An aerial photograph showing a large body of water, likely a bay or estuary, with a prominent landmass on the right side. The water is dark blue, and the land is green with some brown patches. The sky is light blue with some white clouds. The text is overlaid on the top half of the image.

Why Accurate Elevations are essential for the Rebuilding of a Safe and Sustainable South Louisiana

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Why are accurate elevations and understanding subsidence essential for rebuilding South Louisiana?

Tactical Issues

- To rebuild levees to original design heights and to help design “Cat 5” levee to proper heights to account for future subsidence.
- To provide a system that can provide accurate elevations for local rebuilding of homes and infrastructure.

Strategic Issues

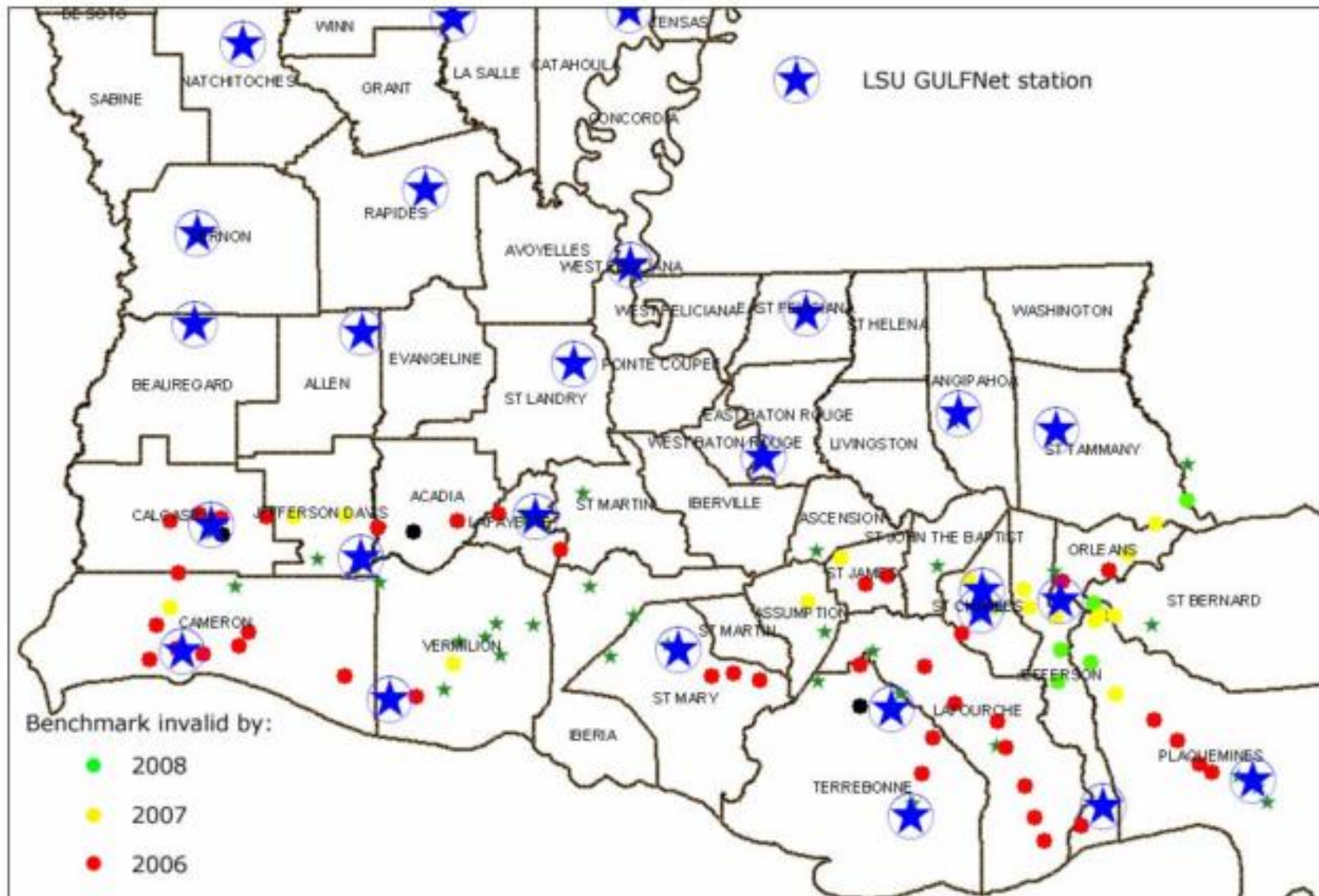
- To help people understand why this disaster occurred.
- To appreciate that our vulnerability is increasing.
- To understand that we must be very careful in developing mitigation strategies to avoid “unintended consequences”.
- To understand that we need a dynamic 3-D positioning that will be universally accessible and sustainable.

Elevation and Vertical Control

The State of Vertical Control

- Today → 85 benchmarks and LSU CORS are the only means of obtaining accurate elevations in the ENTIRE state.
- Most of the benchmarks and derivatives will be stale in 2 years. CORS will remain accurate.
- 2001-Oct. 2004 → All benchmarks stale.

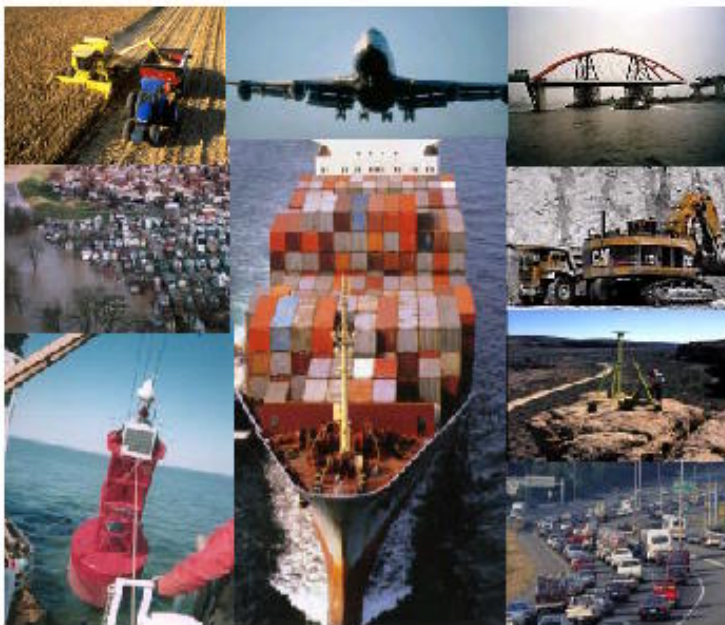
The only valid benchmarks in LA. Released in 2005, most will be bad by end of 2007





