



Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires



Natural Hazards
to
Science for a Changing World

science for a changing world

Virginia Burkett
9 March 2006

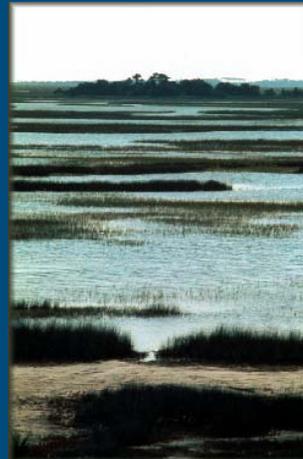
*2006 Ocean and Coastal
Program Managers Meeting*



Chandeleur Islands

Overview

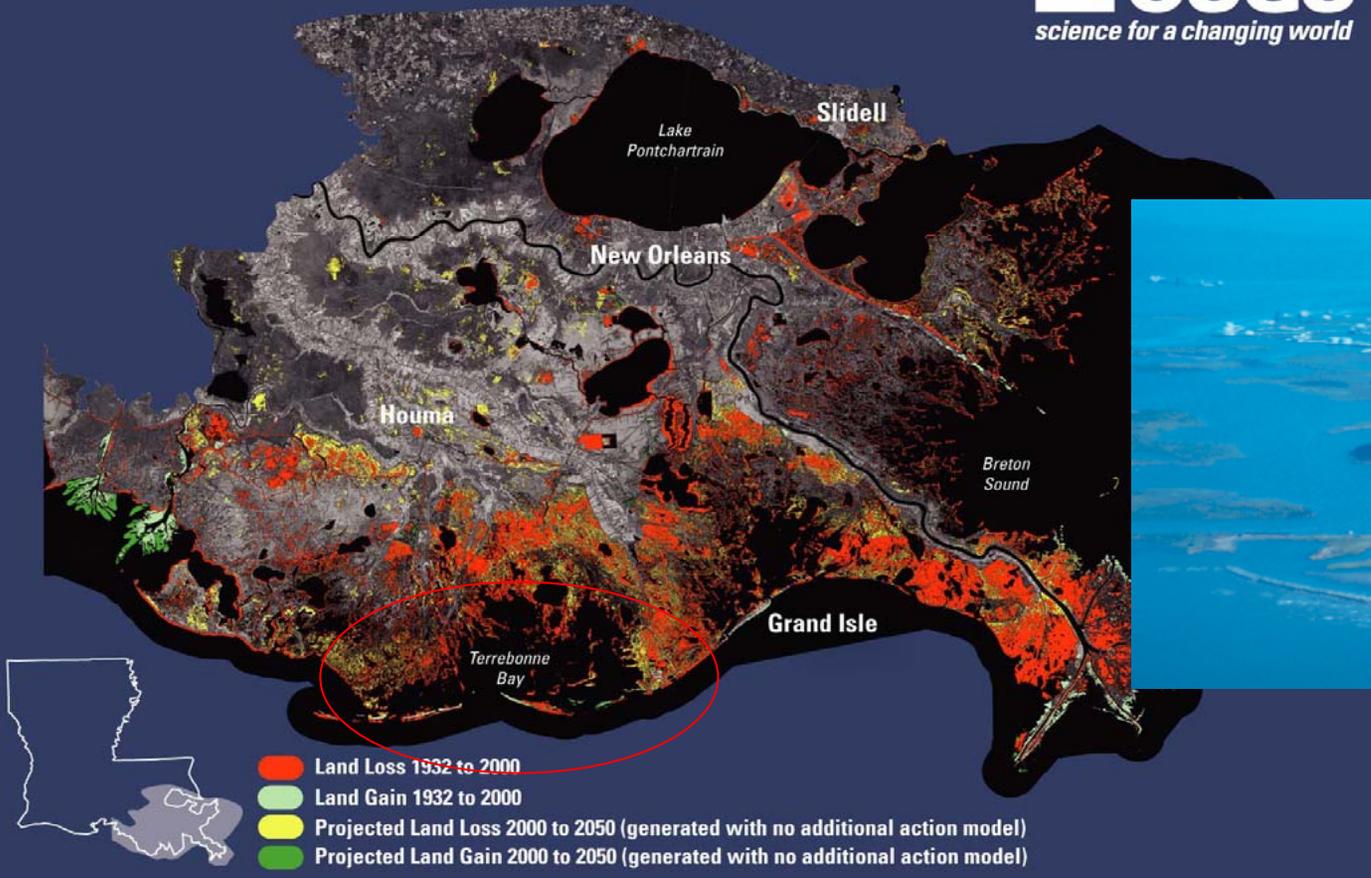
- Protective role of natural coastal features
- Observed effects of Hurricane Katrina
- How climate warming affects sea level and tropical storms
- Coastal protection strategies



- Flood water retention is an important ecological function of wetlands
- The connection between “barrier” islands and wave energy is intuitive

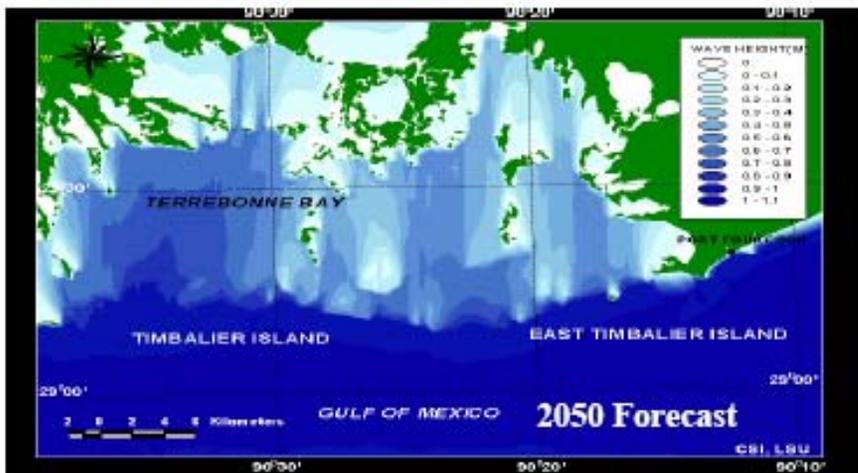
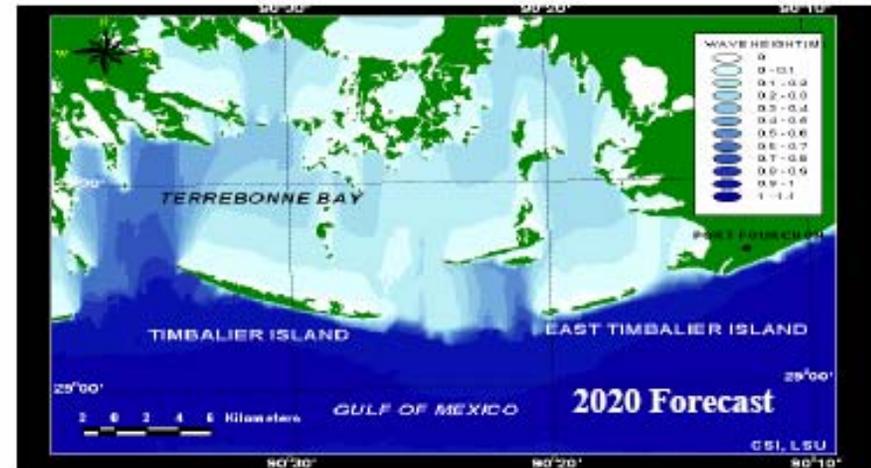
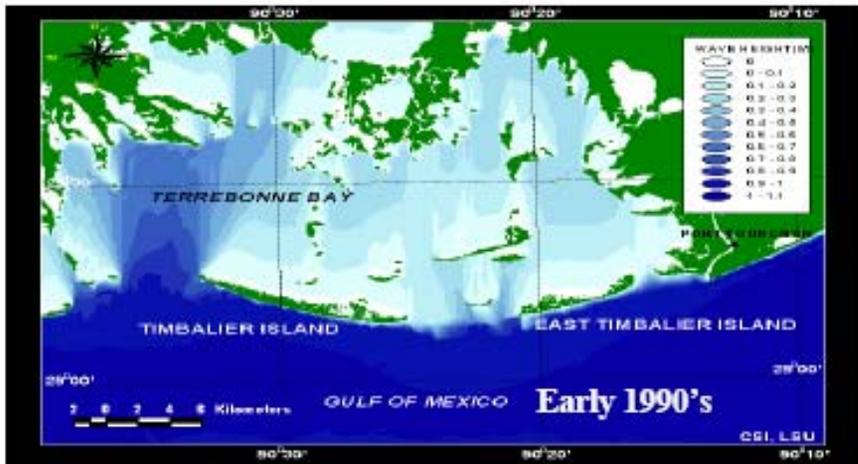


