

Board of Commissioners of SLFPA-E

vs.

Tennessee Gas Pipeline Co., et.al.

Legal and Geological Evaluaton



**Bd. of Comm'rs of the S.E. La. Flood
Prot. Auth. E. v. Tn. Gas Pipeline Co.,
LLC., et al., No. 13-6911 (D. Ct.
Orleans Parish, La. Jul 24, 2013).**

The Coastal “Erosion” Lawsuit

The Parties

○ Plaintiffs

- Southeast Louisiana Flood Protection Authority - East ("the Authority"), individually and as the board governing the Orleans Levee District, the Lake Borgne Basin Levee District, and the East Jefferson Levee District

○ Defendants

- List of energy companies involved in exploration and production over the past 80 years.

The Good Old Days

“Coastal lands have for centuries provided a crucial buffer zone between south Louisiana's communities and the violent wave action and storm surge that tropical storms and hurricanes transmit from the Gulf of Mexico. Coastal lands are a natural protective buffer, without which the levees that protect the cities and towns of south Louisiana are left exposed to unabated destructive forces.”

The Delta after 1932

“This natural protective buffer took 6,000 years to form. Yet, as described below, it has been brought to the brink of destruction over the course of a single human lifetime. Hundreds of thousands of acres of the coastal lands that once protected south Louisiana are now gone as a result of oil and gas industry activities...”

The Legal Claims

- This is a third party beneficiary lawsuit.
 - The landowners have the primary rights to the restoration of the land after production.
 - The damage to the land increased the cost of hurricane protection to the levee board.
- The mechanism of damage
 - Canals and pipelines destroyed wetlands, which acted as buffers against hurricane storm tide.
 - Oil extraction caused surface subsidence, which increases the risk of hurricane storm tide.

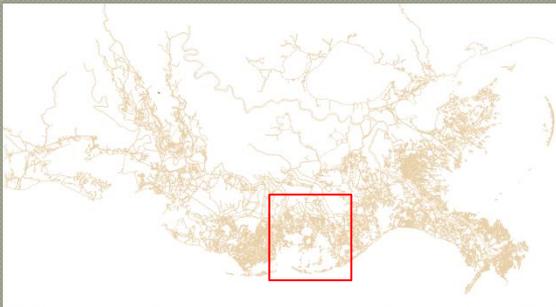
The Coastal Restoration Demand

“...including, but not limited to, backfilling and revegetating each and every canal dredged by them, used by them, and/or for which they bear responsibility, as well as undertaking all manner of abatement and restoration activities determined to be appropriate, including, but not limited to, wetlands creation, reef creation, land bridge construction, hydrologic restoration, shoreline protection, structural protection, bank stabilization, and ridge restoration...”