National Height Modernization Study

Report to Congress
Executive Summary



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
National Geodetic Survey

NOAA told Louisiana in 2001 that the system used to measure elevations is,

**“inaccurate
and
obsolete.”**

**What caused
this?**

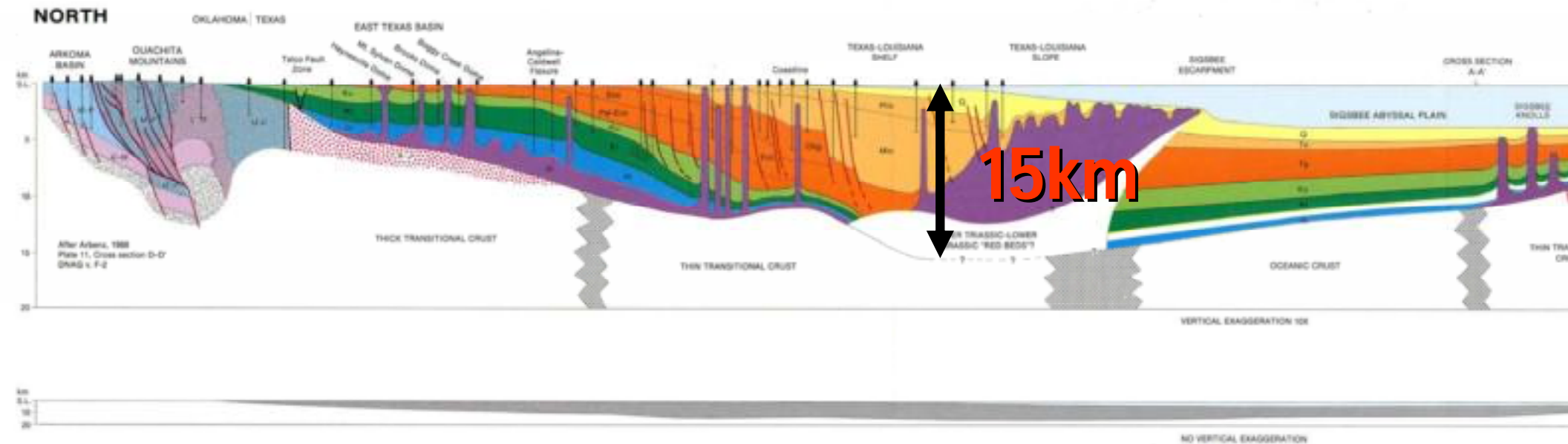
**It is directly related to the loss
of our coast.**

It's called Nature!

**(including the unintended consequences
resulting from humans trying to control it).**

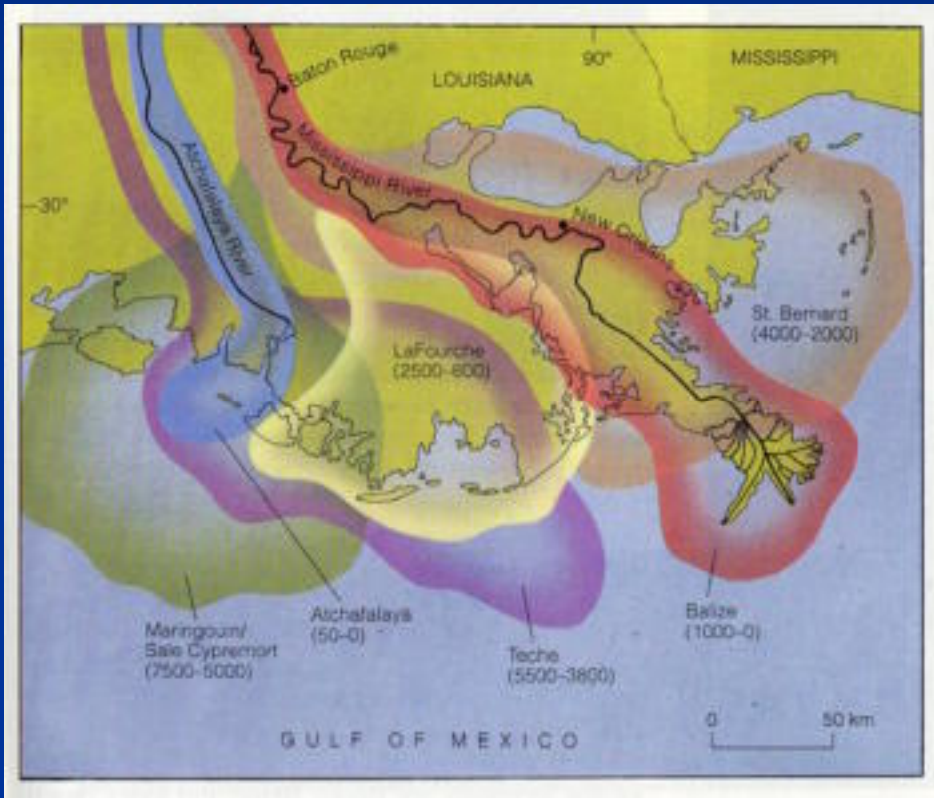
Let's review how the coast actually works.

Reminder: Gulf Coast is the product of 200 million years of sedimentation



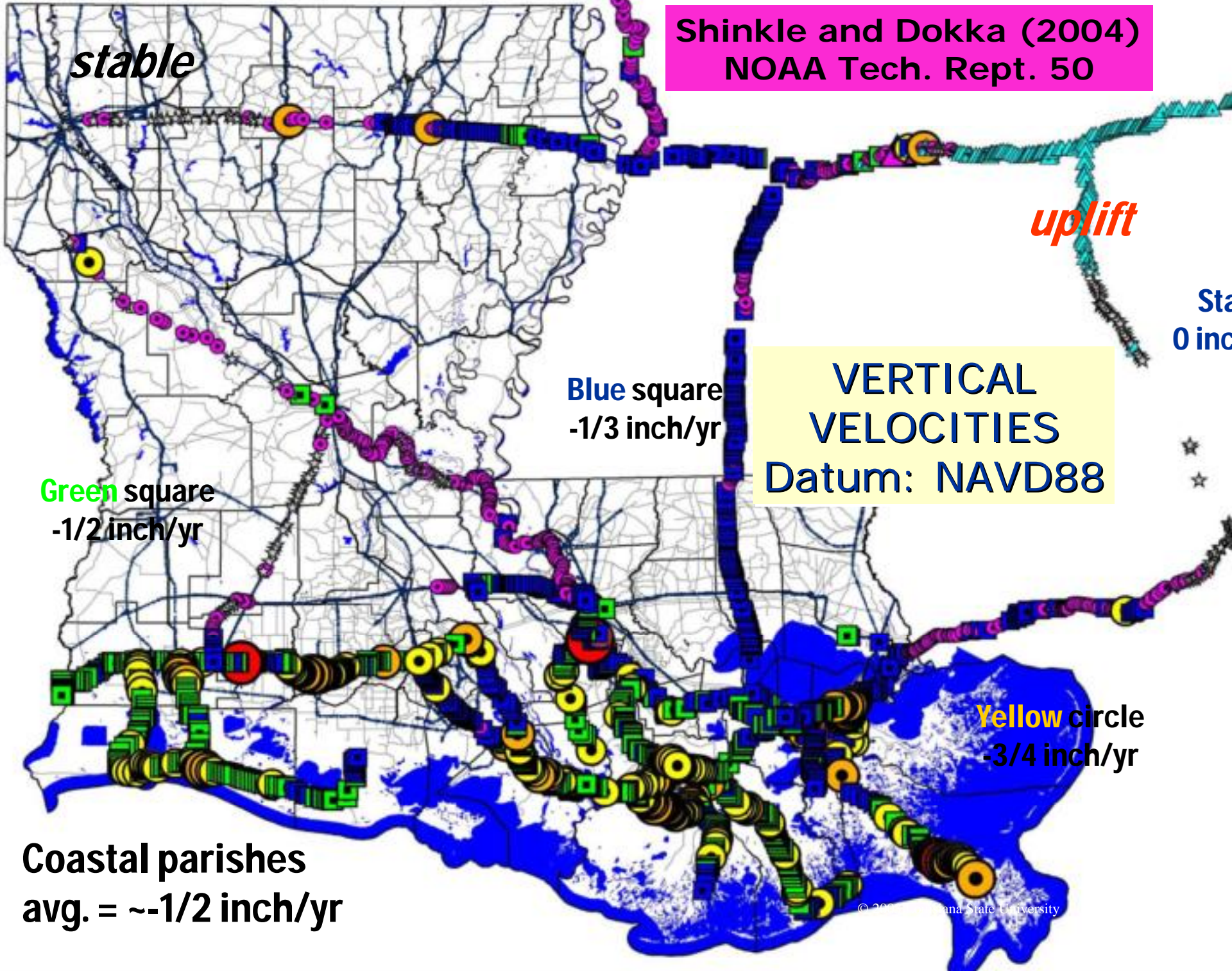
- ~60,000 ft thick → stack of 10 Grand Canyon sections.
- Delta and shallow marine sediments.
- The “Depositional Space Problem”
 - ✓ Sea level rise (range = ~1000 feet)
 - ✓ Salt evacuation due to differential loading.
 - ✓ Bending of the crust and flow of underlying mantle.

