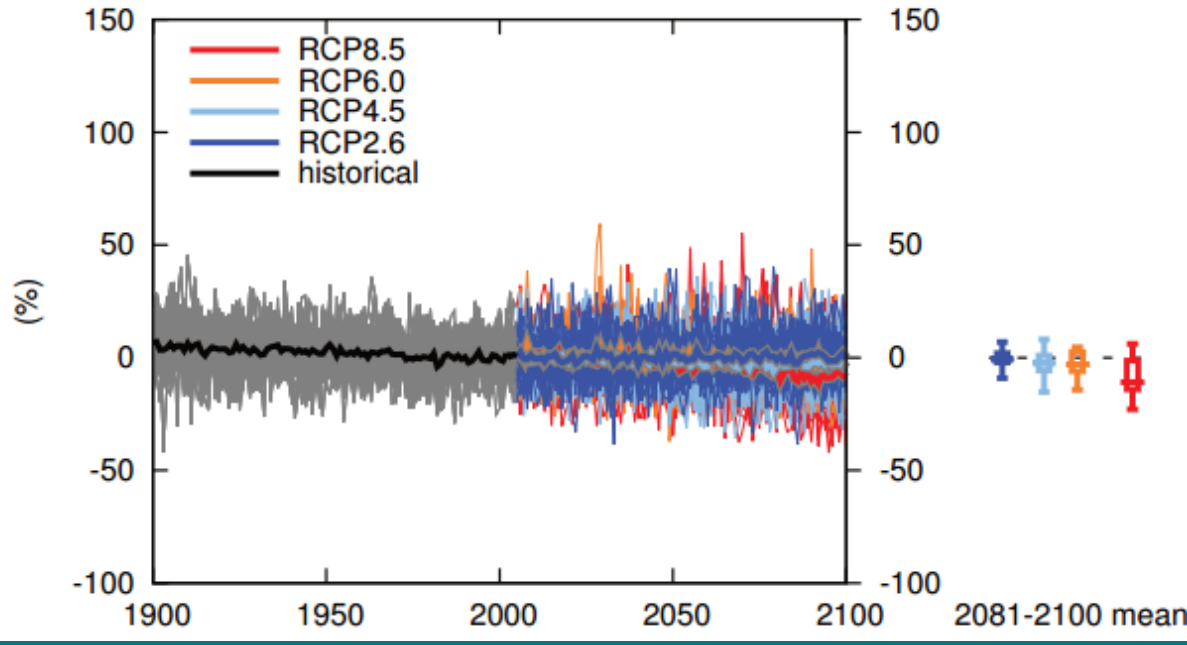


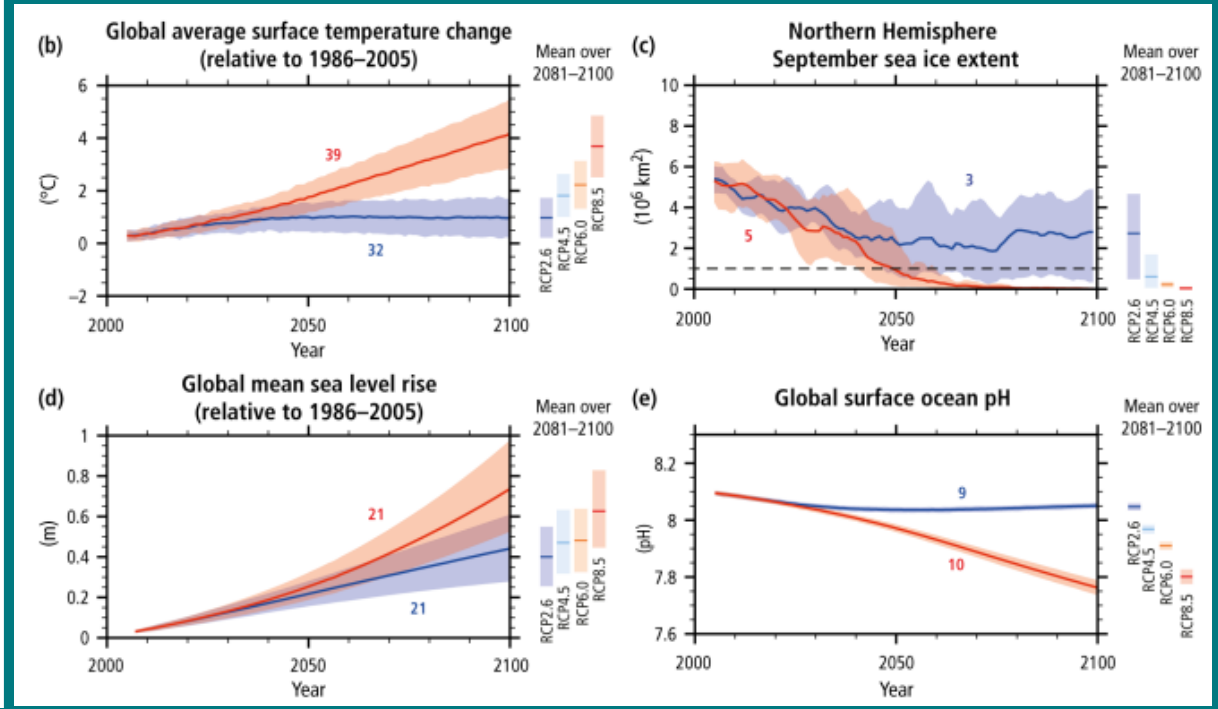
Representative Concentration Pathways (RCP)