Coastal Louisiana Land Loss



Recent studies have quantified the importance of coastal barriers in reducing wave energy and storm surge

Change in Wave Height



(From Stone *et al*, 2003)

8'-10' Increase in Storm Surge, 1950-1990

As coastal barriers deteriorate.....

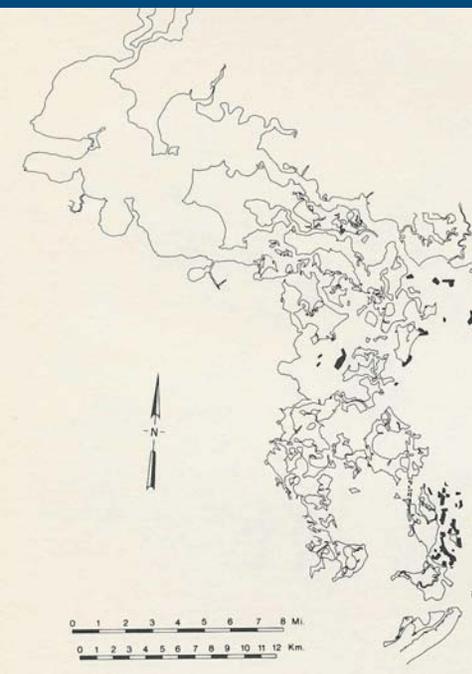


- Erosion on bay shorelines and wetland loss increases
- Mainland environments become more prone to inundation during frontal passages and tropical storms
- Tidal influence and salinity increases in bays and estuaries



Times Picayune photo

Inland Expansion of Oyster Leases as Salinity Increased in Barataria Basin, LA (1947, 1959, 1975)

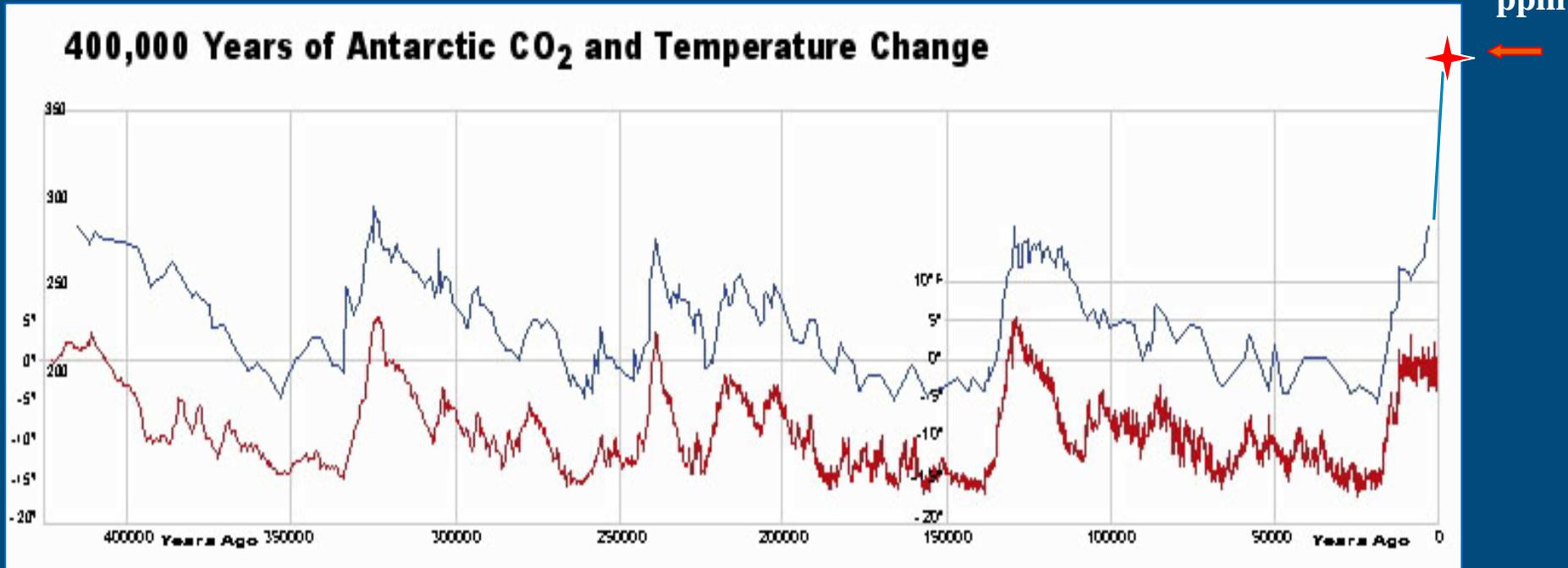


(Van Sickle, Barrett, Gulick and Ford, 1976)

Sea-level rise influences Gulf Coast ecosystems through several mechanisms

- Increased salinity
- Increased storm surge & normal tide levels
- Accelerated shoreline erosion
- Enhanced removal of sediment from the system
- Altered plant community structure & productivity
- Altered fish, shellfish and wildlife populations
- Makes restoration more difficult & expensive
- Amplified effects of other stresses, such as navigation channels

Accelerated sea-level rise is one of the more certain consequences of global warming.