The surface upon which present-day Louisiana is built has formed since the last ice age



- Modern Mississippi River delta deposited over last ~8,000 yrs.
- Landscape due to interplay between subsidence and accretion. Flooding builds land by physical and biologic processes. Deltas cannot grow much above sea level.
- Delta composed of lobes that shift position with time. When a lobe is abandoned, it longer accretes and only subsides.
- Building levees prevent flooding and thus accretion. The land is going to continue to sink if there are levees.
- Traditional society cannot safely exist in south Louisiana without levees.

Shinkle and Dokka (2004)
NOAA Tech. Rept. 50



Implications of Tech Report 50

- The entire coast from Texas to Florida is subsiding and is gradually being inundated.
- The coast has been sinking at rates from 1/4 to 2 inch/yr. Most rates are not linear over time, reflecting non-linear processes.
- Most subsidence is natural and unrelenting. It is making low-lying, coastal communities increasingly more vulnerable to storm surge.

→ If subsidence continues and/or sea level rises, and human action fails to take place, the entire coast will be inundated (soon).

→ Benchmarks in most coastal areas need re-calibration. In Louisiana, the system currently cannot support public safety.

→ The rates do not support the current scientific paradigm that explains subsidence along the coast.

* There is a large tectonic component.

* Petroleum extraction--local and limited.

Subsidence of Benchmarks: The Result of Regional and Local Processes

Regional Processes:

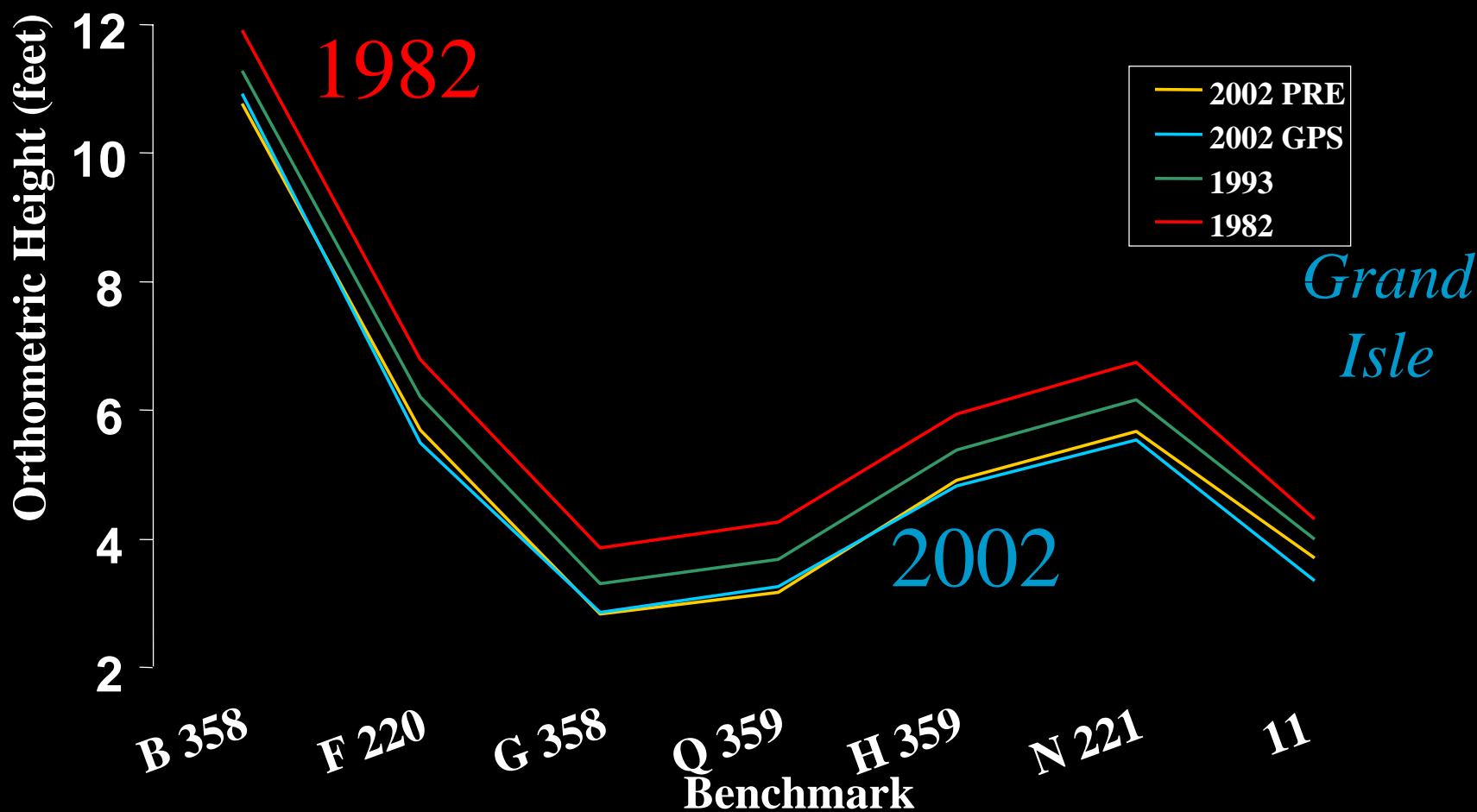
- Load induced flexure of the lithosphere
+5 to -8mm/yr

Local Processes:

- Consolidation and compaction
- Organic soil oxidation
- Faulting *0 to -15mm/yr*
- Oil & gas extraction *0 to -3 mm/yr*
- Water pumping *0 to -50mm/yr*
- Salt evacuation *0 to -15mm/yr*