Projected Annually-Averaged Temperature Change



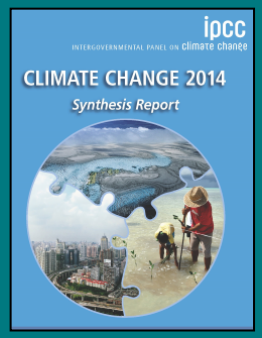
Precipitation change Central America April-September

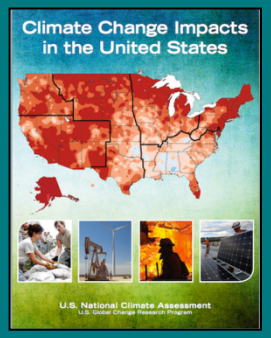


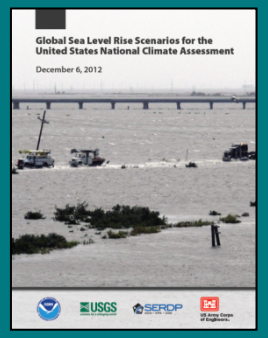


Scenario choice

- IPCC & NCA projections for climate change
  - Parris et al. 2012 for SLR
- 3 scenarios
  - Why not 2? Or 4? RCP2.6?
- Time stamp 2100







		Scenarios		
		Low	Mid	High
Scenario Family	RCP (IPCC 2013)	4.5	6.0	8.5
	Example literature	Rogelj et al. 2012	Rogelj et al. 2012	Watson et al. 2015
	SRES (IPCC 2000)	B1	B2	A2
Temperature anomaly by 2100 since pre-industrial (°C)		2.5	3	5
CO2 (ppm)		520	620	950+
SLR (m)		0.5	1.2	2.0
Ocean pH decrease		0.15	0.21	0.32

Vulnerability assessment

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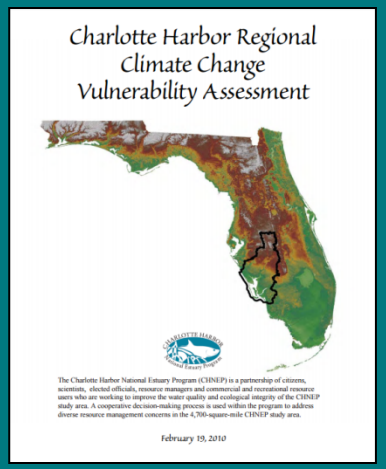
4. **Sectors identification**
5. Sectors analysis

Sector identification

- IPCC AR5 WGII Chapter 26- North America (2014)

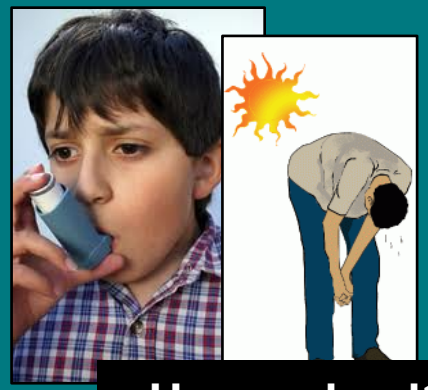
- Charlotte Harbor Regional Climate Change Vulnerability Assessment (2010)