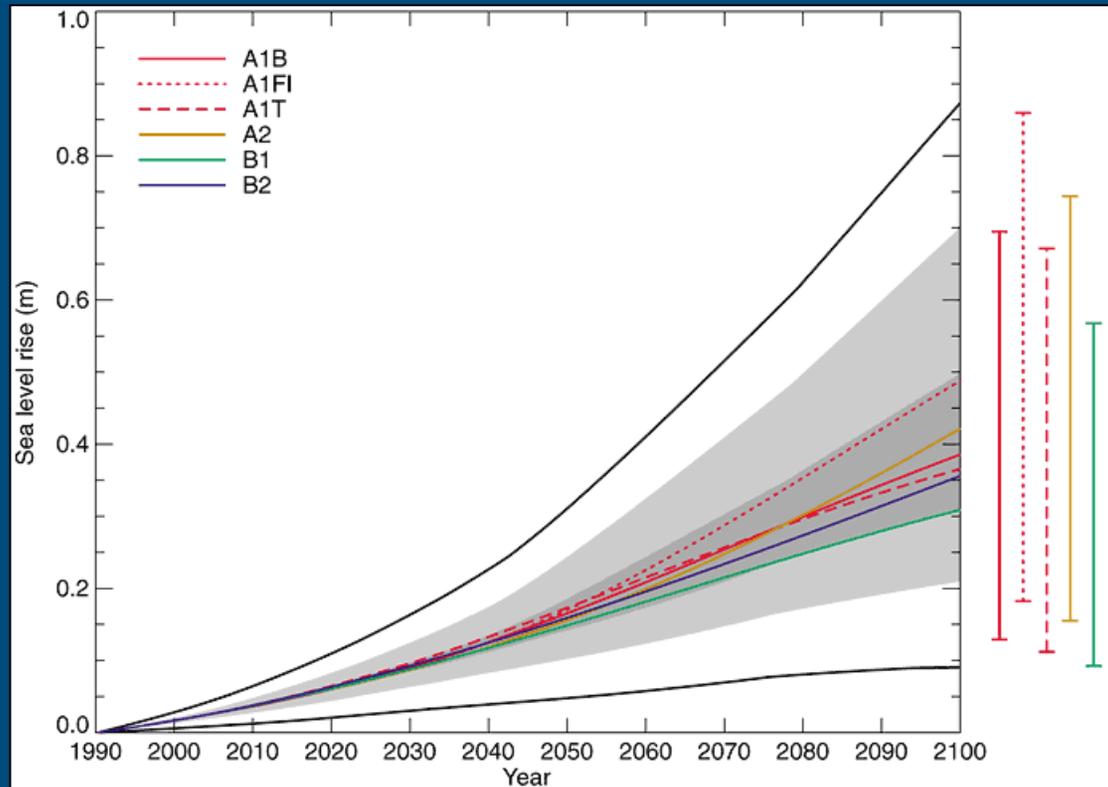


Upper, blue line = CO₂ level

Lower, red line = temperature

Ice ice core data from Vostok, Antarctica
(Petit et al. 1999)

Sea level rise an average of 1-2 mm globally over the past century



- Sea-level rise is projected to accelerate 2- 4 fold during next 100 years.

Processes Influencing Global Sea-Level Change

“Eustacy”

- 📄 **Thermal expansion**
- 📄 **Melting of glacier
and ice caps/sheets**



Processes affecting regional or local changes in sea level

- Tectonism, isostasy and other land movements
- Storm surge
- Atmospheric pressure and alongshore windstress
- Water column density
- Thermocline depth
- Interdecadal, interannual oscillations