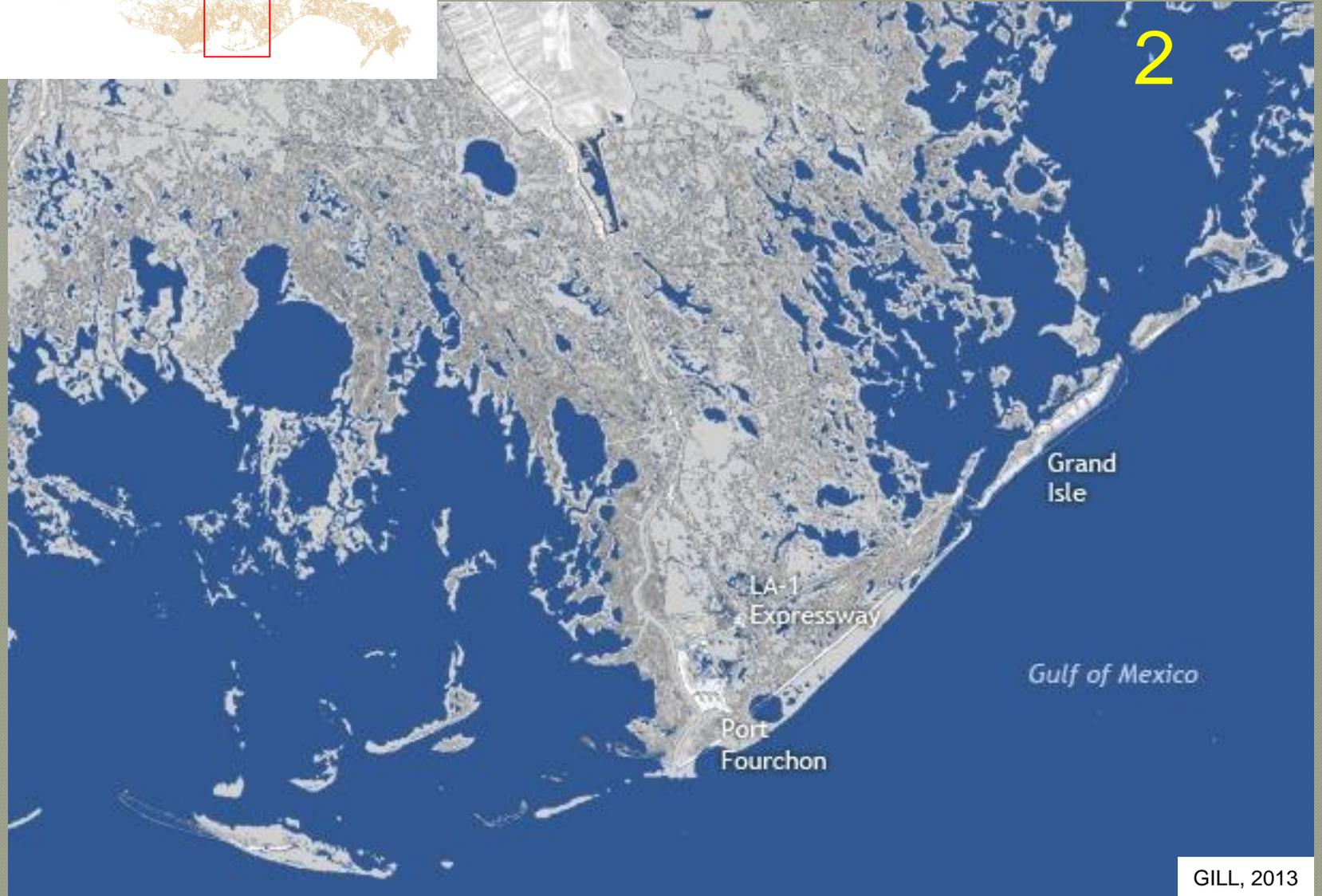
Wetlands Lost Since 1932

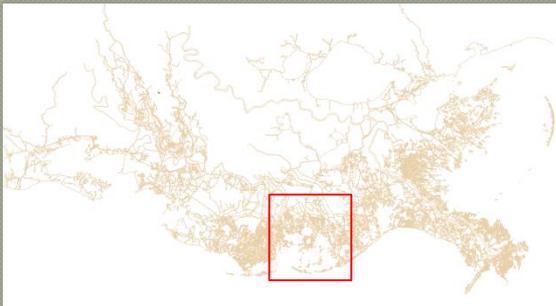
Port Fourchon



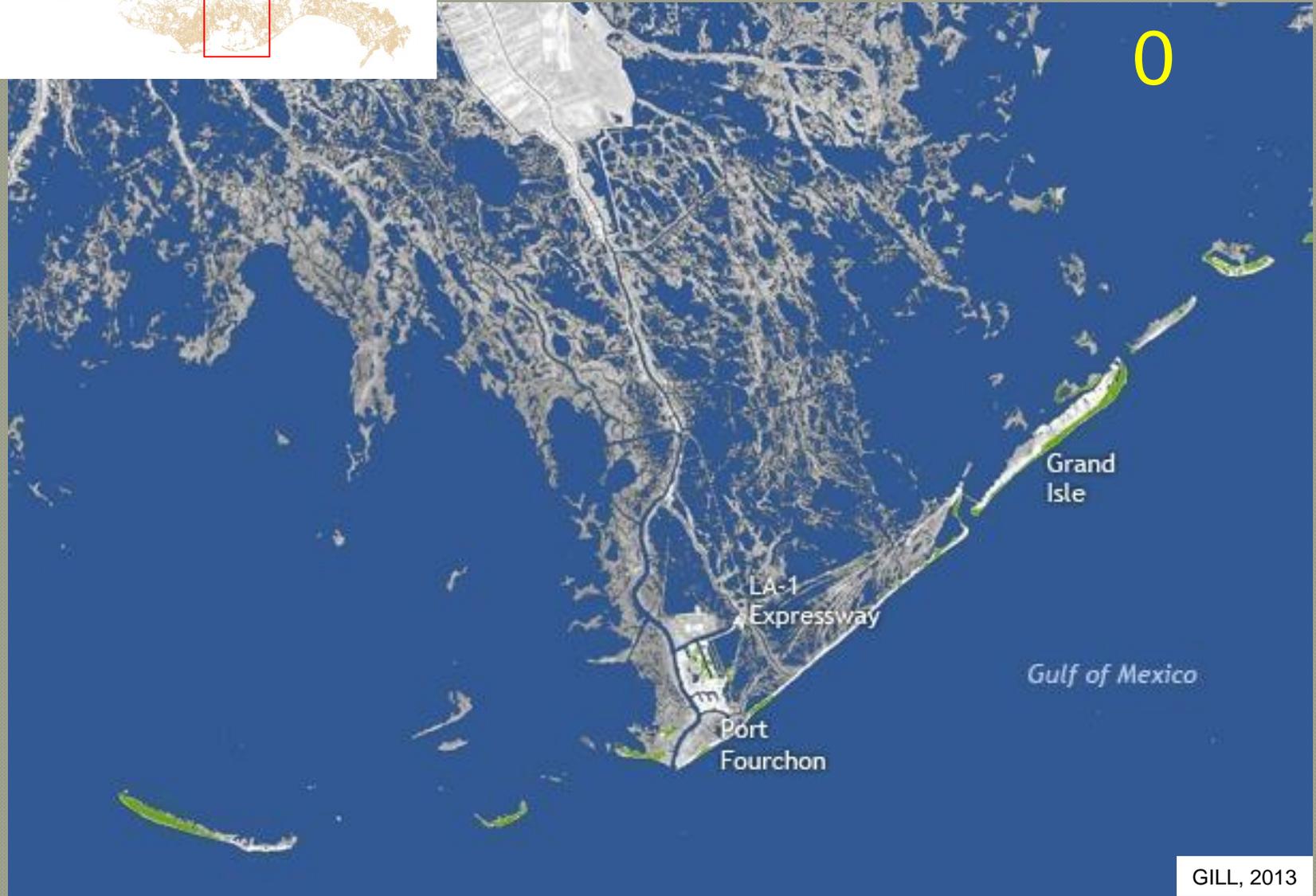


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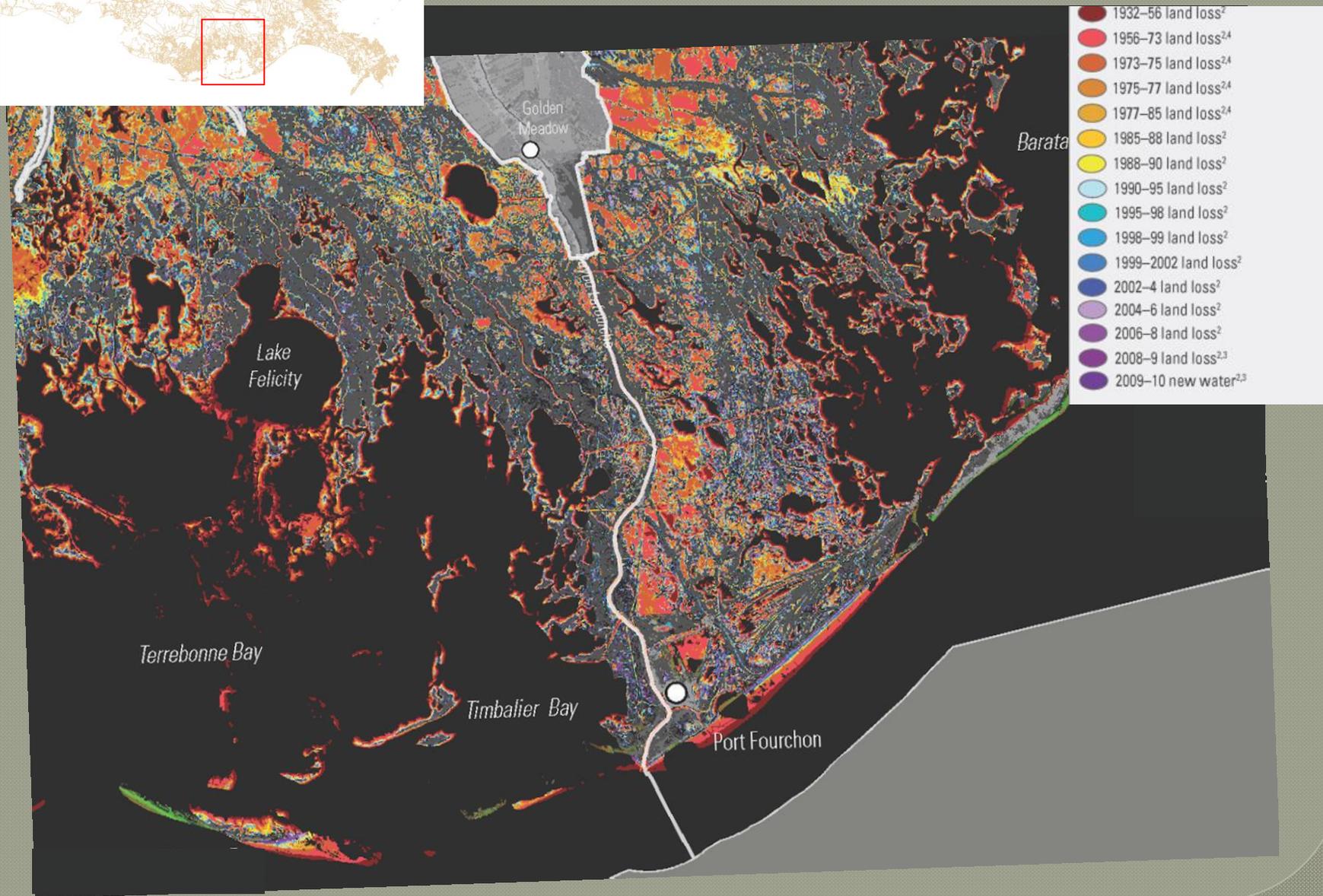
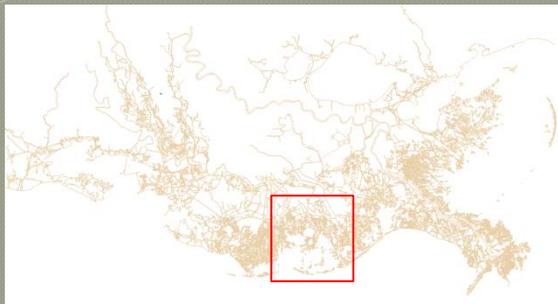




201
0



U.S.G.S - Land Area Change in Louisiana 1932-2010



- 1932-56 land loss²
- 1956-73 land loss^{2,4}
- 1973-75 land loss^{2,4}
- 1975-77 land loss^{2,4}
- 1977-85 land loss^{2,4}
- 1985-88 land loss²
- 1988-90 land loss²
- 1990-95 land loss²
- 1995-98 land loss²
- 1998-99 land loss²
- 1999-2002 land loss²
- 2002-4 land loss²
- 2004-6 land loss²
- 2006-8 land loss²
- 2008-9 land loss^{2,3}
- 2009-10 new water^{2,3}

Coastal Land Area Change since 1932

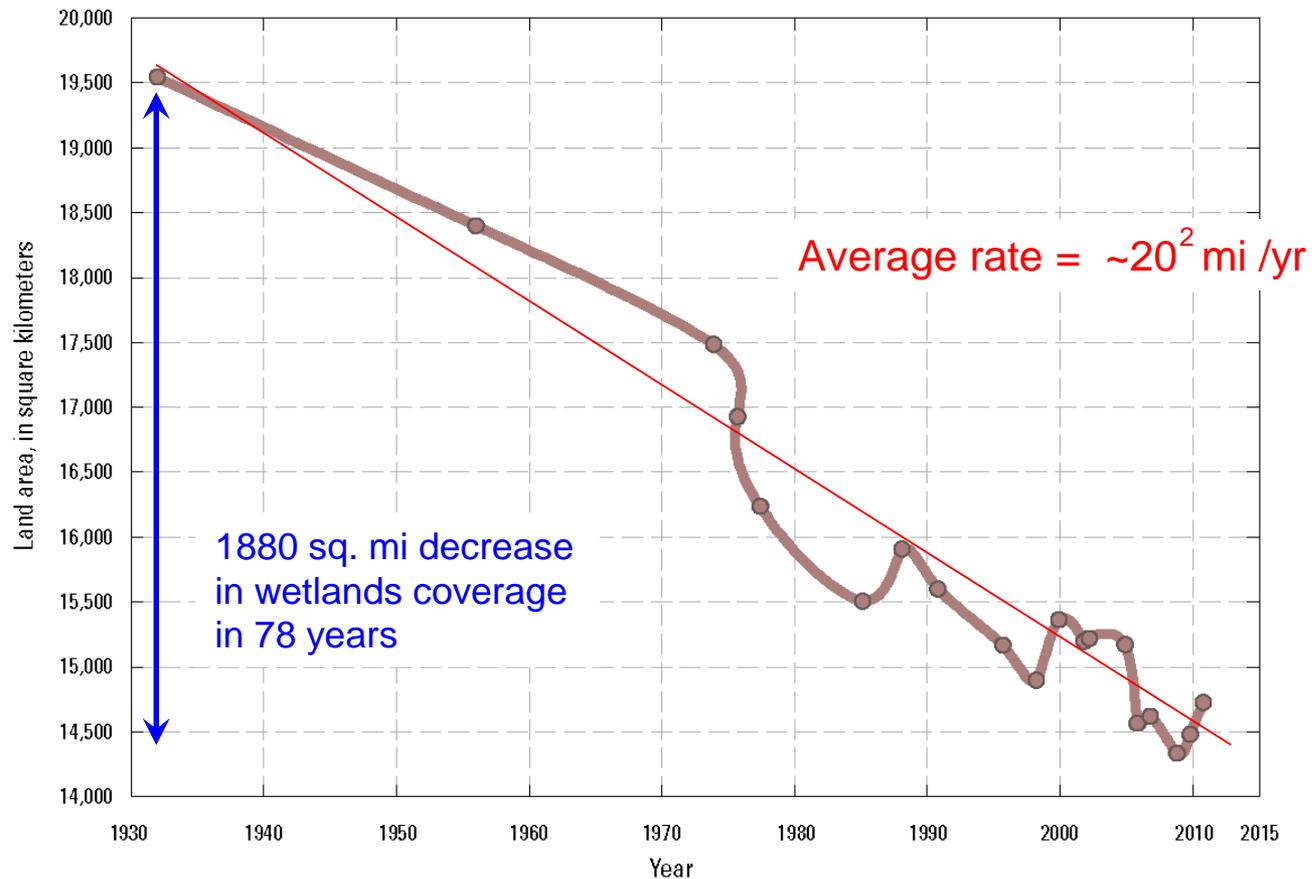


Figure 25. Time series of land-area changes in coastal wetlands of Louisiana, 1932 to 2010 (modified from Couvillion and others, 2011).