Sectors ID

Critical facilities

Cultural resources



Human health

Ecosystems & wildlife

Water resources

Coastal resources

Economic activity

Vulnerability assessment

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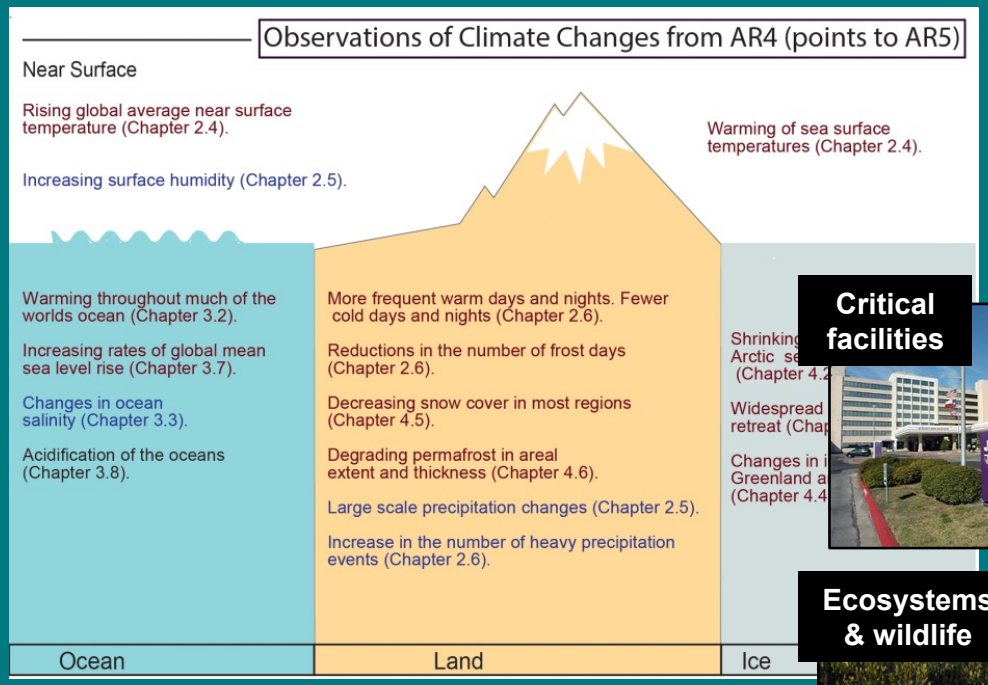
Sectors analysis

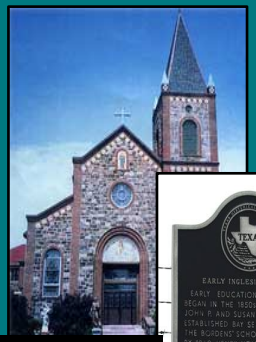
- How does climate change impact sectors?
- Can we measure that impact?

Sector analysis



Critical facilities

Ecosystems & wildlife



Cultural resources

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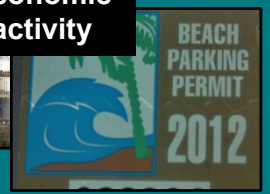
Economic activity