Subsidence has lowered evacuation roads throughout coastal Louisiana

Raceland



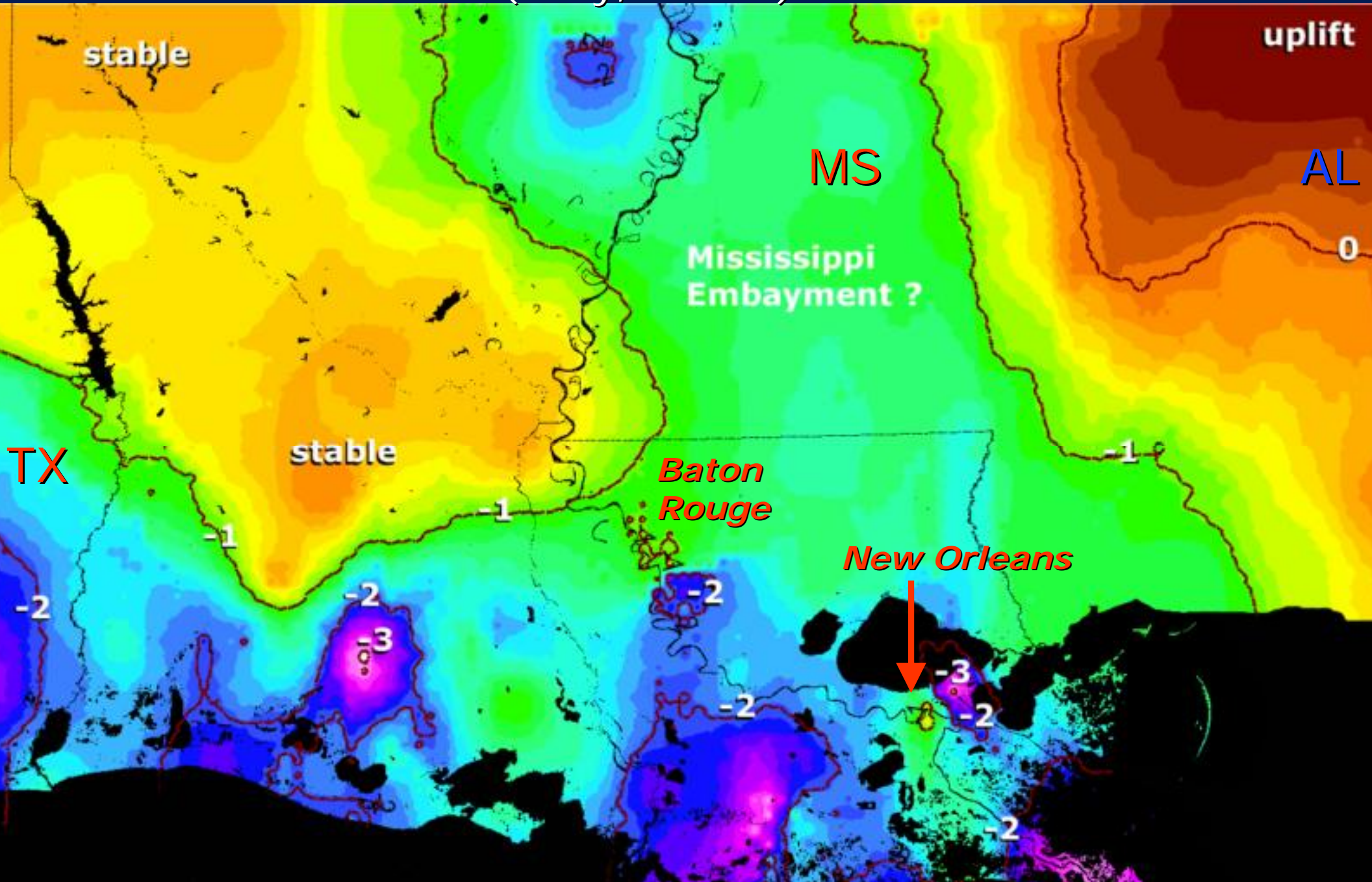
La Hwy 1 has sunk ~1 foot since 1982

More Practical Implications of Subsidence

- New flood maps will show greater vulnerability throughout the Gulf Coast. Homes will need to be built higher than commonly thought. The cost of insurance will control the geography of rebuilding.
- The vertical control system we use to determine elevations is ruined. The remaining valid benchmarks are too few to support proper rebuilding.
- New levees need to be built with **FUTURE** subsidence in mind!!

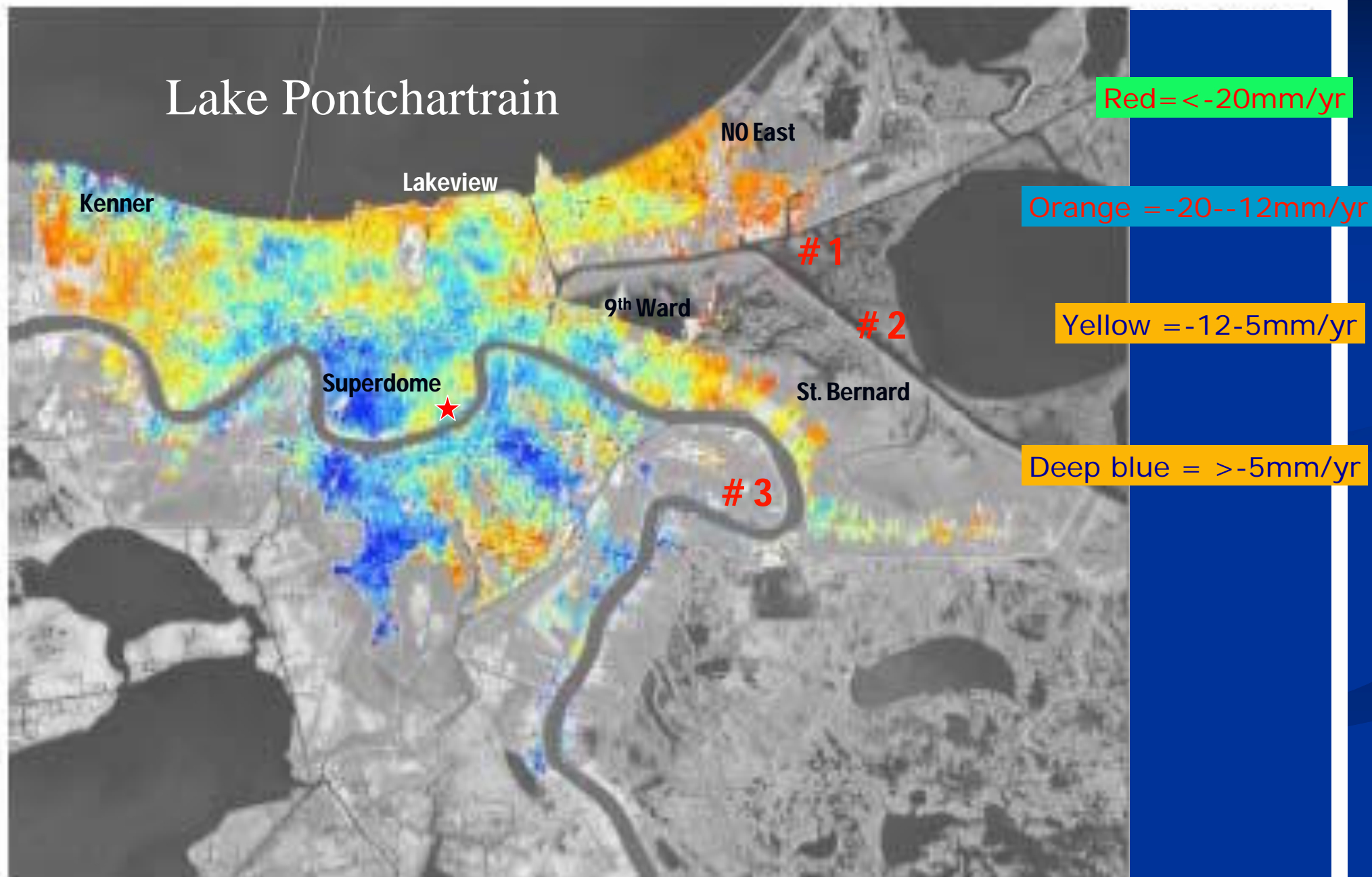
Subsidence in past 50-75 years

(sorry, in feet!)