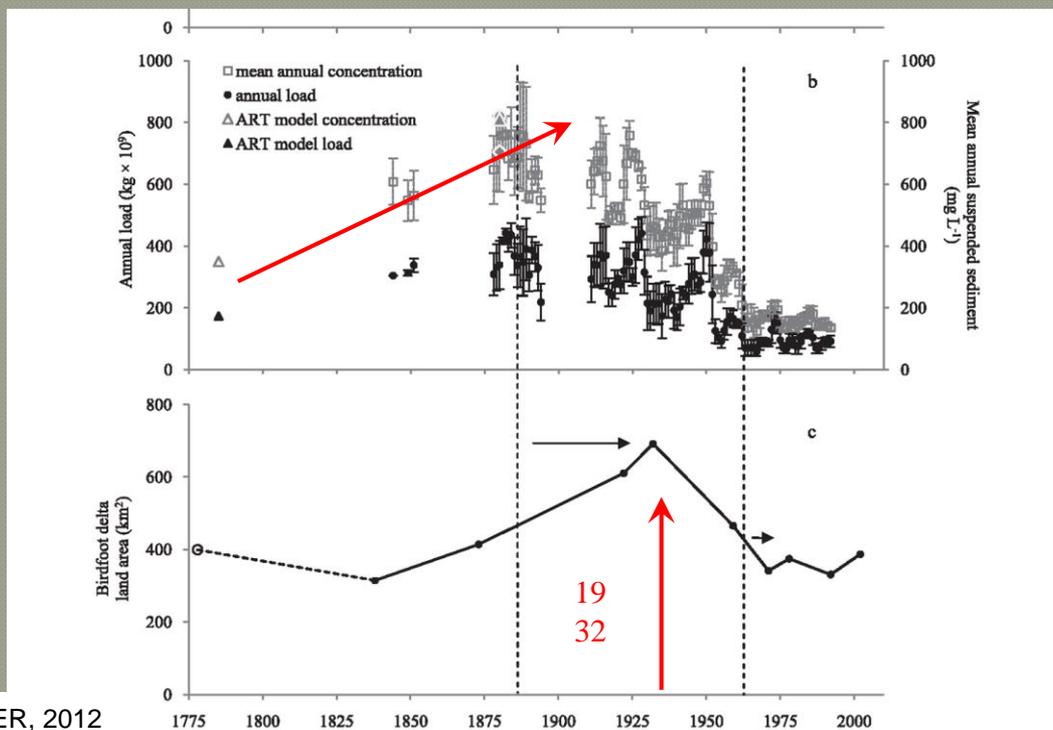
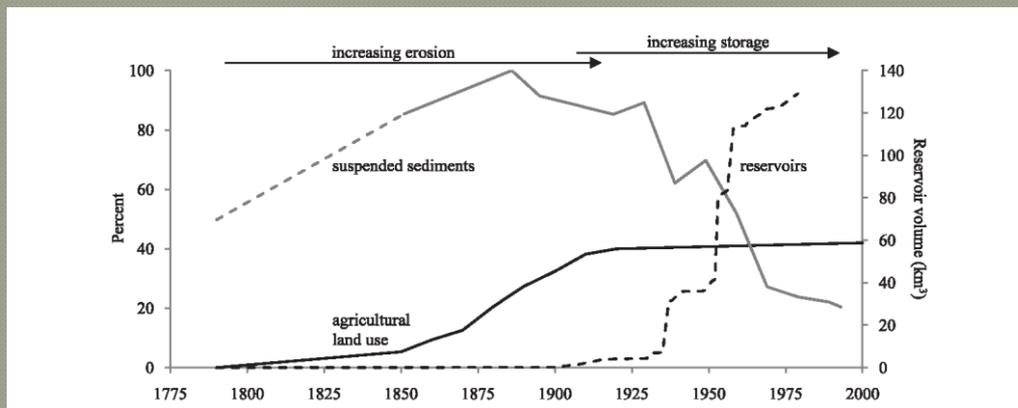
Why 1932?

- The plaintiffs and their supporters would say that oil exploration began in earnest in the 1930s.
- While that is true, the reason that the coastal wetlands loss begin with 1932 is that was the year when aerial photography of the coast began.
- The missing information is what happened before 1932.

Determining the Effect of Oil and Gas Production post 1932

This requires determining what other human factors have affected the delta since 1932 and the effect of longer term natural processes.

Why 1932 Might Be the Modern Sediment High Point



Anthropogenic Changes Since 1932

- Sediment in the river peaked in 1932, then declined due to modern farming practices and levees.
- Dams have been built, trapping sediment.
- Levees have been built, preventing upstream sediment from entering the river and downstream sediment from flooding the delta.

Long Term Natural Processes

The Mississippi Delta from the
Holocene to 1932

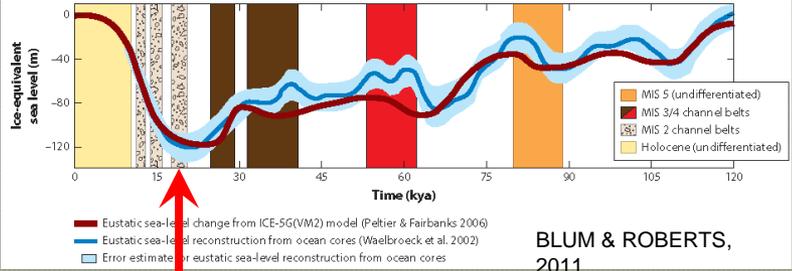
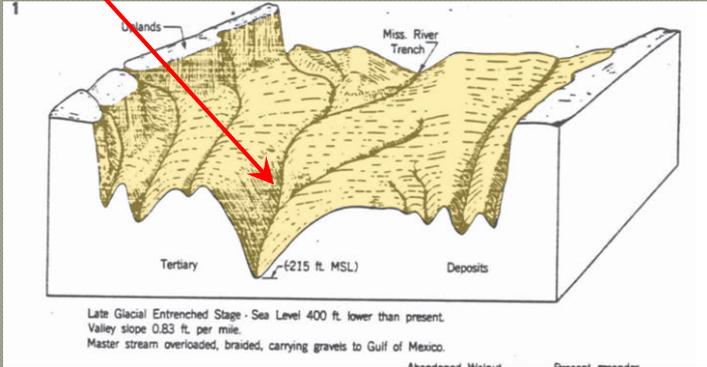
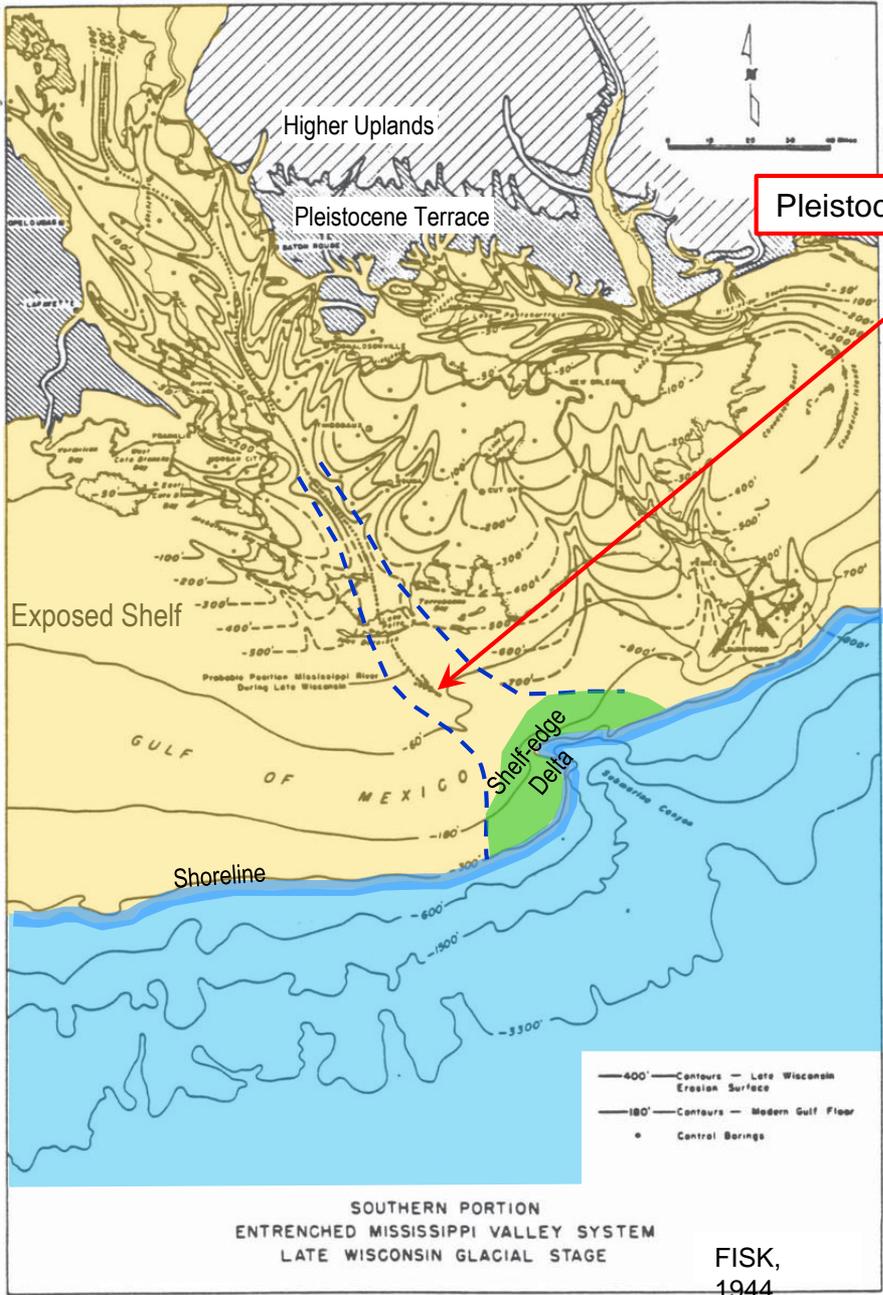
Why do Plaintiff's Claim the Wetlands Built over 6000 Years?

- This in the end of the Holocene, which began about 12,000 years ago.
- The glaciers were melting and sea level was rising until about 6,000 years ago.
- The modern Mississippi Delta started 6,000 years ago.