Sector analysis: General impacts

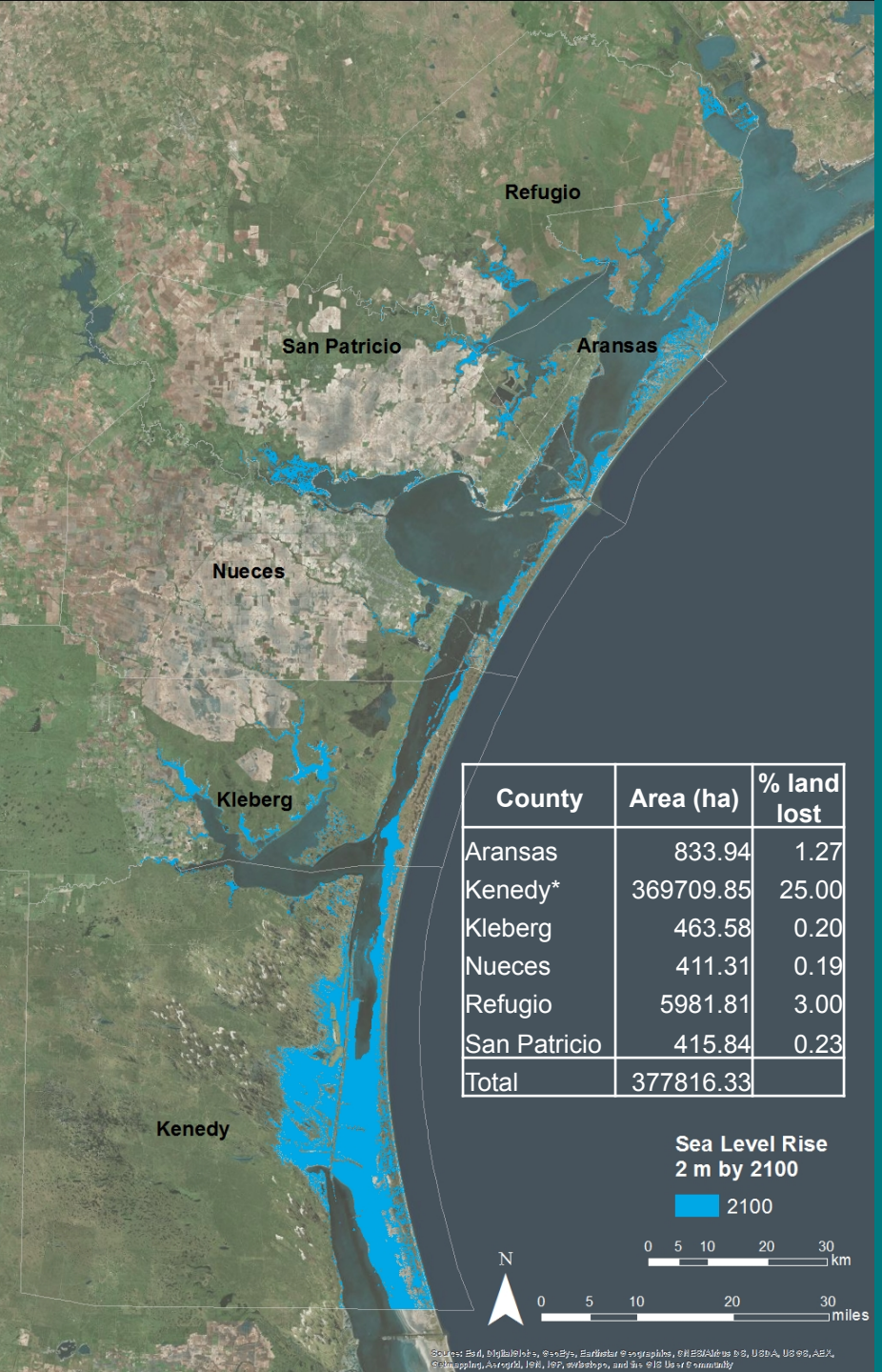
- Human health
  - Temperature-related illness and death
  - Extreme weather-related mortality and health effects
  - Vector-borne diseases
  - Freshwater and food shortages
  - Water and food-borne illnesses
  - water and air pollution
- Water resources
  - Water quality decline
  - Freshwater shortage
  - Saltwater intrusion
- Economic activity
  - Fisheries decline
  - Tourism and recreation threatened
- Cultural resources & Critical facilities
  - Threatened by sea level rise and extreme weather events
  - Cost of protection
- Ecosystems & wildlife
  - Heat stress
  - Shift of ecological zones
  - Decrease in biodiversity
  - Invasion of exotics
- Coastal resources
  - Increased erosion
  - Loss of coastal lands (and the protection they provide)