October 1997,
before El Niño winter storms

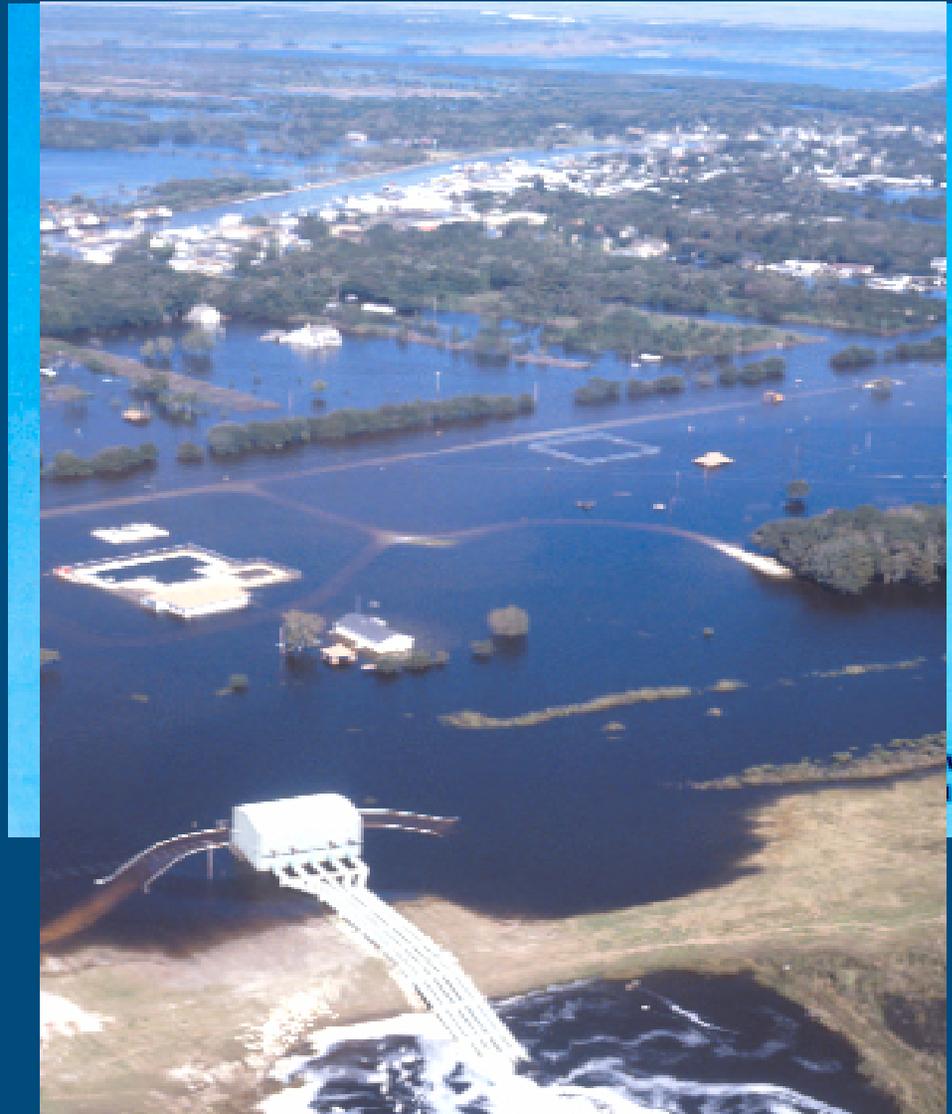


April 1998,
after El Niño winter storms



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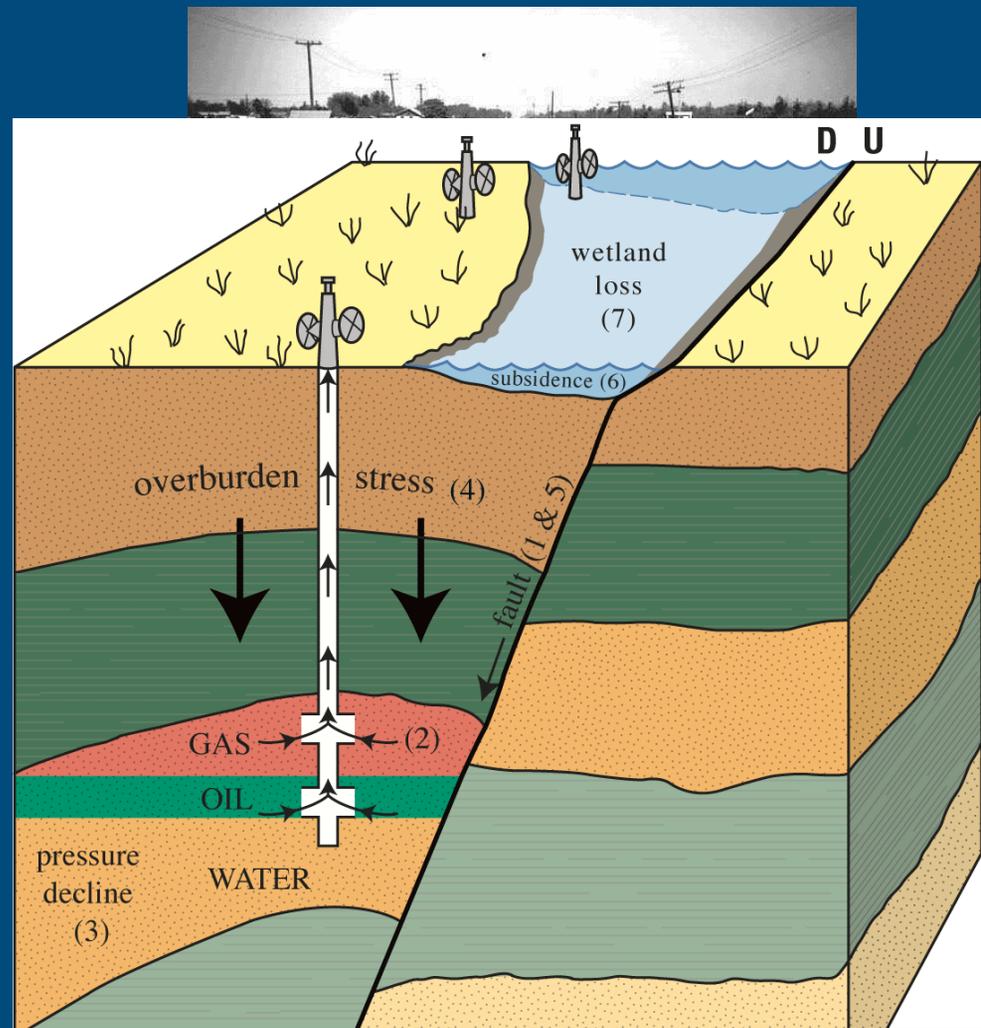


VEY
(1986)

Land-Surface Subsidence

Some causes along the Gulf Coast

- Drainage of organic soils
- Loading at land surface
- Deeper tectonic processes
- Natural sediment dewatering and compaction
- Sediment deprivation
- Ground water withdrawals
- Oil and gas extraction
- Salt evacuation



Most of the City of New Orleans is already below MSL.

Examples:

Decatur St. Gate Stop	-3.45 m
I-510 near Lake Forrest Blvd.	-2.58 m
Dwyer Road/Wilson Ave.	-2.84 m
Morrison Road/Blueridge Ct.	-2.63 m
NOLA Airport, runways 6 & 10	-1.08 m
Chef Menteur Hwy/Chantilly Dr.	-0.86 m
Canal/S. Tonti St.	-0.34 m
Judge Perez/Perrin Road	-0.96m



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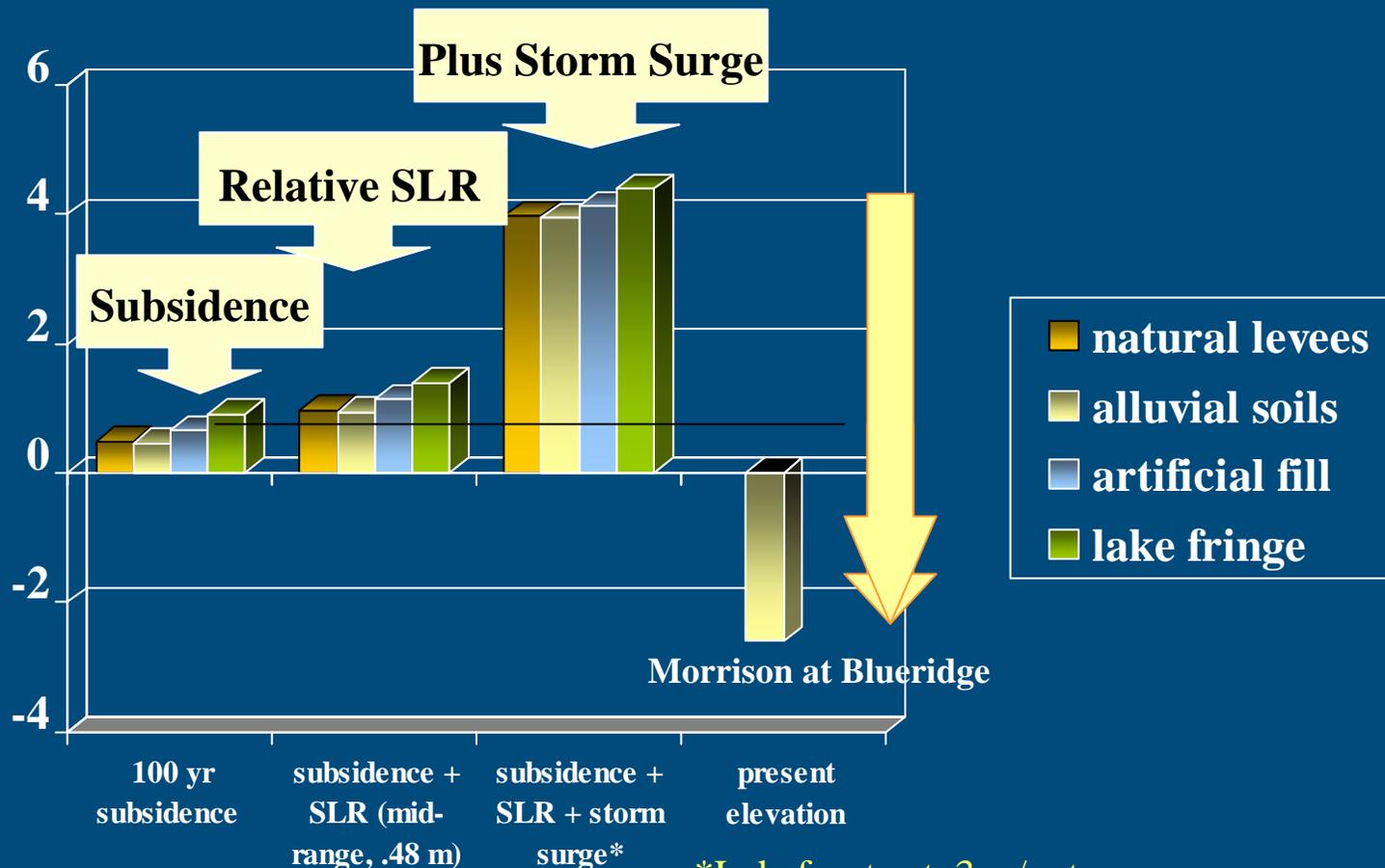
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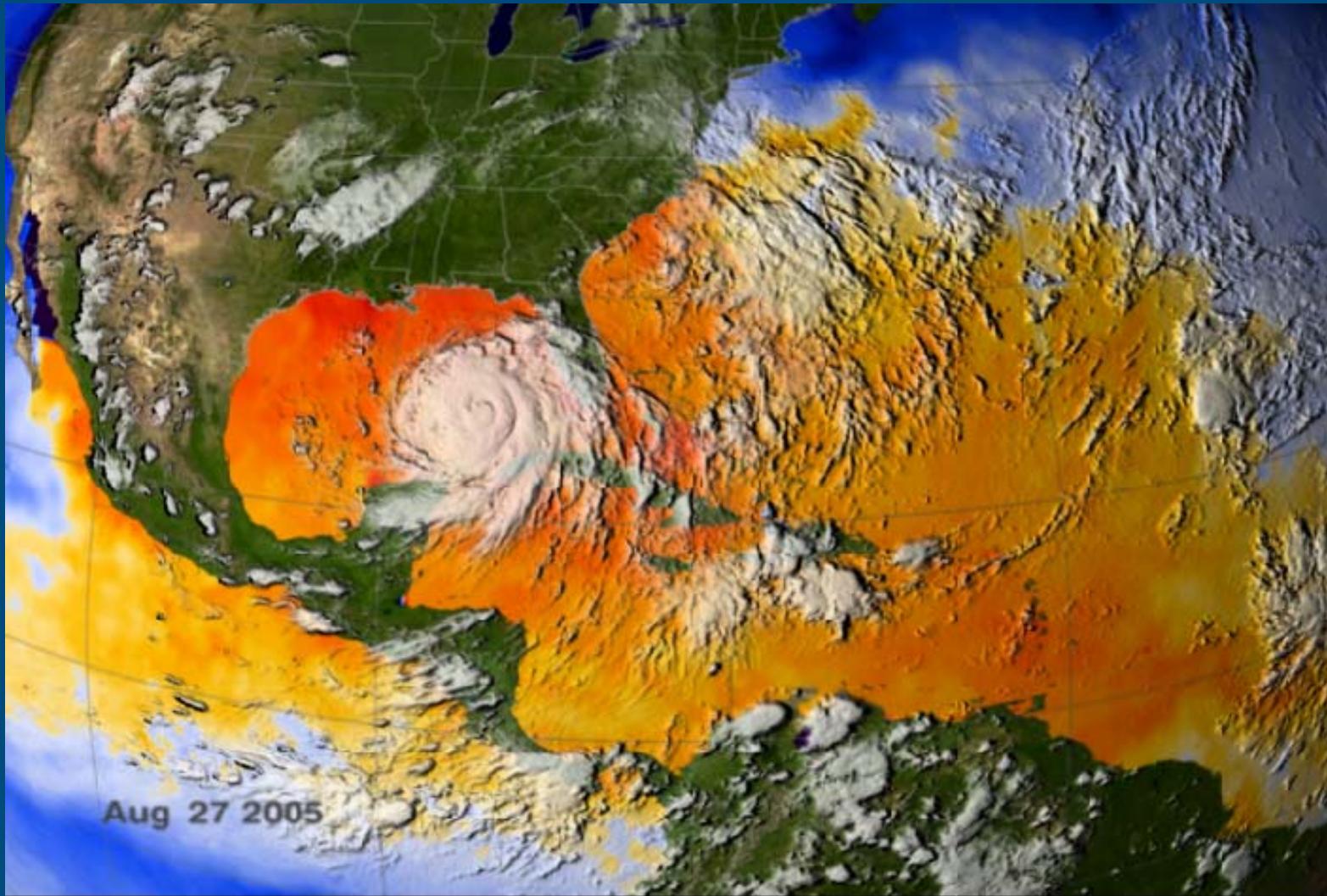