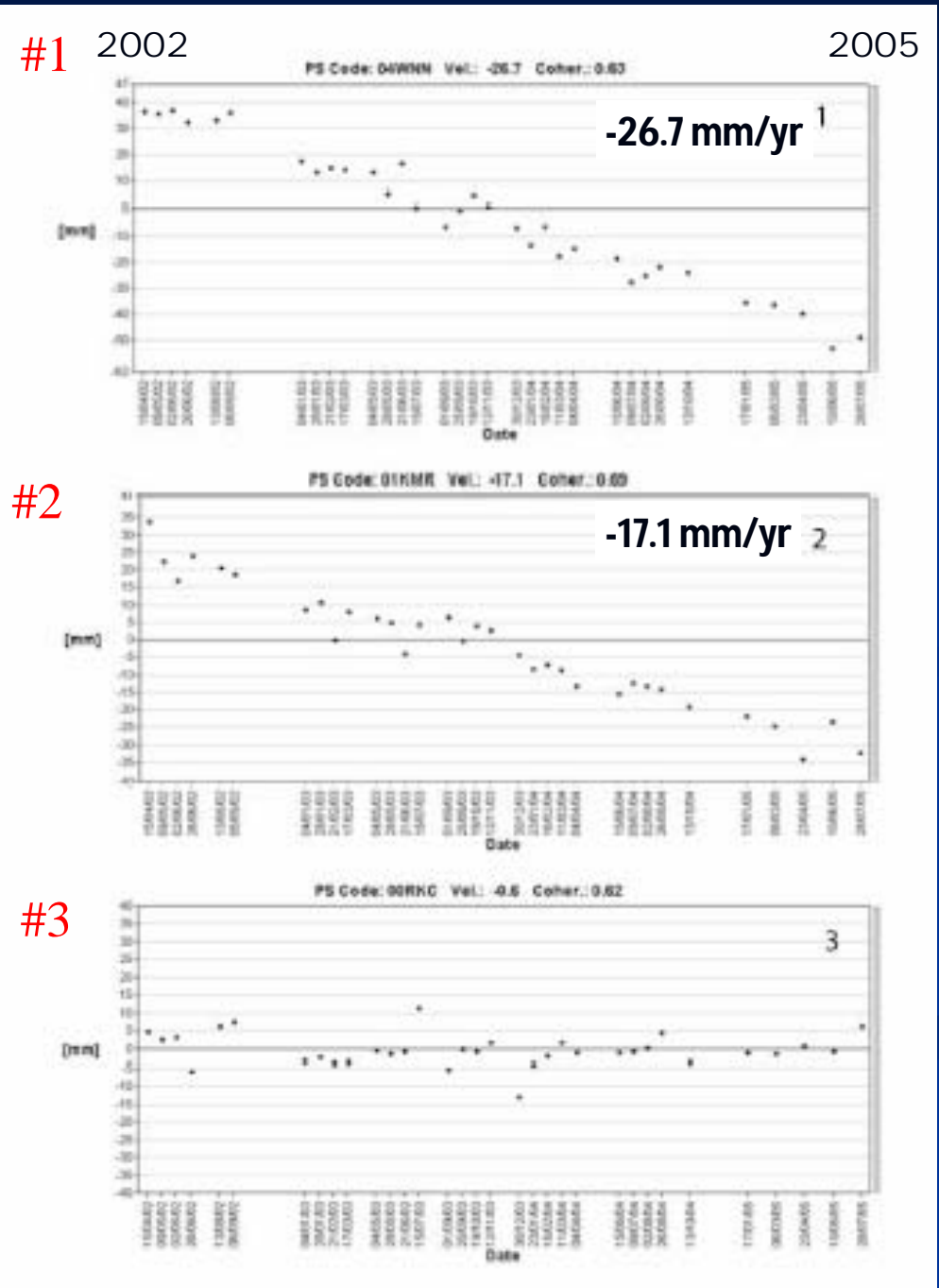
**Did I mention that it is
actually worse than this
because benchmarks
don't measure all of the
subsidence?**

Preliminary Radar PS Interferometry 2002-late 2005 Radarsat C-Band (6cm)



Subsidence have lowered our levee defenses

Time Series from three PS. #1 and #2 are along levees in St. Bernard Parish that failed. #3 is USCG English Turn CORS. It moves at -5 mm/yr NAVD88.