Sectors analysis: Measurable impacts

Coastal resources

Inundation extent

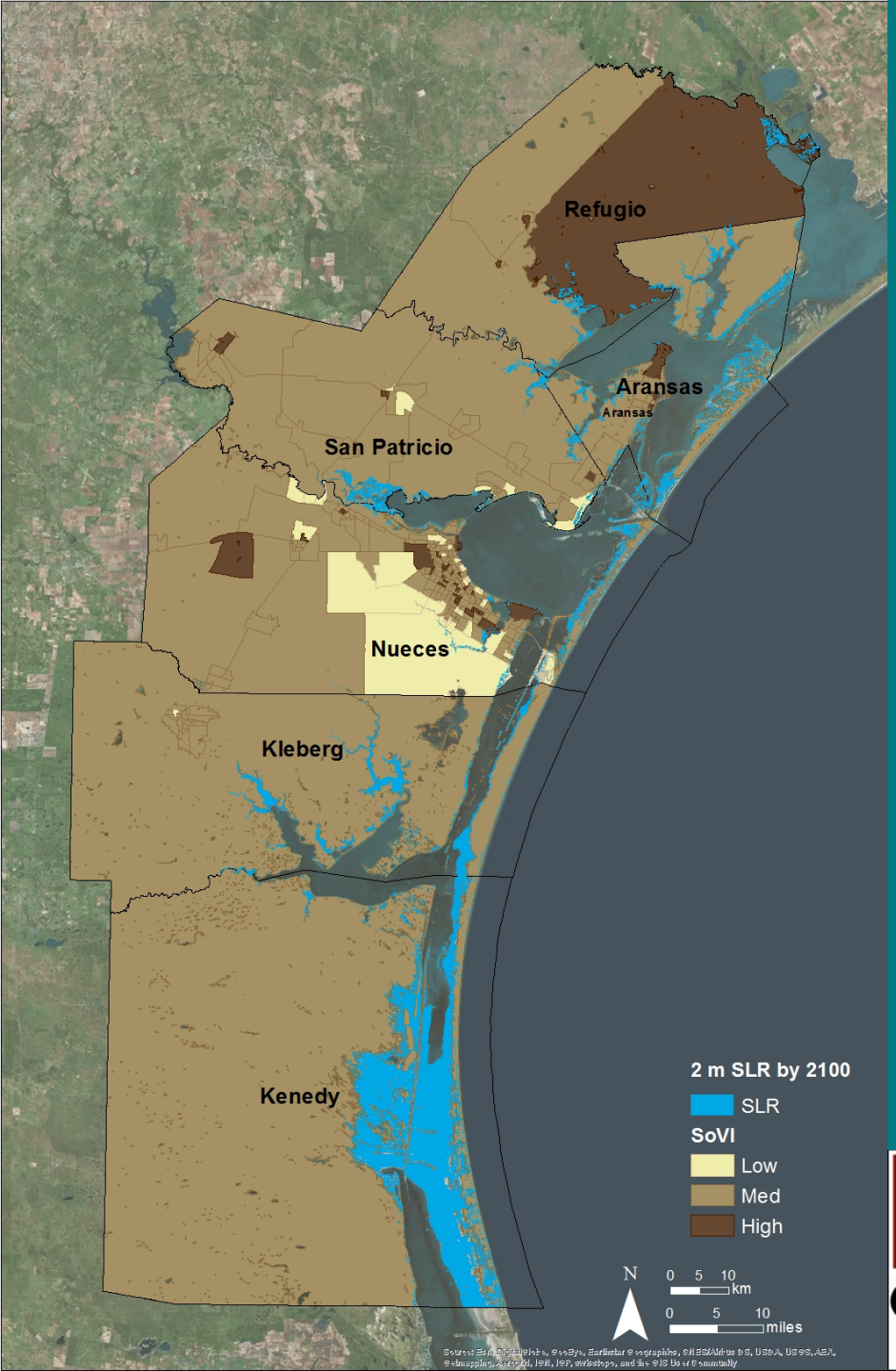
- Coastal land lost
- Overlay to obtain vulnerable sectors



County	Area (ha)	% land lost
Aransas	833.94	1.27
Kenedy*	369709.85	25.00
Kleberg	463.58	0.20
Nueces	411.31	0.19
Refugio	5981.81	3.00
San Patricio	415.84	0.23
Total	377816.33	