Relative Sea Level Change: New Orleans by 2100

Meters
(msl)



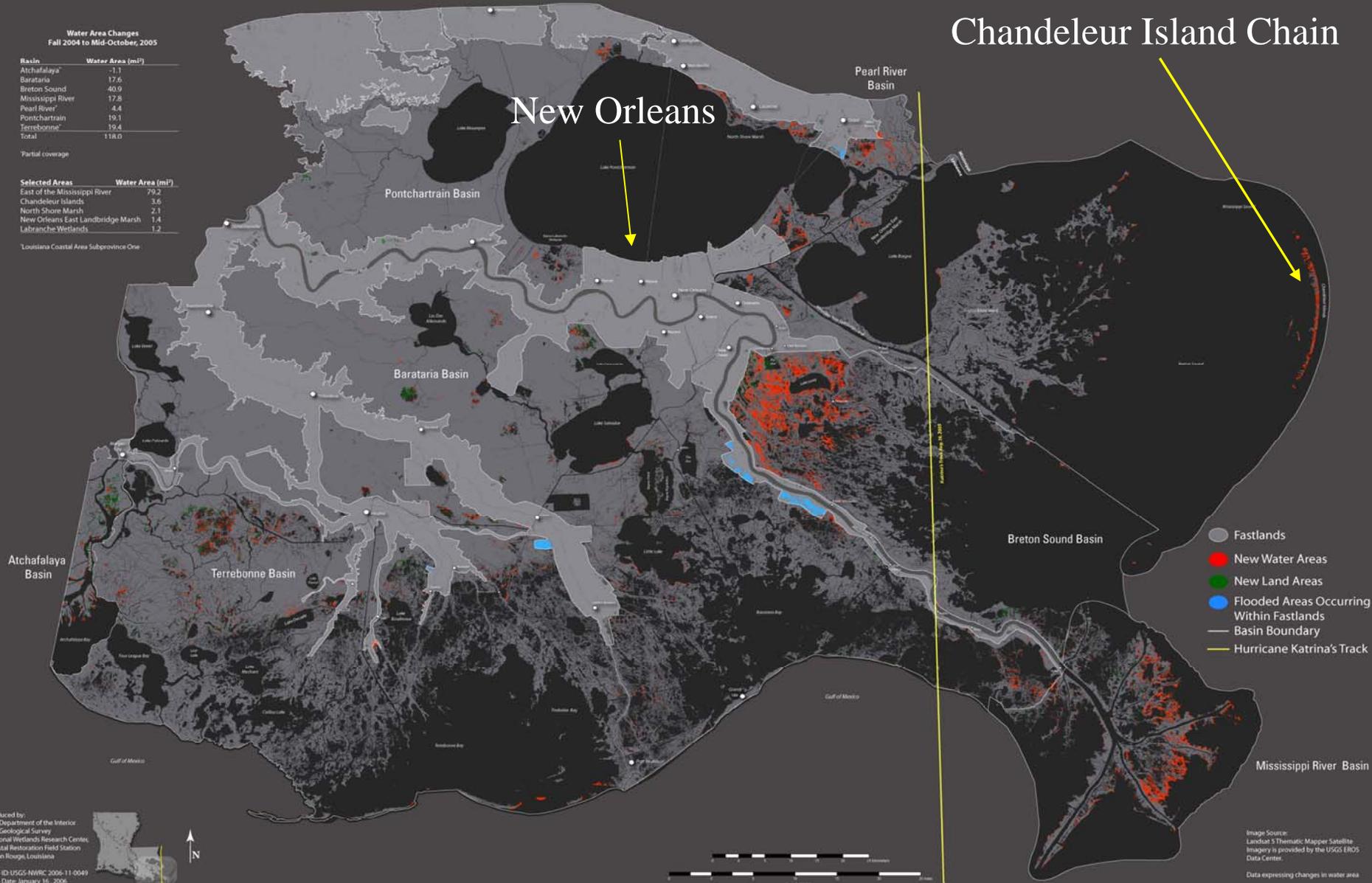
Warming of the sea surface affects both the volume of the ocean and the propensity for hurricanes.