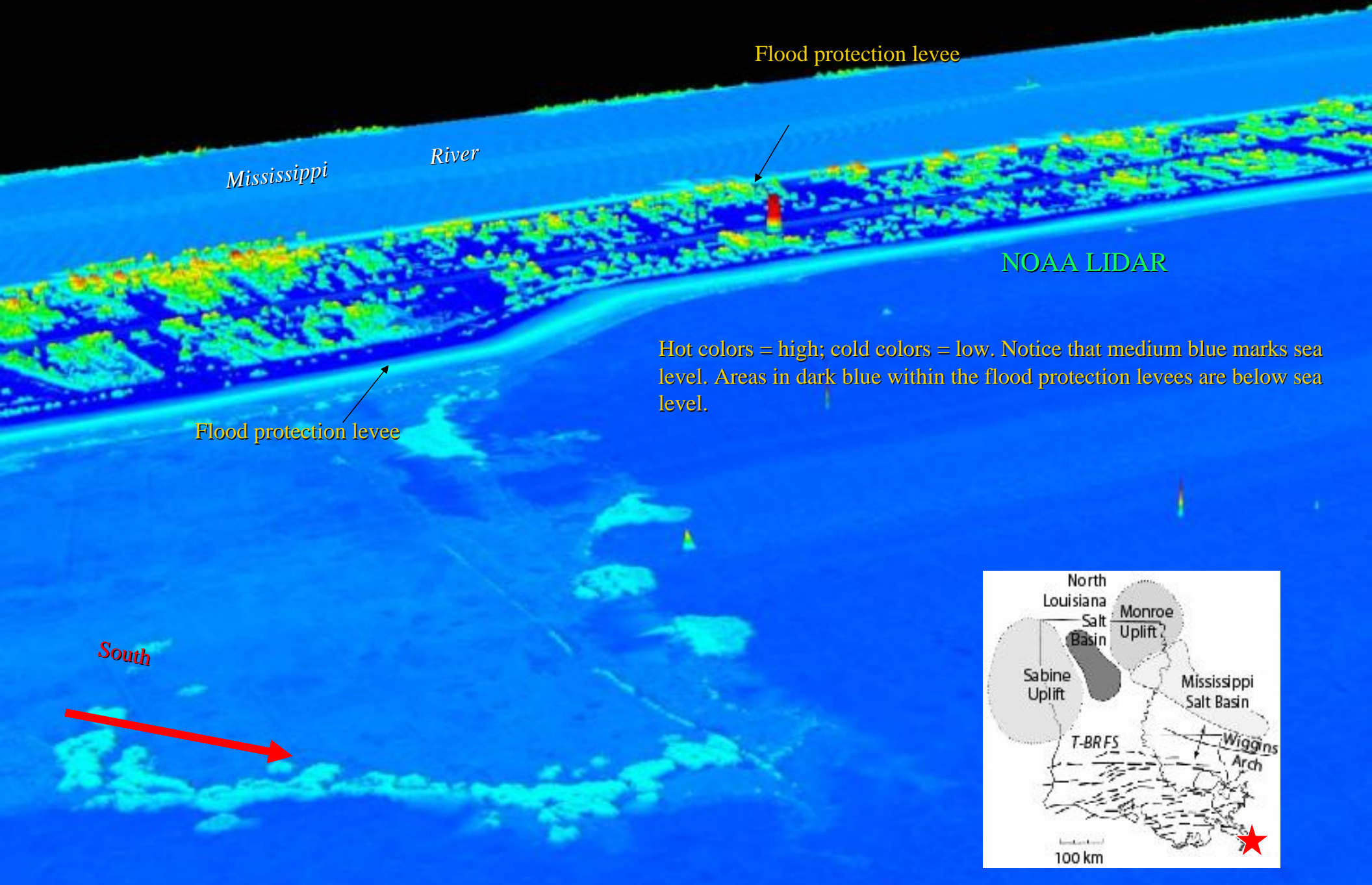


The Effect of Levees on the Louisiana Landscape

Levees do two things:

- They prevent sediment accretion and land building. No sediments, only subsidence.
- They prevent flooding and allow people live and to build conventional society.

Much of Plaquemines Parish is now below sea level. It happened since levee construction.