What was here before the Modern Delta?

- The ice cap from the last ice age was at the maximum about 20-25,000 years ago.
- So much water was tied up in the ice that the sea level was about 120 meters (nearly 400 feet) lower than today.
- The Mississippi River was more than 100 miles out into the Gulf of Mexico, in a huge canyon.
- What is seen as the delta did not exist.

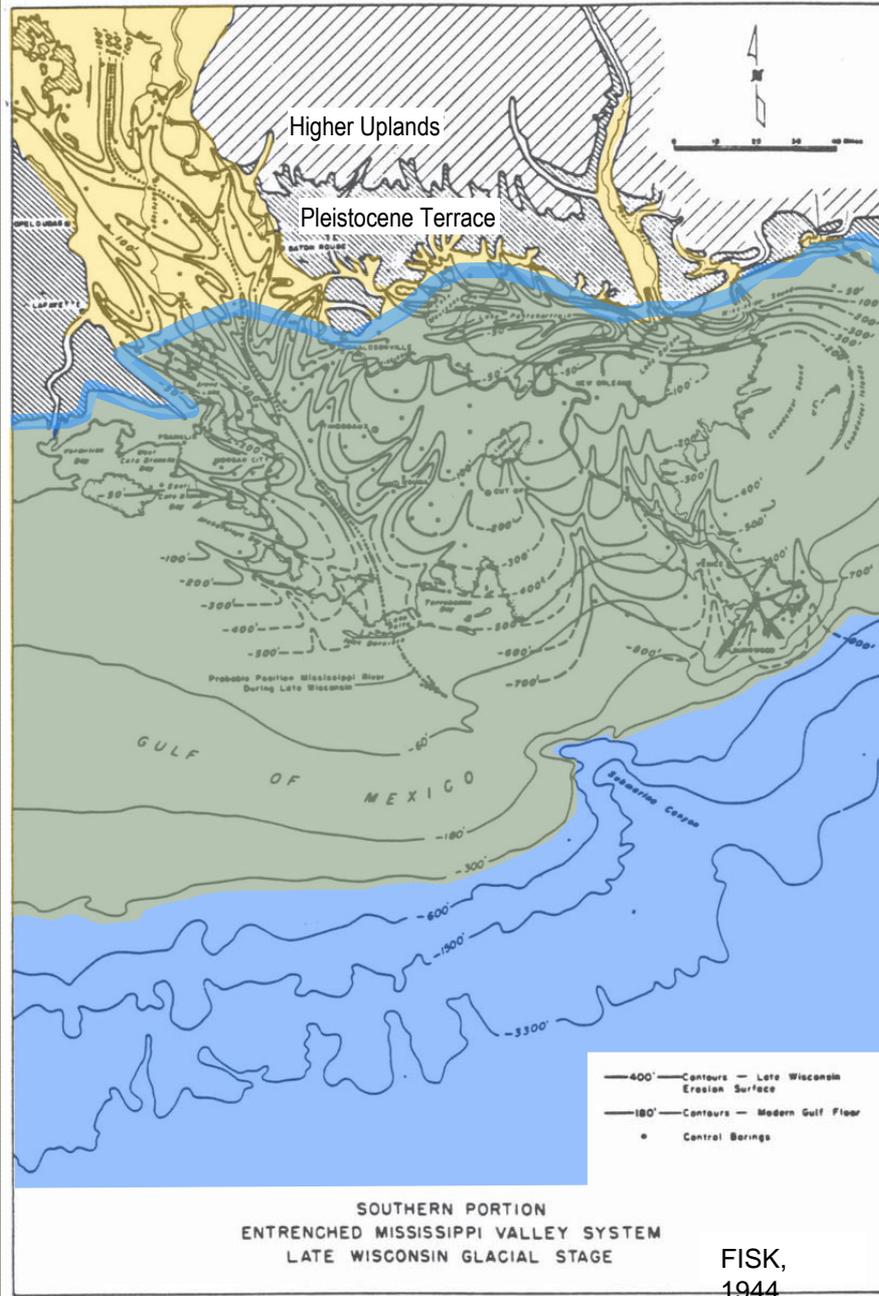
Exposed Continental Shelf During the last Ice Age



What Happened When the Ice Melted?

- The Mississippi was a flooding torrent for thousands of years and carried much more sediment at that time than since.
- Despite this mountain of sediment, coastal edge – what we call the delta today – retreated inland more than 100 miles.
- Lesson for sea level rise from climate change: sea level rise trumps sediment.

Rising Sea Level as Ice Cap Melted



Braided stream aggradation

Holocene delta deposits

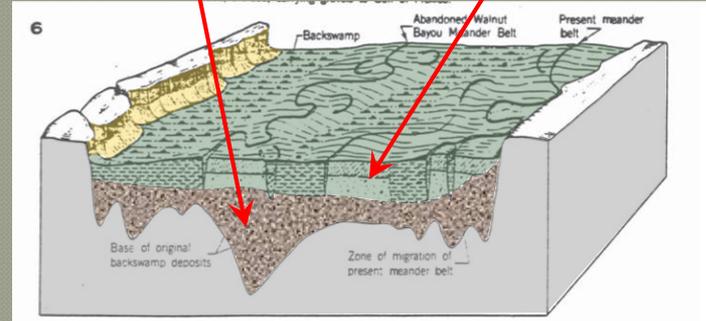
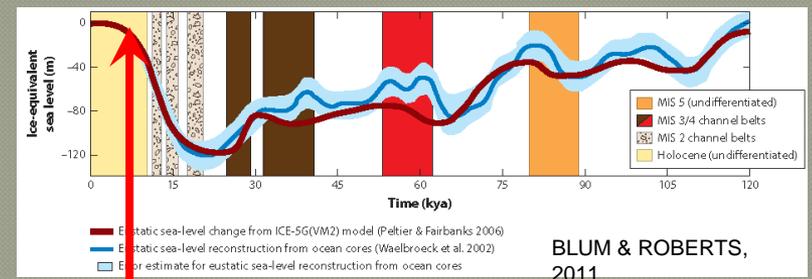


Figure 2.4. Schematic diagrams of the Mississippi River Valley fill. After Fisk (1947).



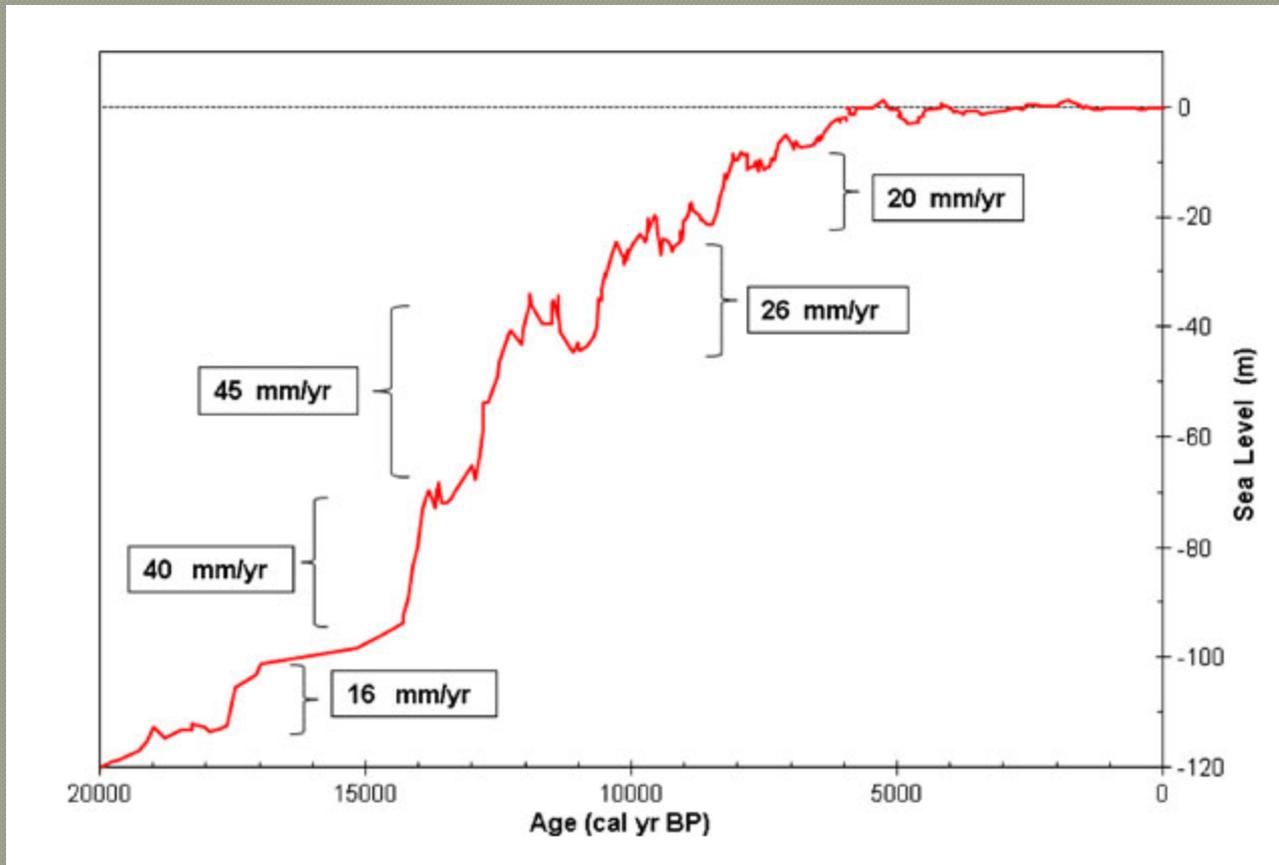
Building the Modern Delta

All of the modern river deltas started to build when sea level stabilized about 6,000 years ago.

As long as sea level was rising at a significant rate, the coast line retreats inland because the river cannot build a delta uphill.