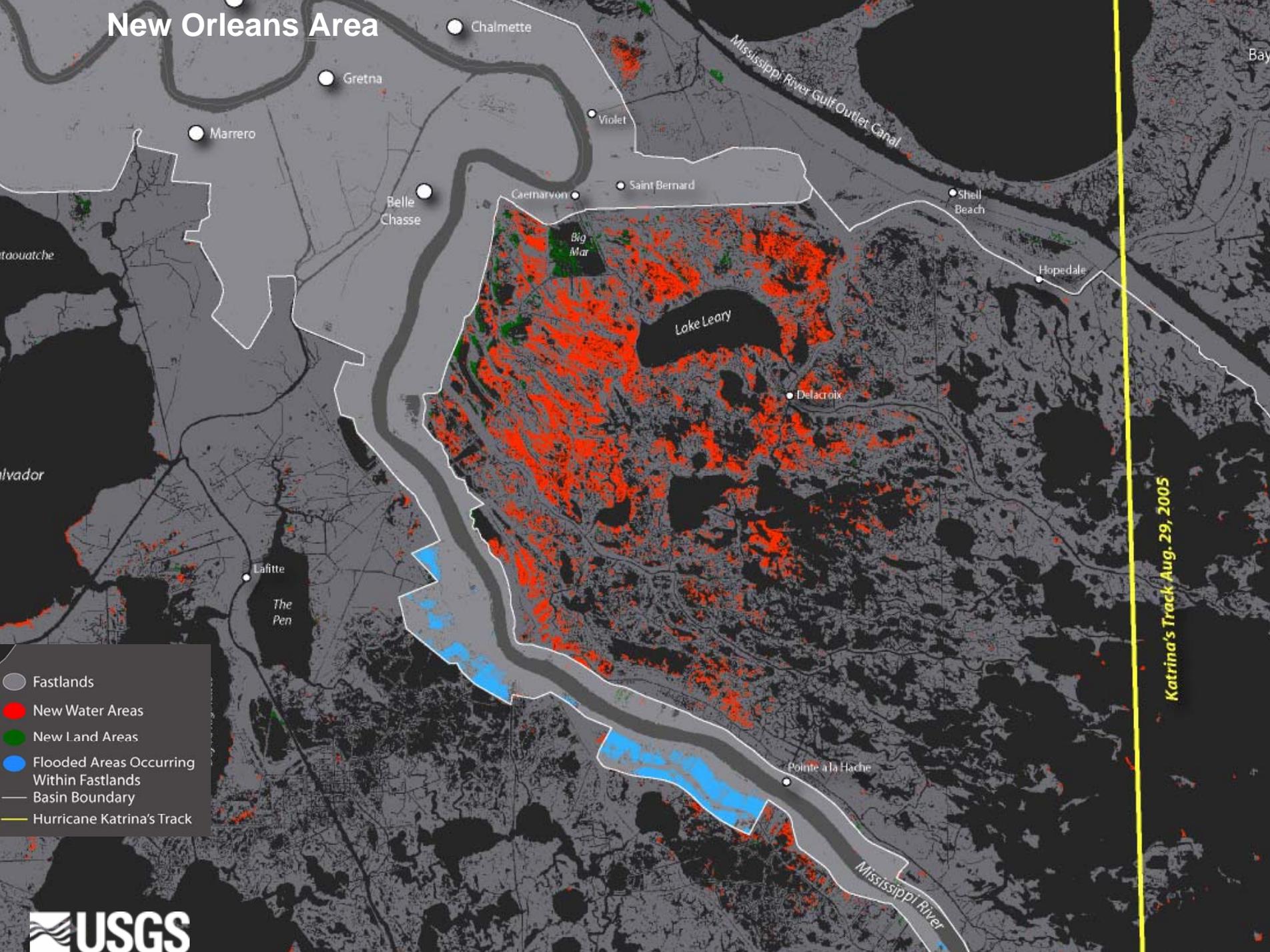
Sea Surface Temperature



Hurricane Katrina converted 118 mi² of Wetlands and Land to Open Water in Southeast LA alone