Sectors analysis: Measurable impacts

Human health



Social Vulnerability Index

- Social vulnerability to environmental hazards
- 29 socioeconomic variables

HVRI

Sectors analysis: Measurable impacts

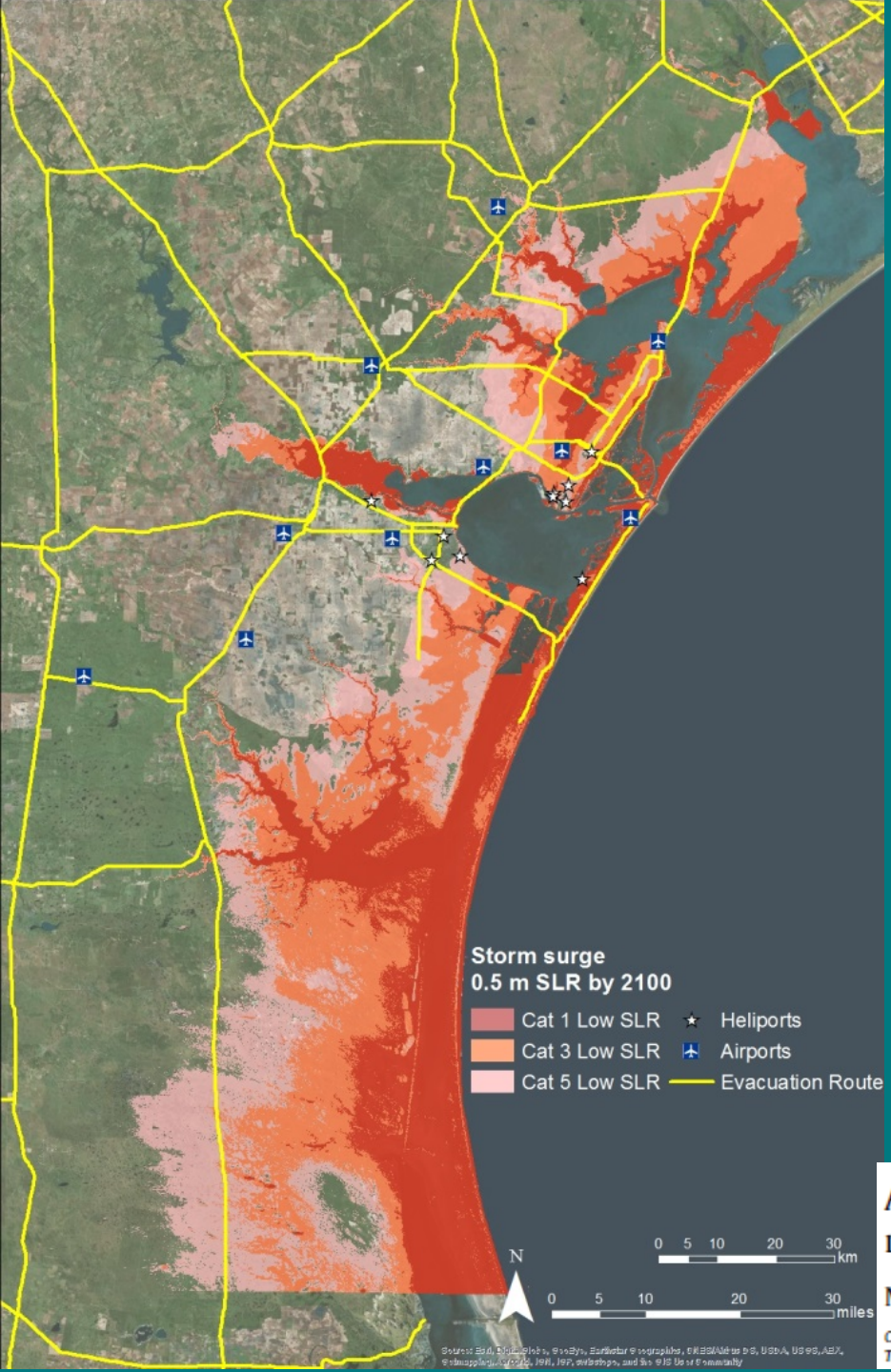
Critical facilities

Transportation infrastructure

- Percentage of roads inundated
- Number of heliports and airports at risk
- Port facilities