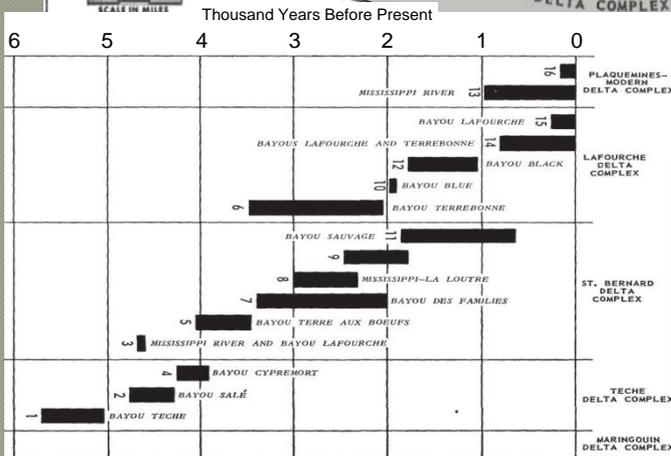
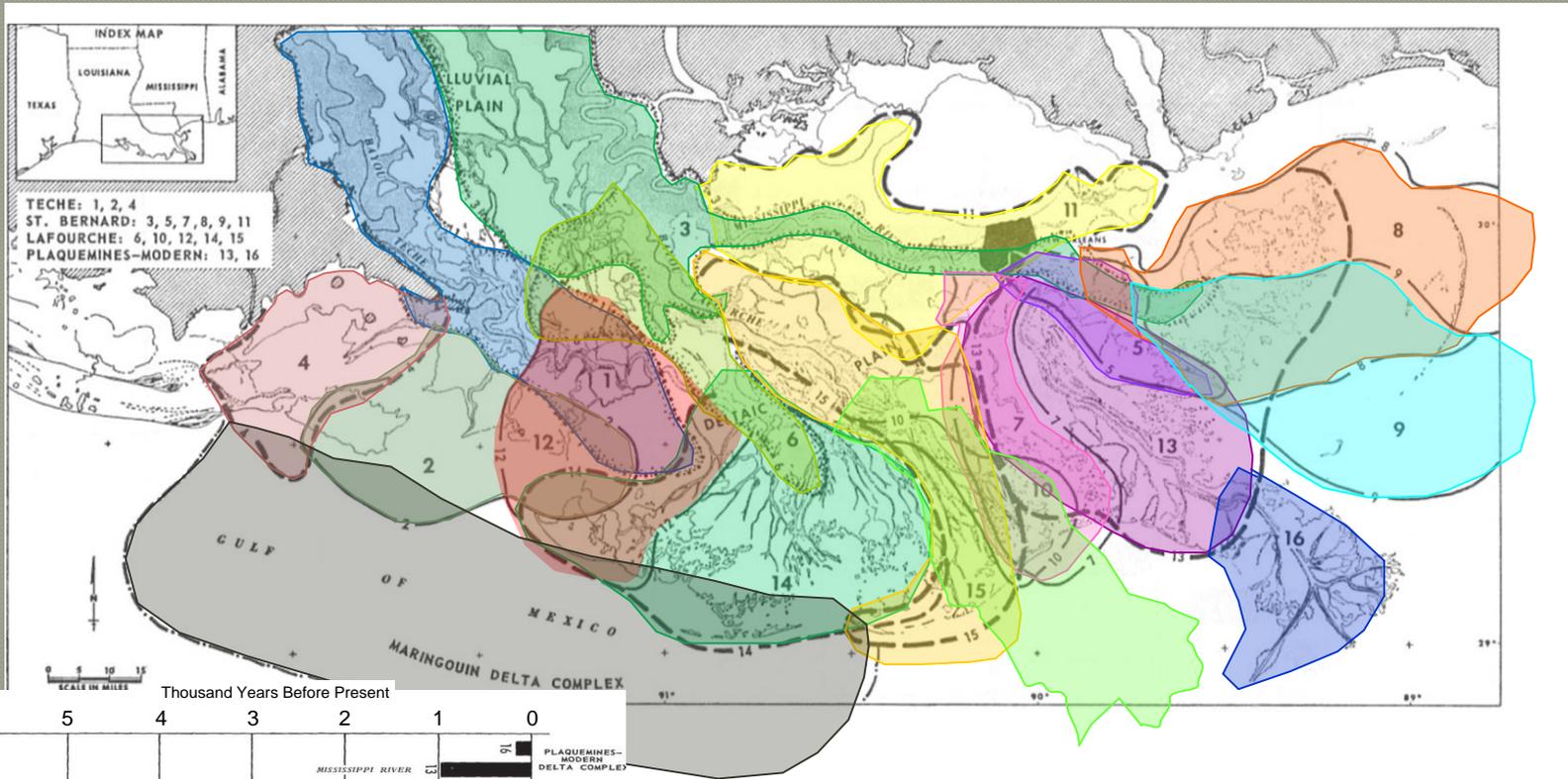
Post-Glacial Maximum Sea Level

Donoghue, Joseph F. "Sea Level History of the Northern Gulf of Mexico Coast and Sea Level Rise Scenarios for the near Future." *Climatic Change* 107, no. 1–2 (2011): 17–33.

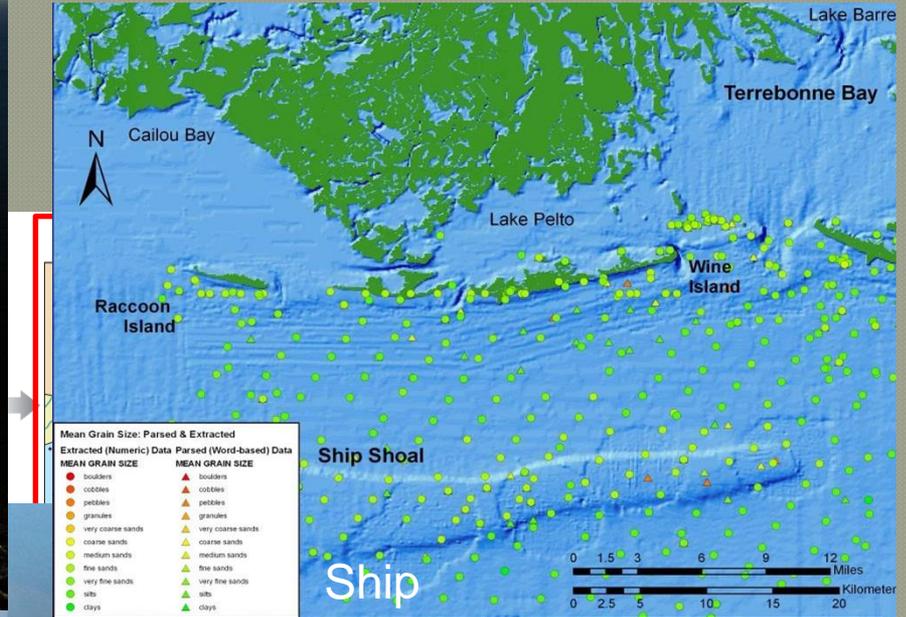


Recent Deltatic Deposits of the Mississippi River:

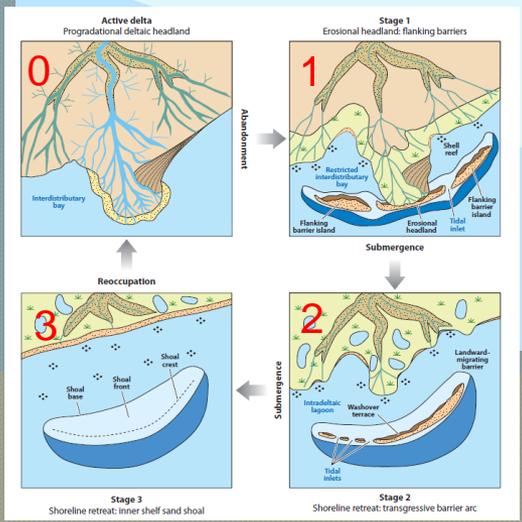
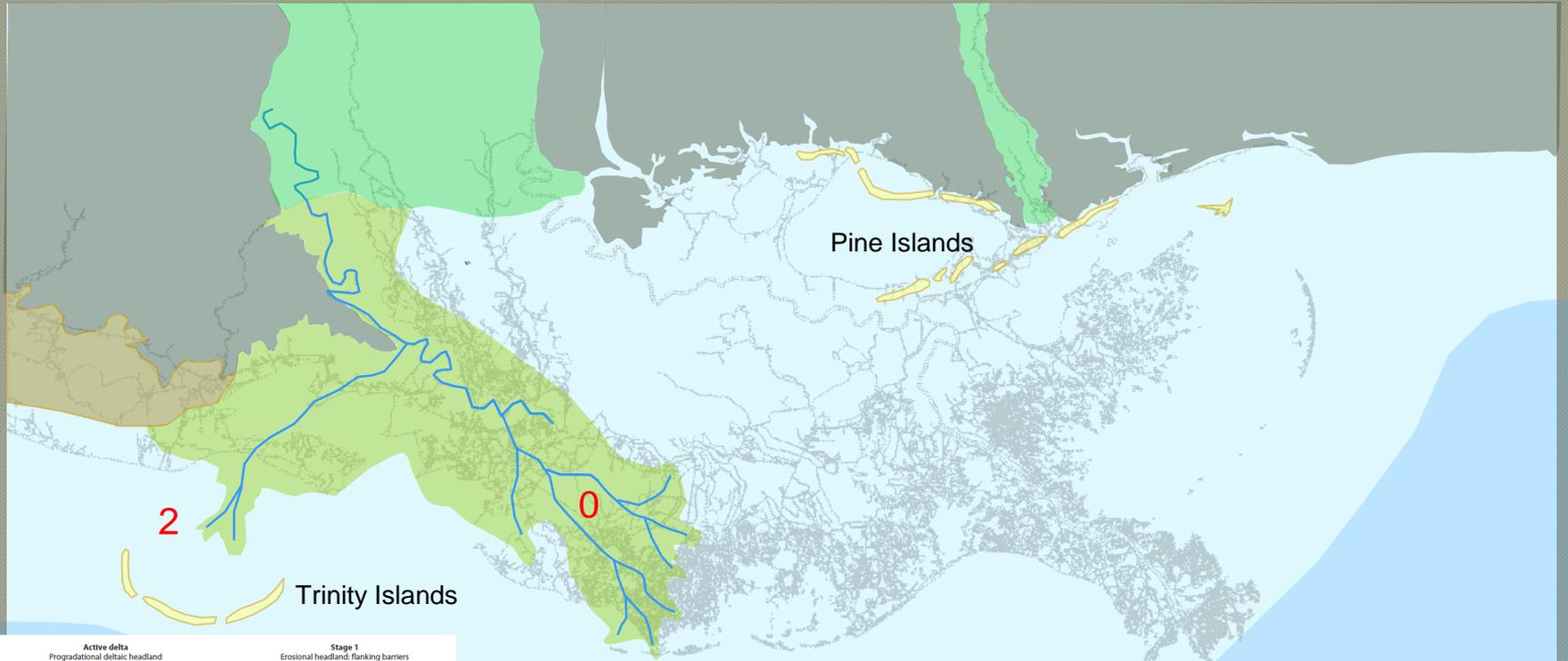
Their development and chronology – David E. Frazier, 1967