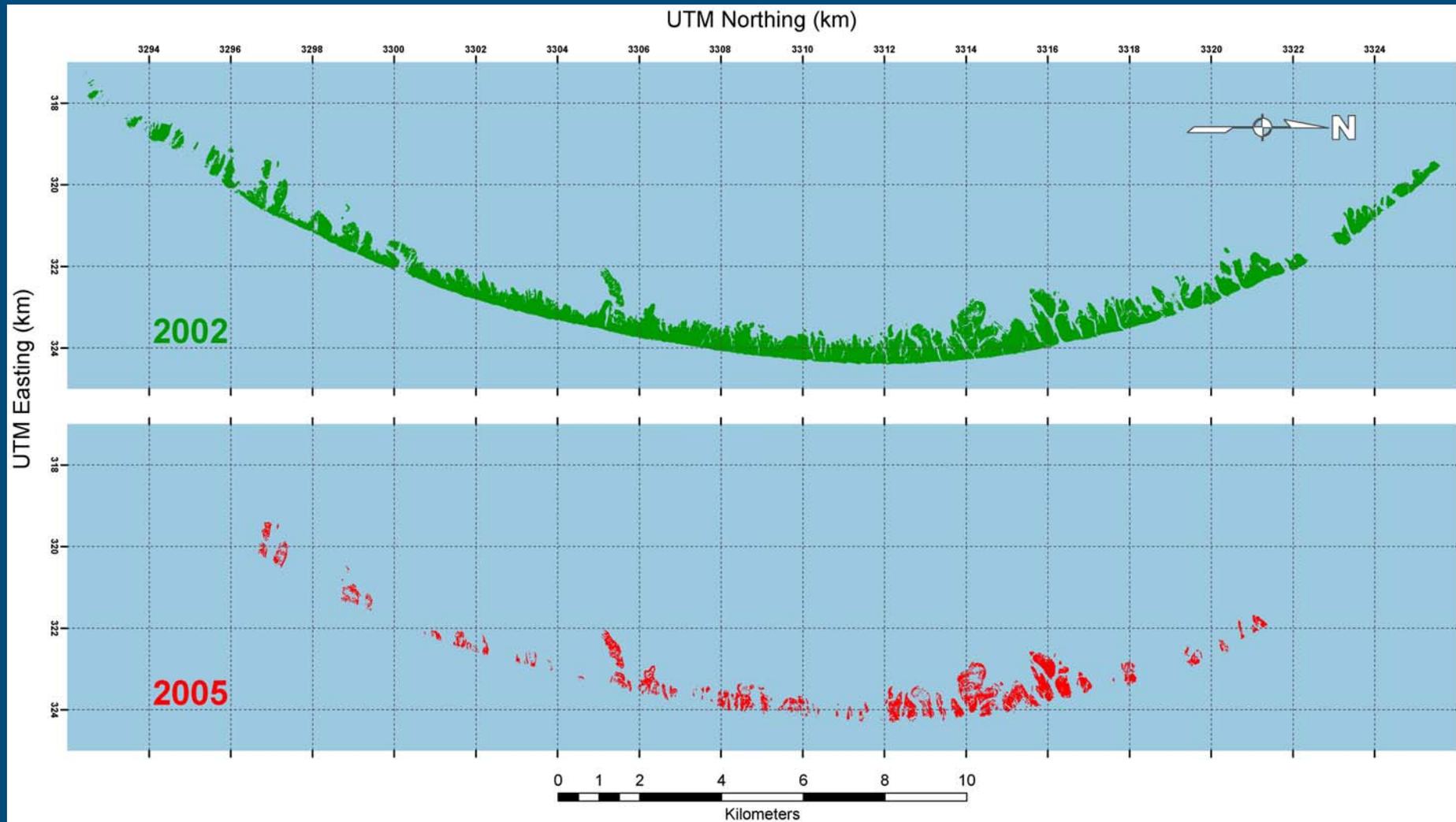


New Orleans Area



Katrina's Track Aug. 29, 2005

Chandeleur Islands

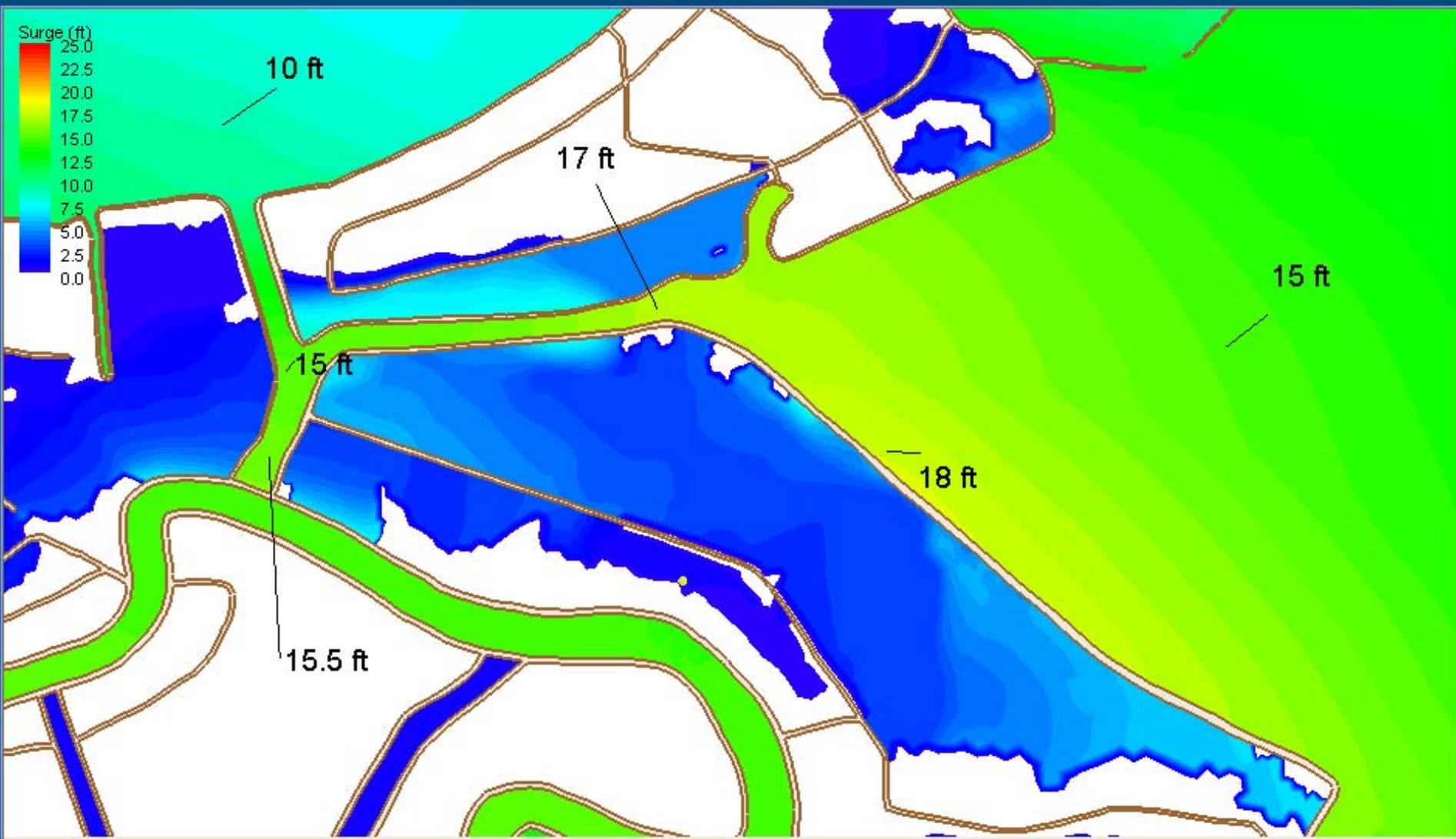




Pre Katrina



Post Katrina



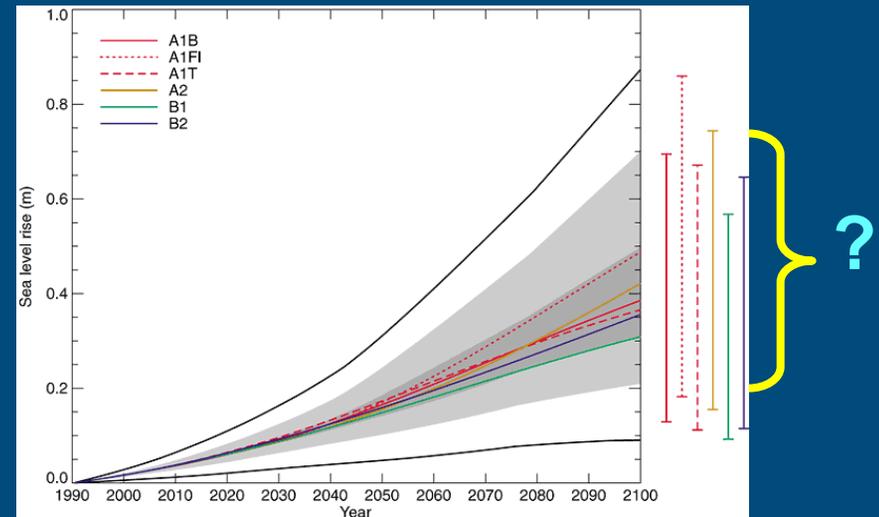
Hurricane Katrina Hindcast

Source: Hassan Mashriqui, LSU Hurricane Center



Kerry St. Pé Photo

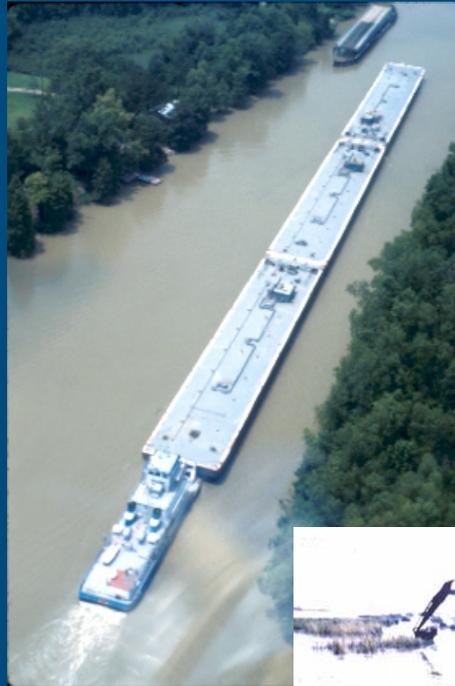
How high should evacuation routes and flood defenses be built?



Which scenario is most likely?