Storm surge + SLR

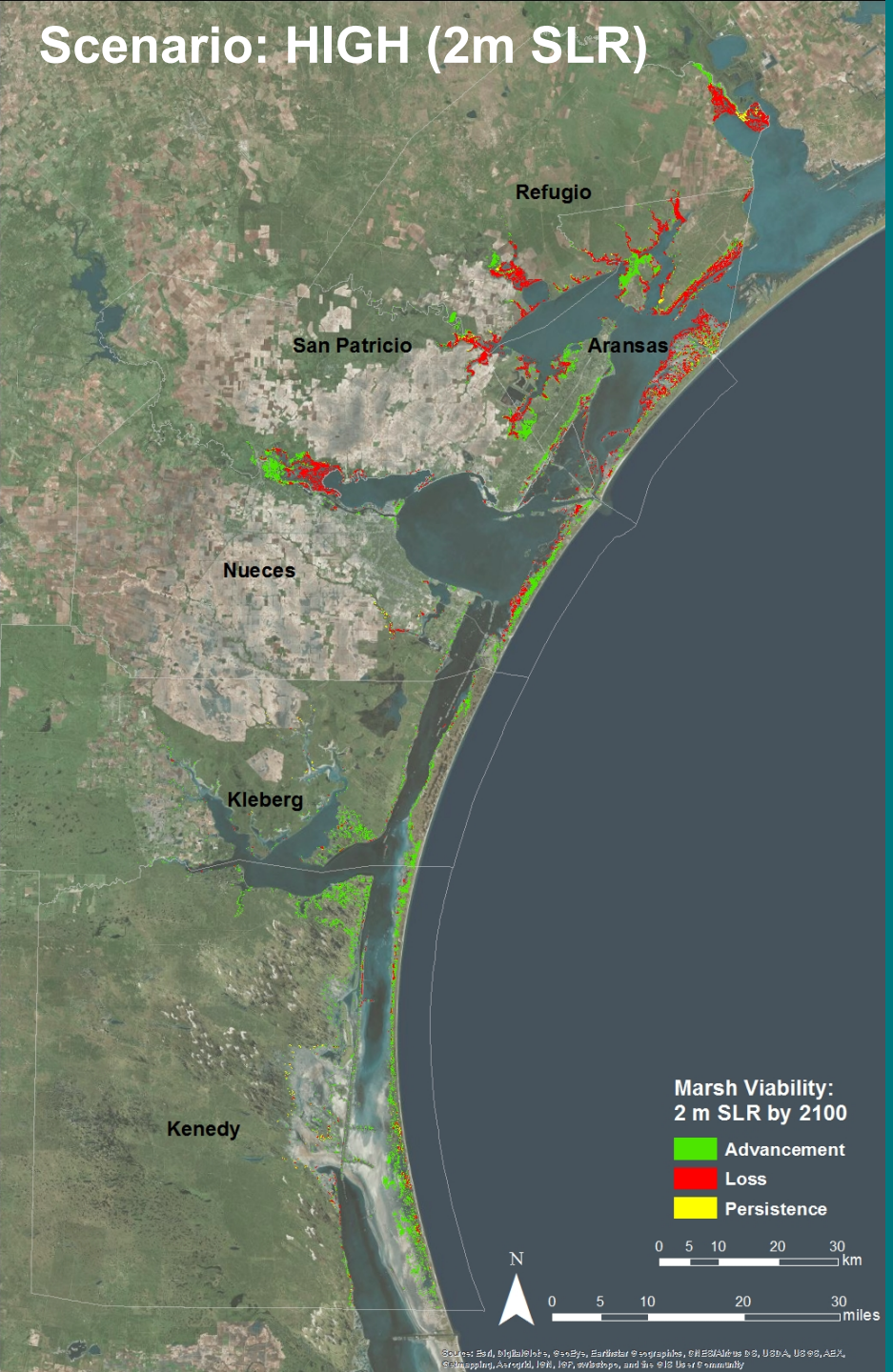
- Storm surge associated with a 0.5m (intermediate scenario) sea level rise



A geospatial dataset for U.S. hurricane storm surge and sea-level rise vulnerability: Development and case study applications

Megan C. Maloney, Benjamin L. Preston *

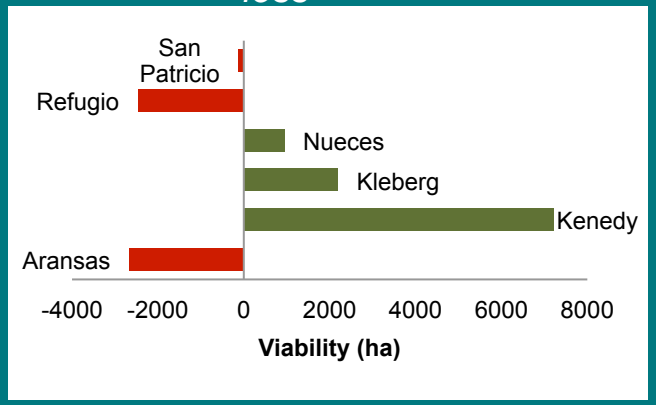
Climate Change Science Institute and Environmental Sciences Division, Oak Ridge National Laboratory, PO Box 2008, One Bethel Valley R
TN 37831-6253, United States