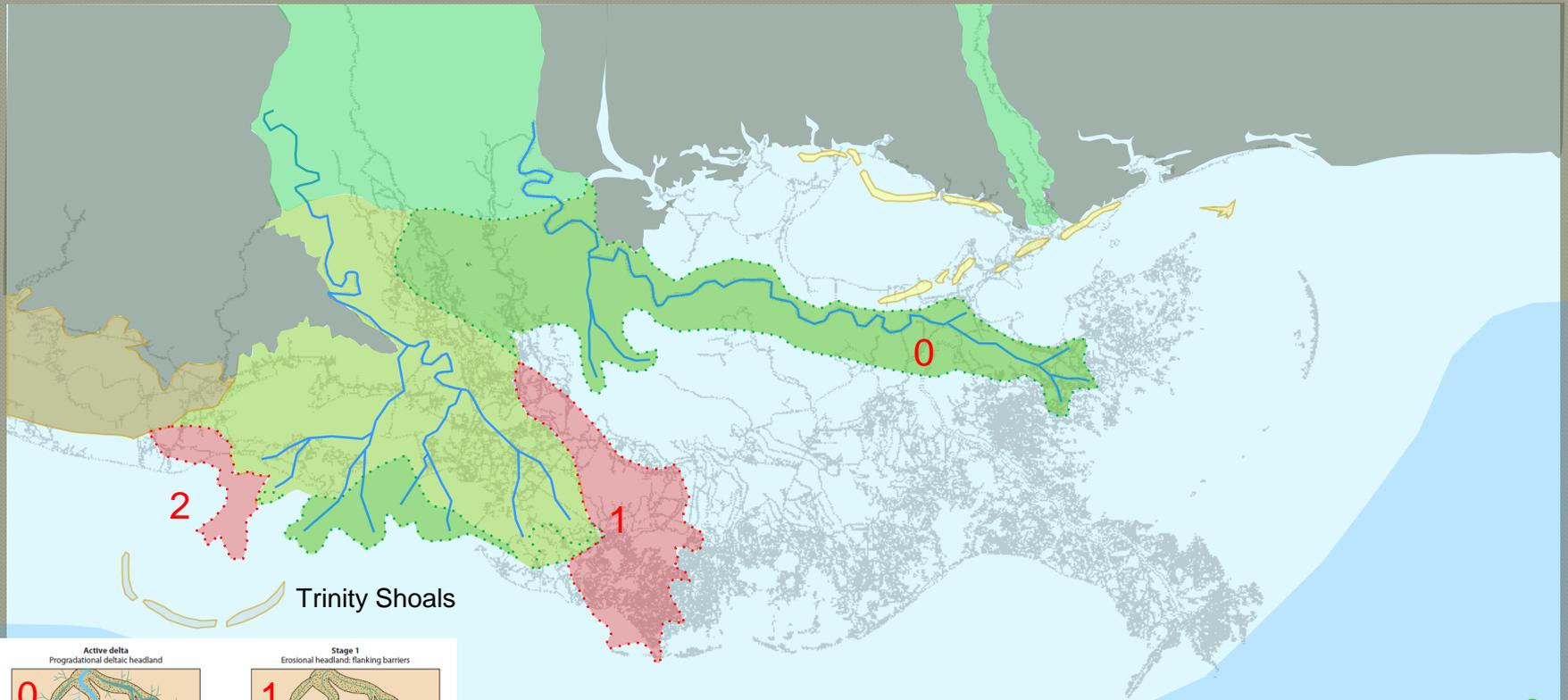
The Delta Cycle



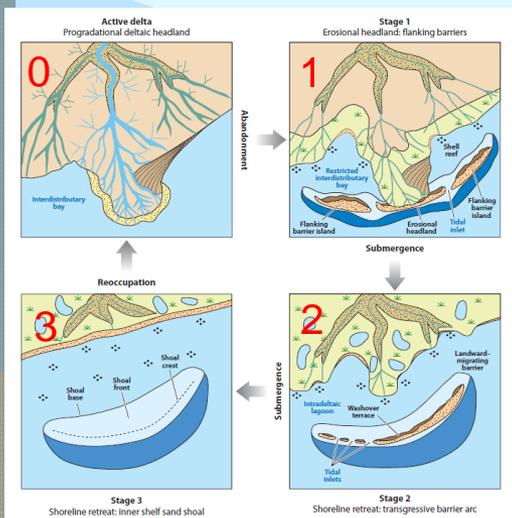
5,500
years before present



4,500
years before present

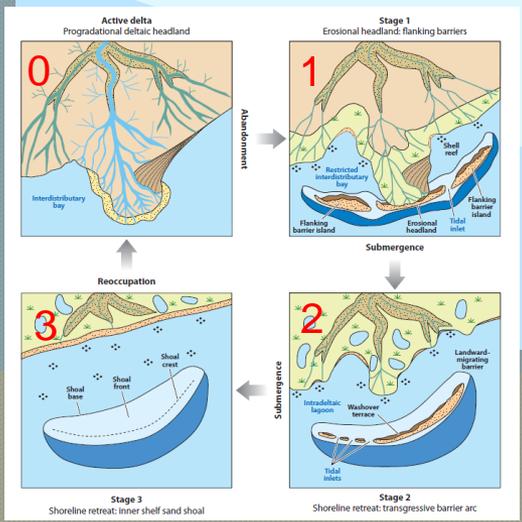
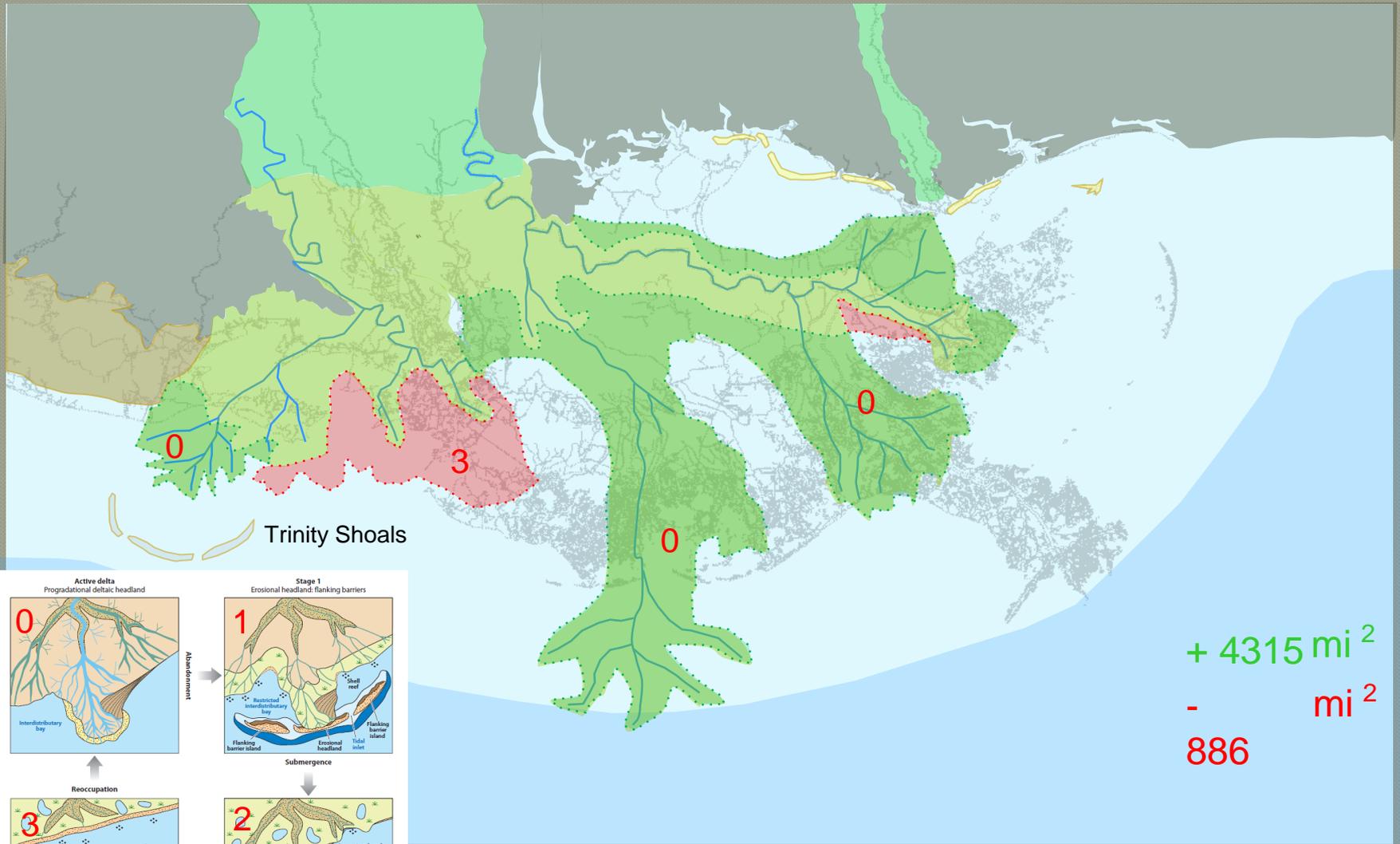