Adaptation Strategies: 10 examples

1. Reduce stressors that cause coastal subsidence, land loss, and erosion – – halt activities that destroy the coast



2. Restore natural coastal defenses

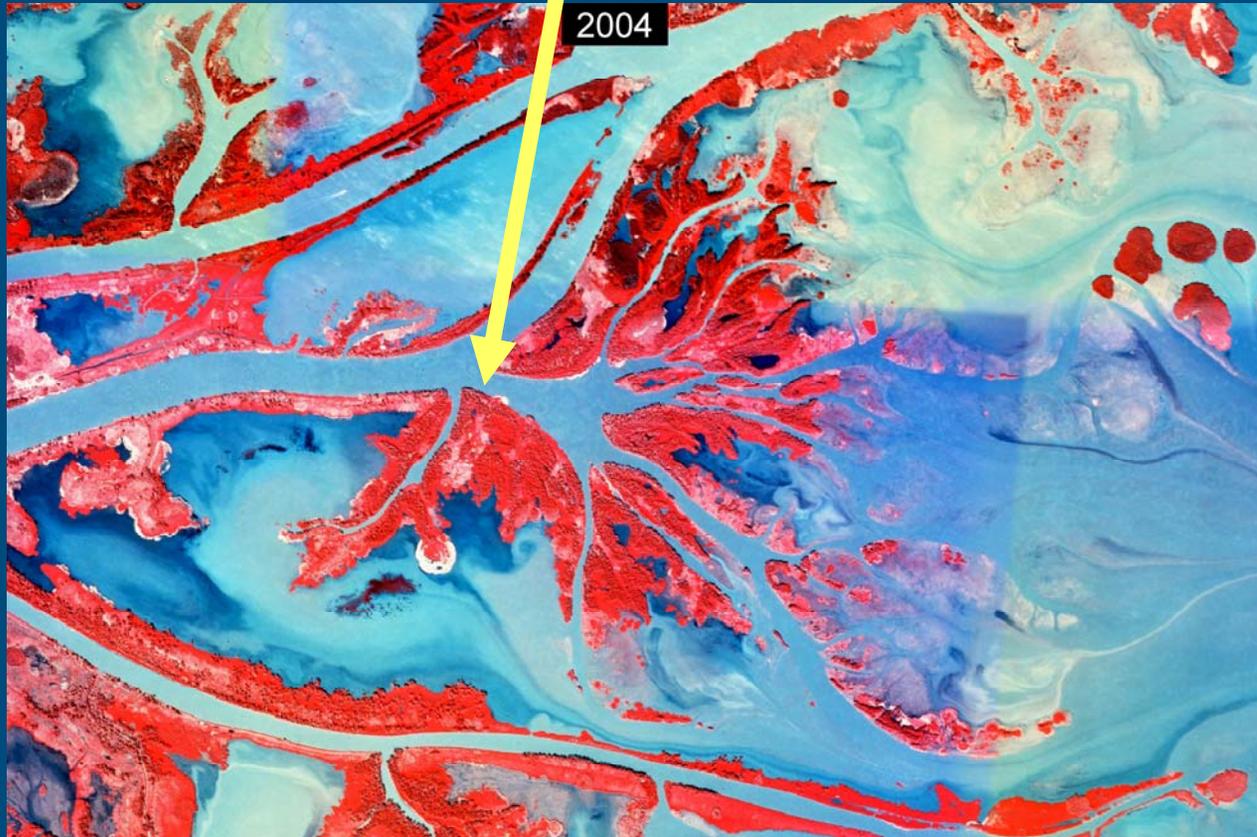


Examples:

- Beach nourishment
- Use of vegetation to create dunes or stabilize marsh sediments
- Beneficial use of dredged spoil
- Removal/construction of hard structures to prevent erosion

3. Restore natural hydrology

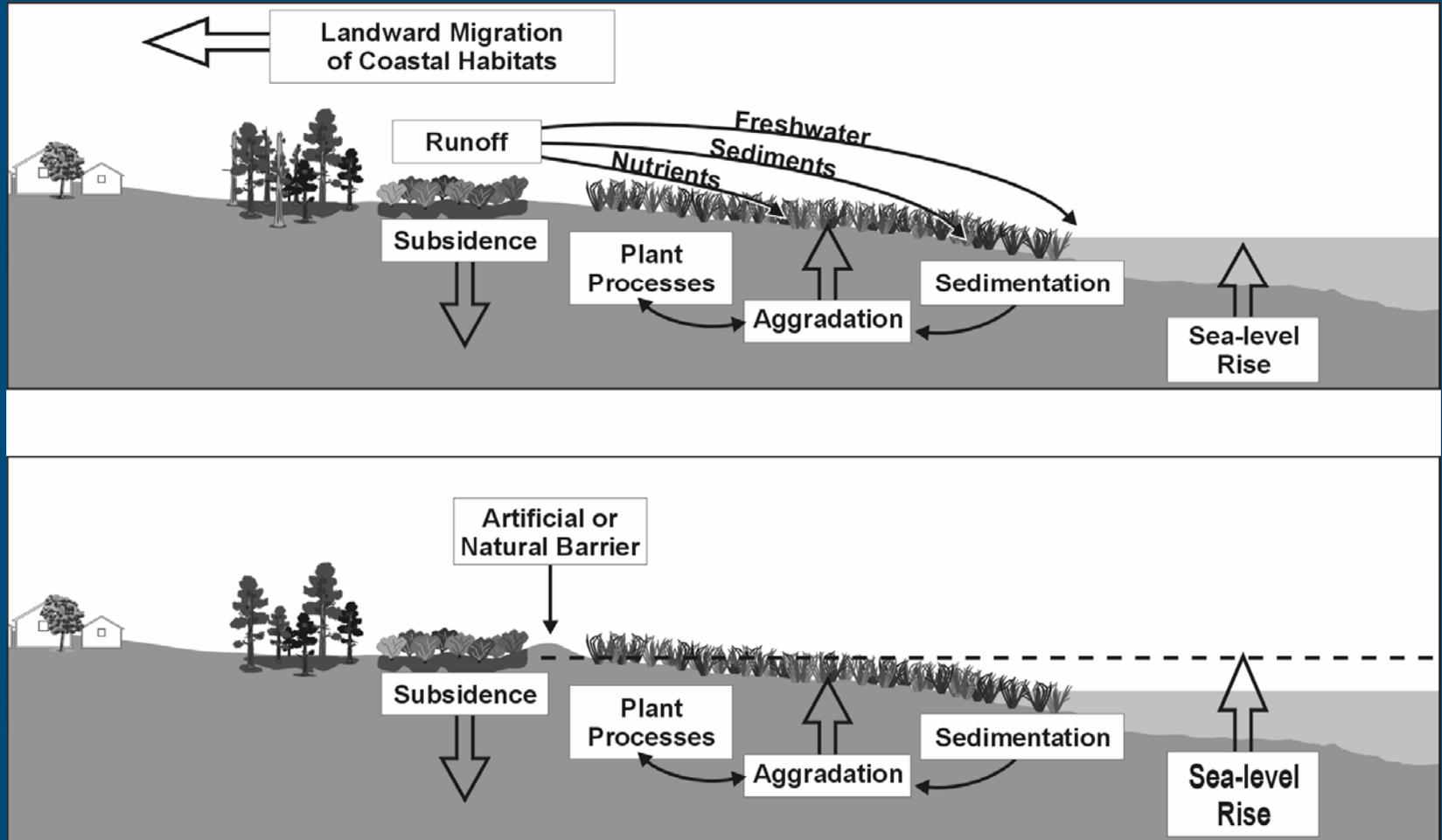
Crevasse in Mississippi River



4. Accommodate sea level rise and natural processes in coastal development and restoration planning



5. Remove impediments to upland transgression of coastal ecosystems (restored and natural)



(Burkett 2001)

6. Establish set-back zones for future coastal development
7. Adapt cities, buildings, and infrastructure – floodproof existing structures, design cities and the built environment to survive the changes that are likely to accompany global warming



8. Improve evacuation capacity & emergency response



9. Retreat

“Protect, Adapt, Retreat”

(IPCC response strategies for accelerated sea level rise)

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In some areas retreat may be the most cost effective option.



Dauphin Island, AL

10. Factor understanding of natural processes and trends into management plans, inform by monitoring