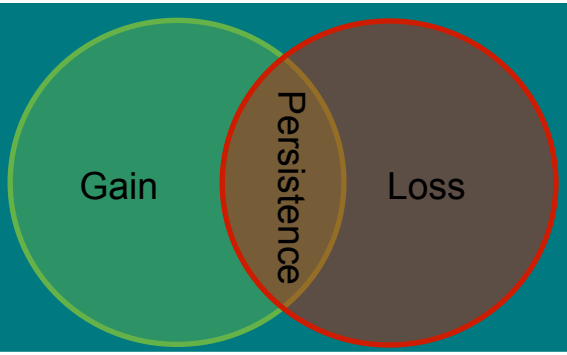


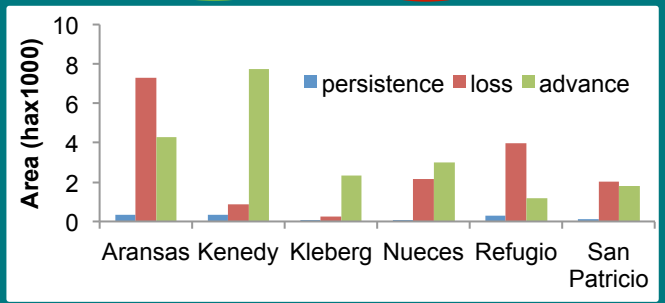
Sectors analysis: Measurable impacts

Ecosystems and wildlife

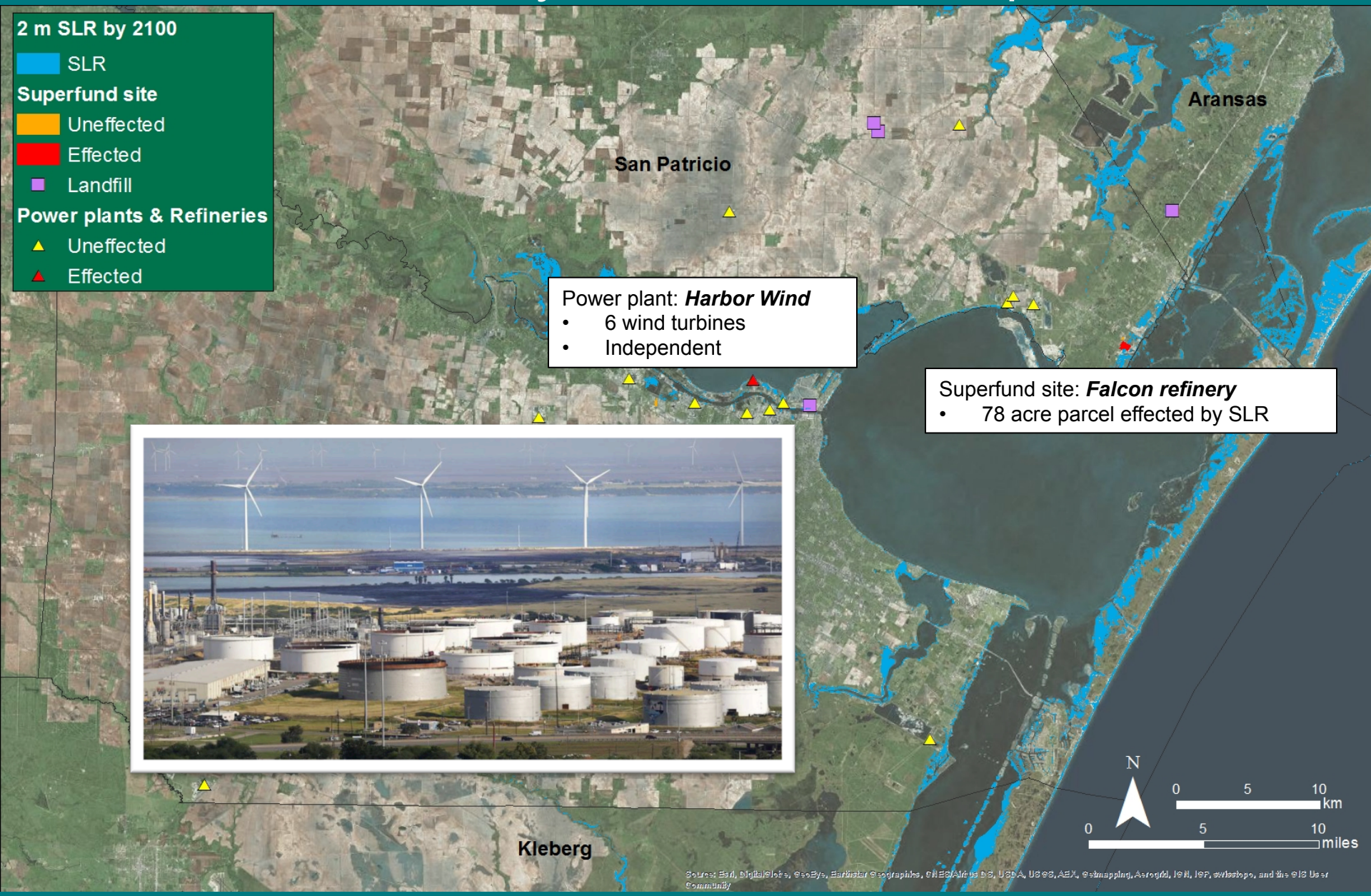
Marsh viability = (marsh gain + marsh persistence)-marsh loss







Sectors analysis: Measurable impacts



Critical facilities

Next steps

- Gather your input
- Complete assessment
- Use assessment to guide development of adaptation strategies

Questions?

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