Flood protection levee

Mississippi River

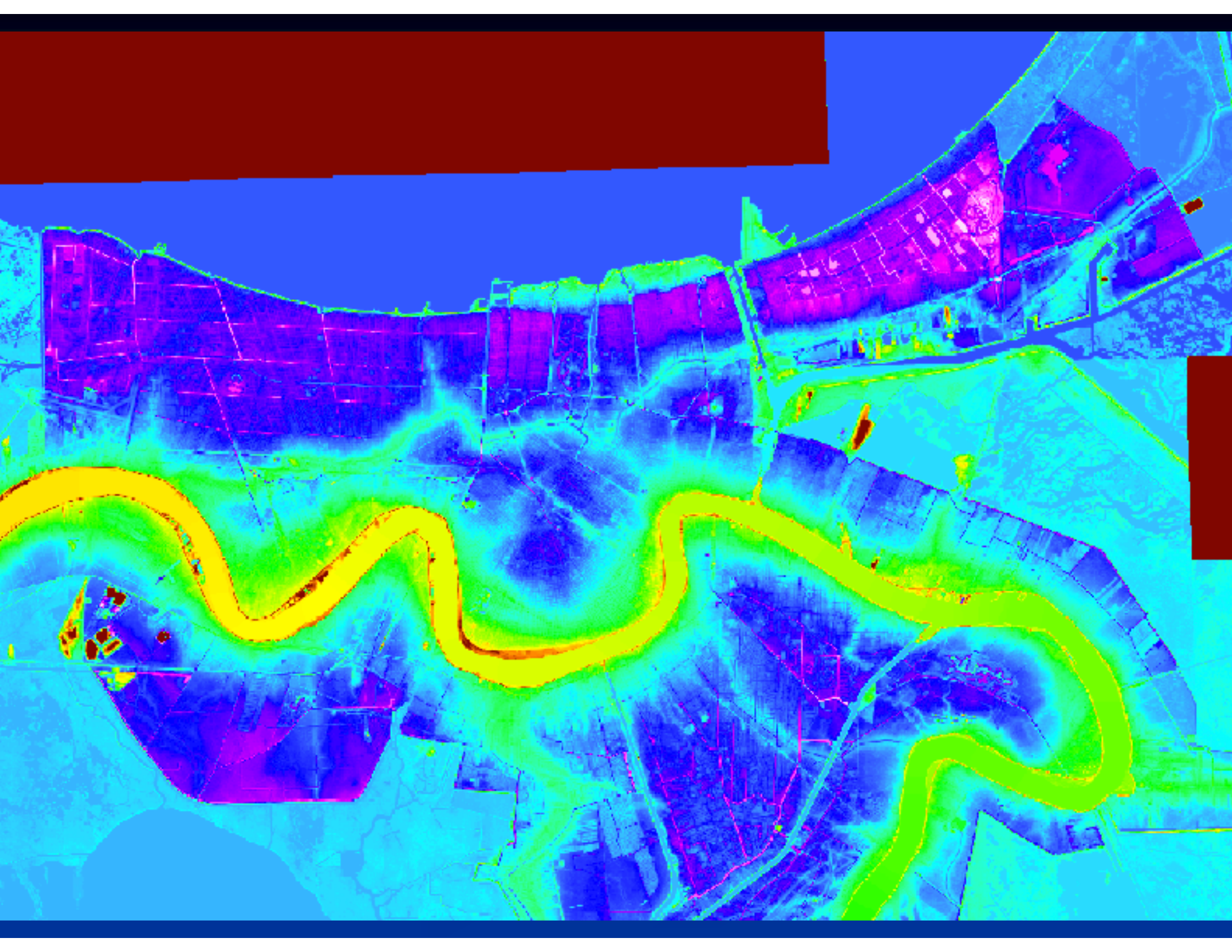
NOAA LIDAR

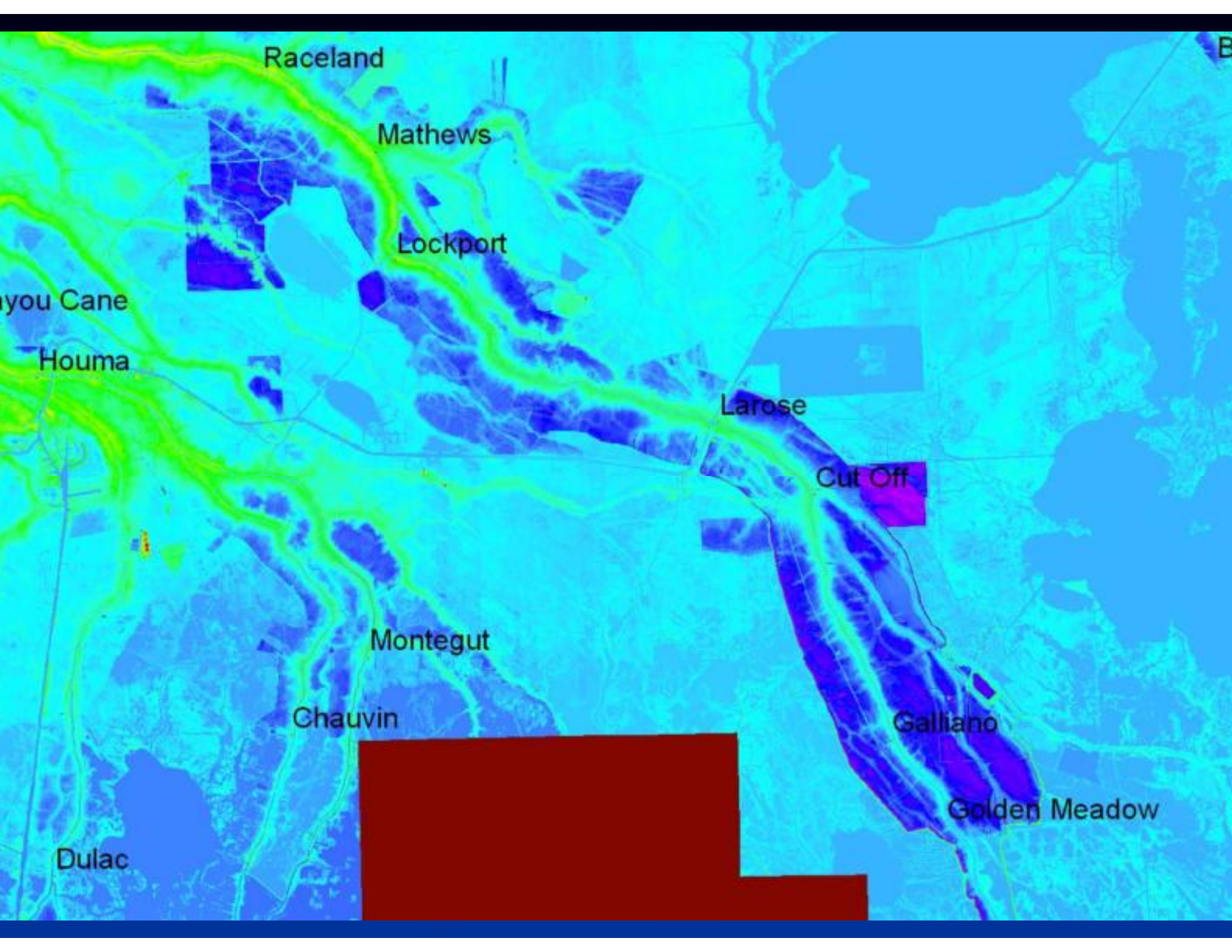
Hot colors = high; cold colors = low. Notice that medium blue marks sea level. Areas in dark blue within the flood protection levees are below sea level.