Trinity Shoals



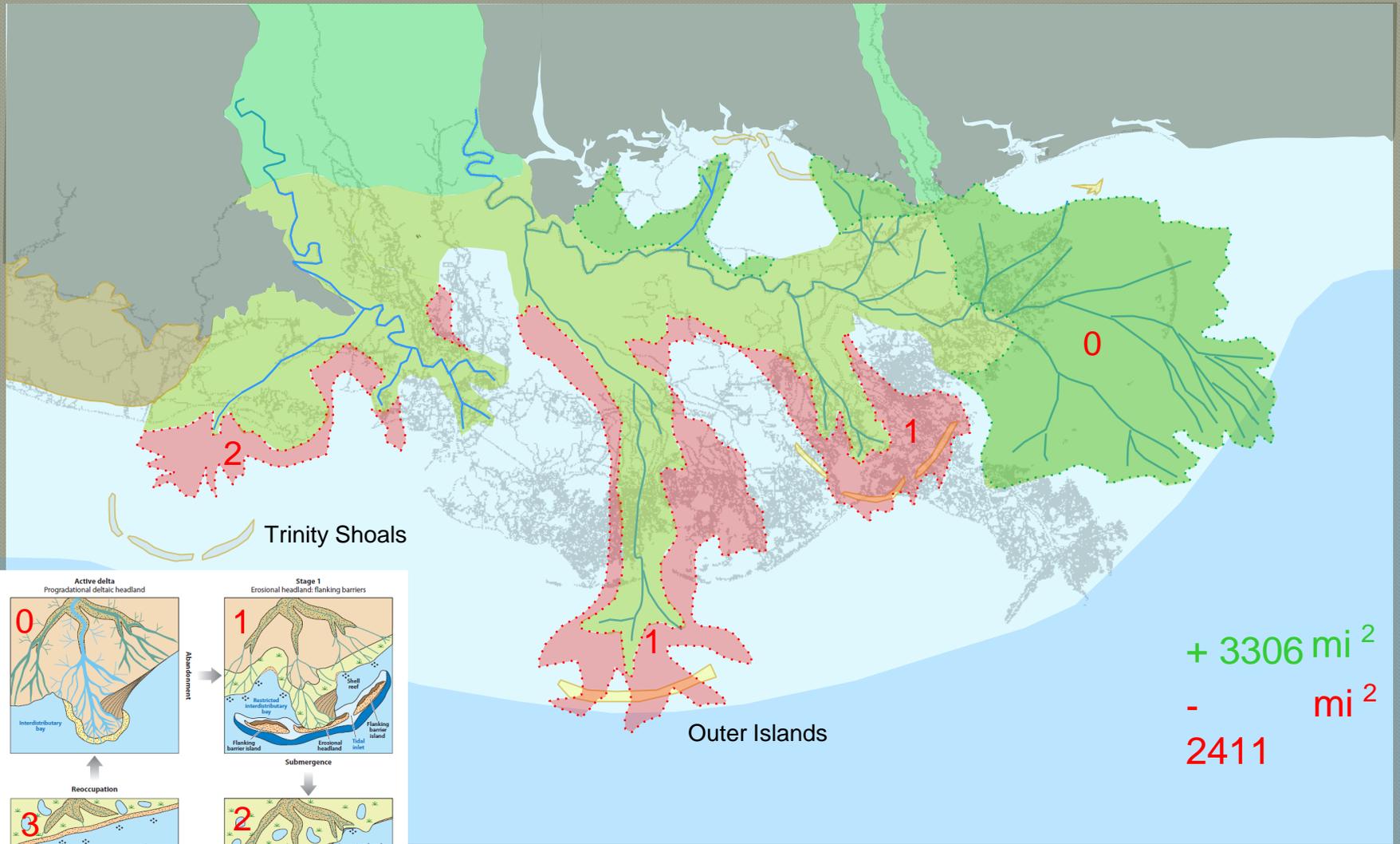
+ 2095 mi²
- 892 mi²

3,500
years before present

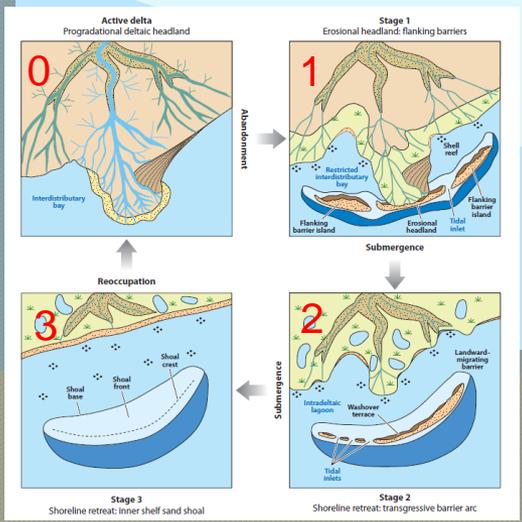


+ 4315 mi²
- 886 mi²

2,500
years before present



+ 3306 mi²
- 2411 mi²



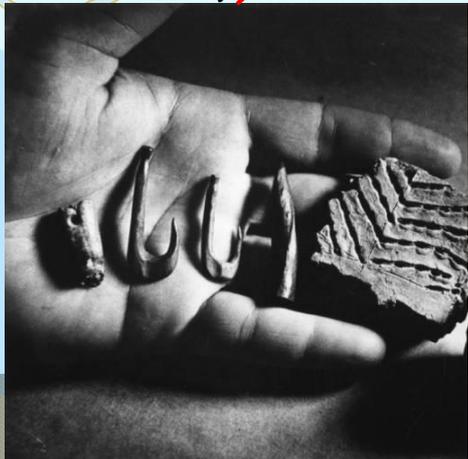
2,500
years before present

Bayou Jasmine Archeological Site
Twinned bag ca. 800 BC



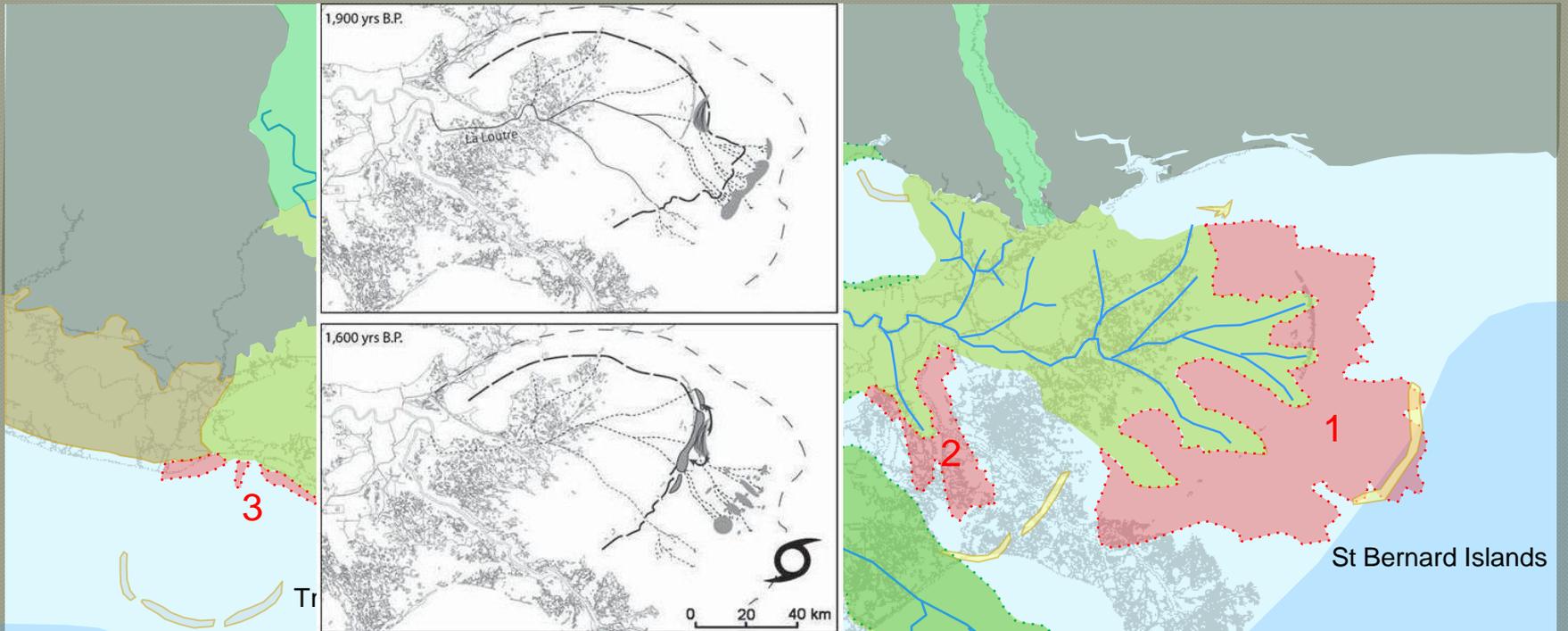