Flood protection levee

South







Raceland

Mathews

Lockport

Bayou Cane

Houma

Larose

Cut Off

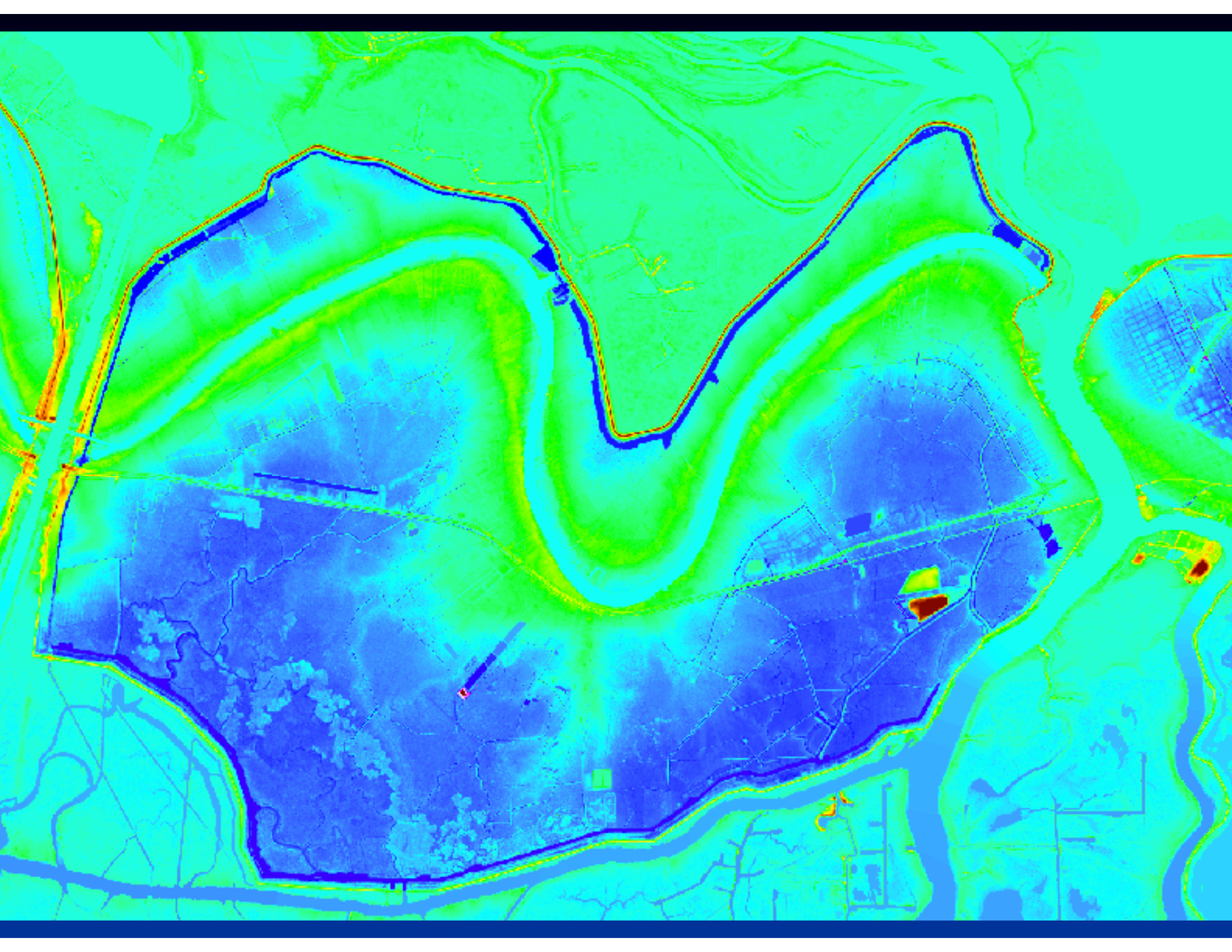
Montegut

Chauvin

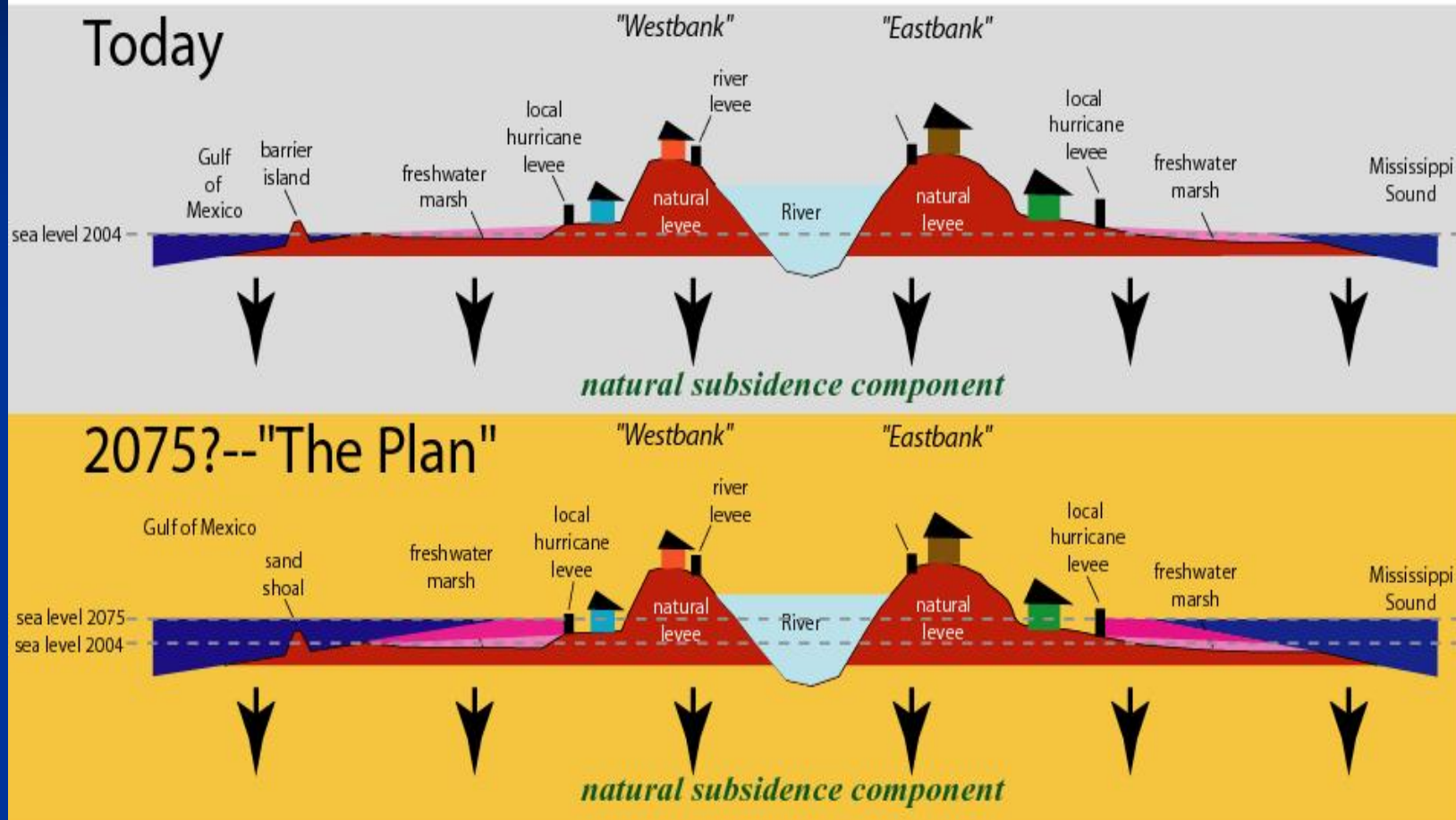
Galliano

Golden Meadow

Dulac

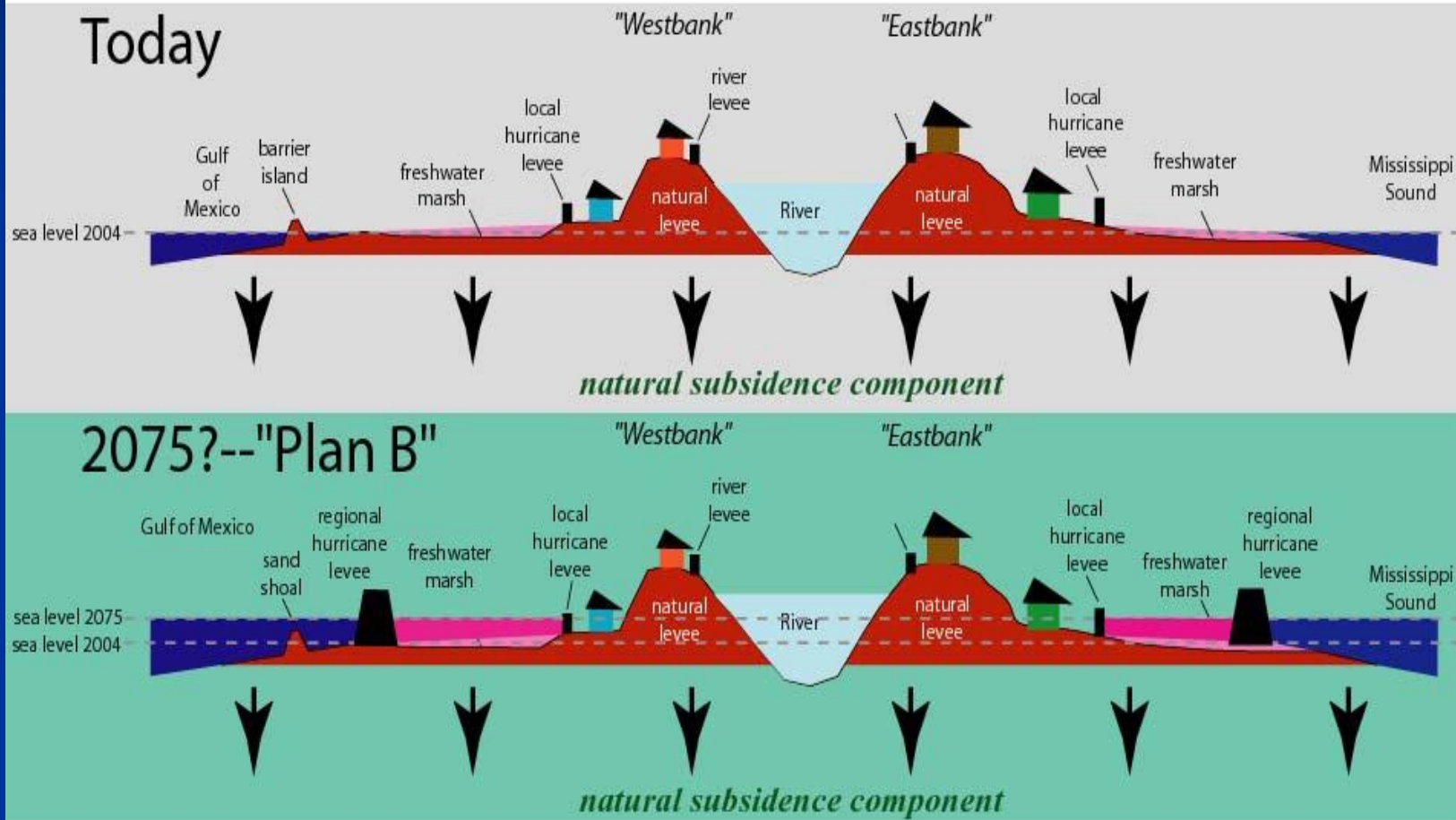


Current plans to save the Coast are focused on fixing the wetlands



As the wetlands are restored, coastal communities will continue to sink. Storms will ultimately make coastal communities uninhabitable.

Sea level rise and subsidence will likely result in inundation of the coast.



*Solution: Protection for coastal communities.
Or RETREAT!*

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