LSU TEXTILE
MUSEUM

Trinity Shoals



+ 3306 mi²
- 2411 mi²

1,500
years before present

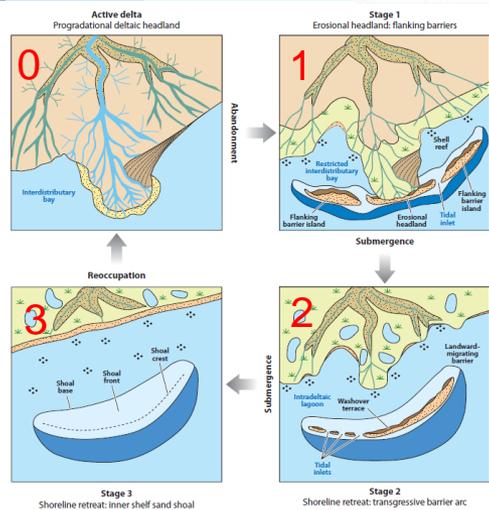


St Bernard Islands

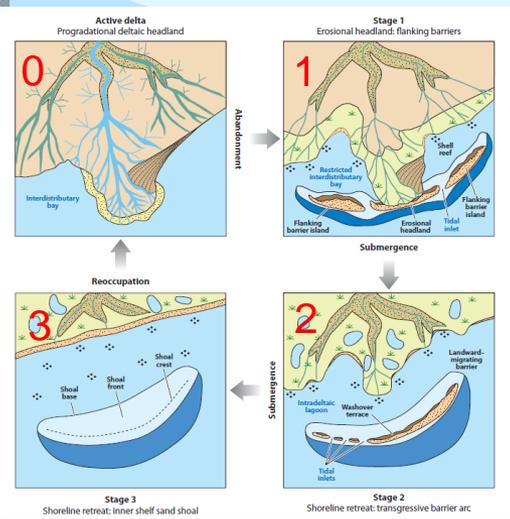
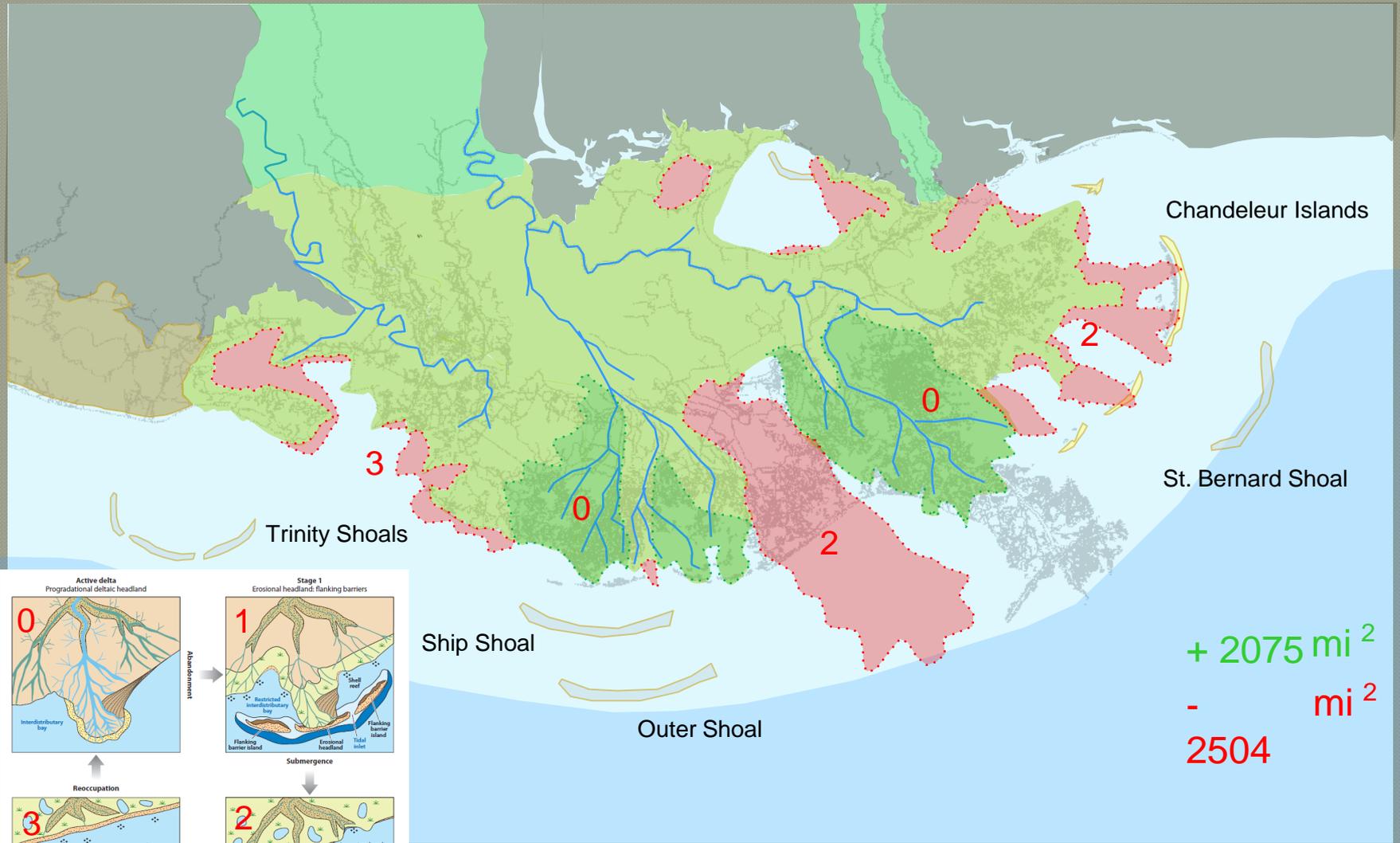
Ship Islands

Outer Shoal

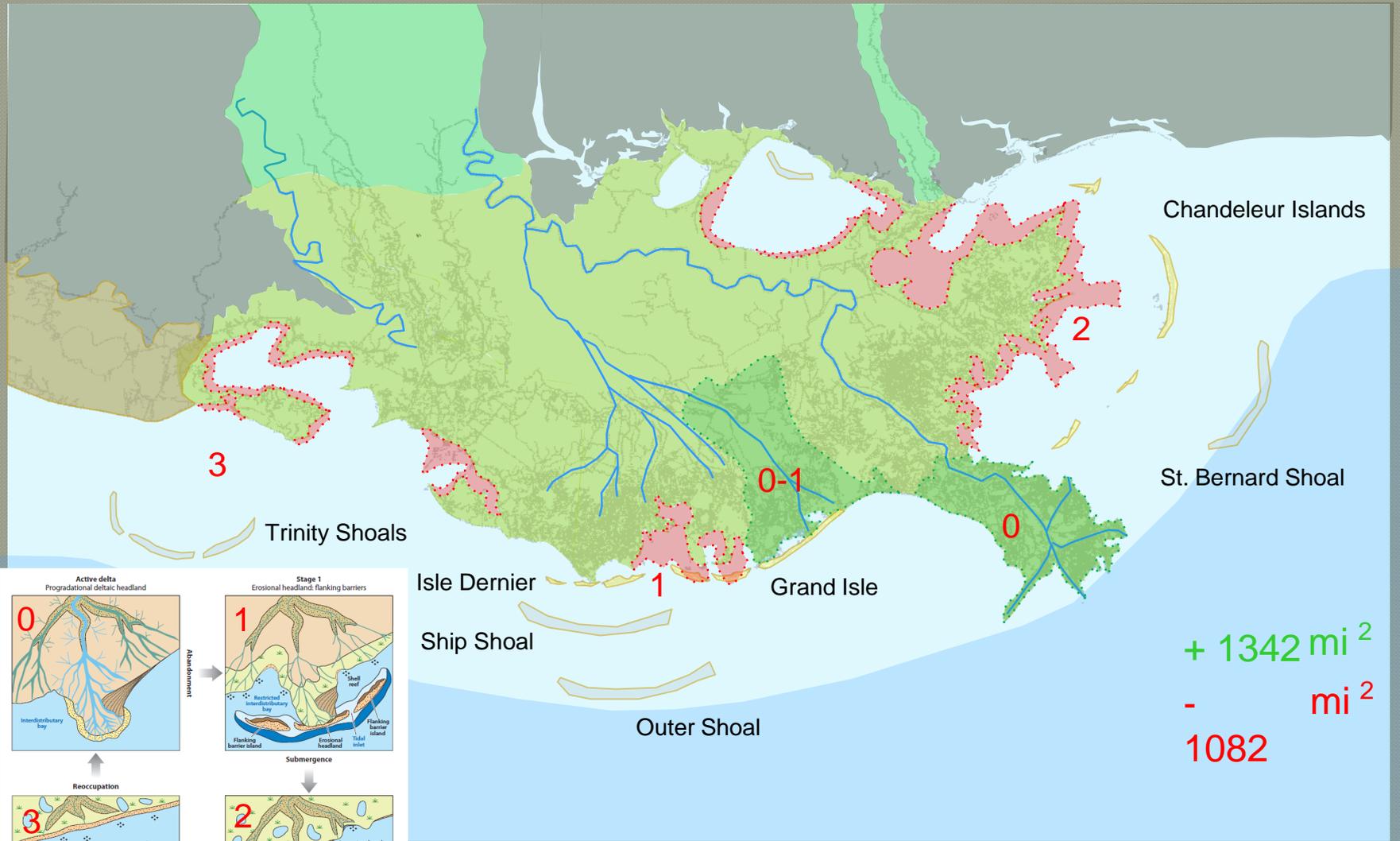
+ 3657 mi²
- 2349 mi²



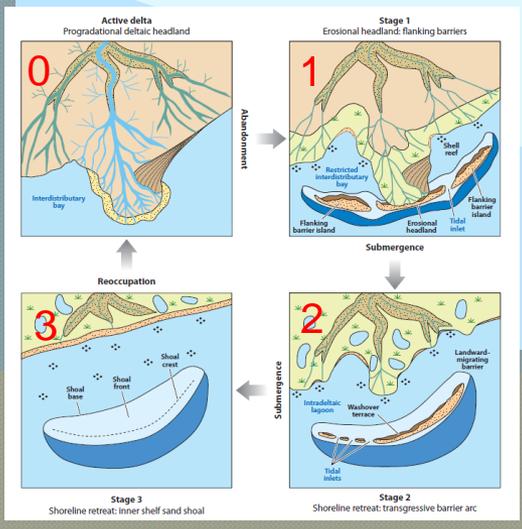
500
years before present



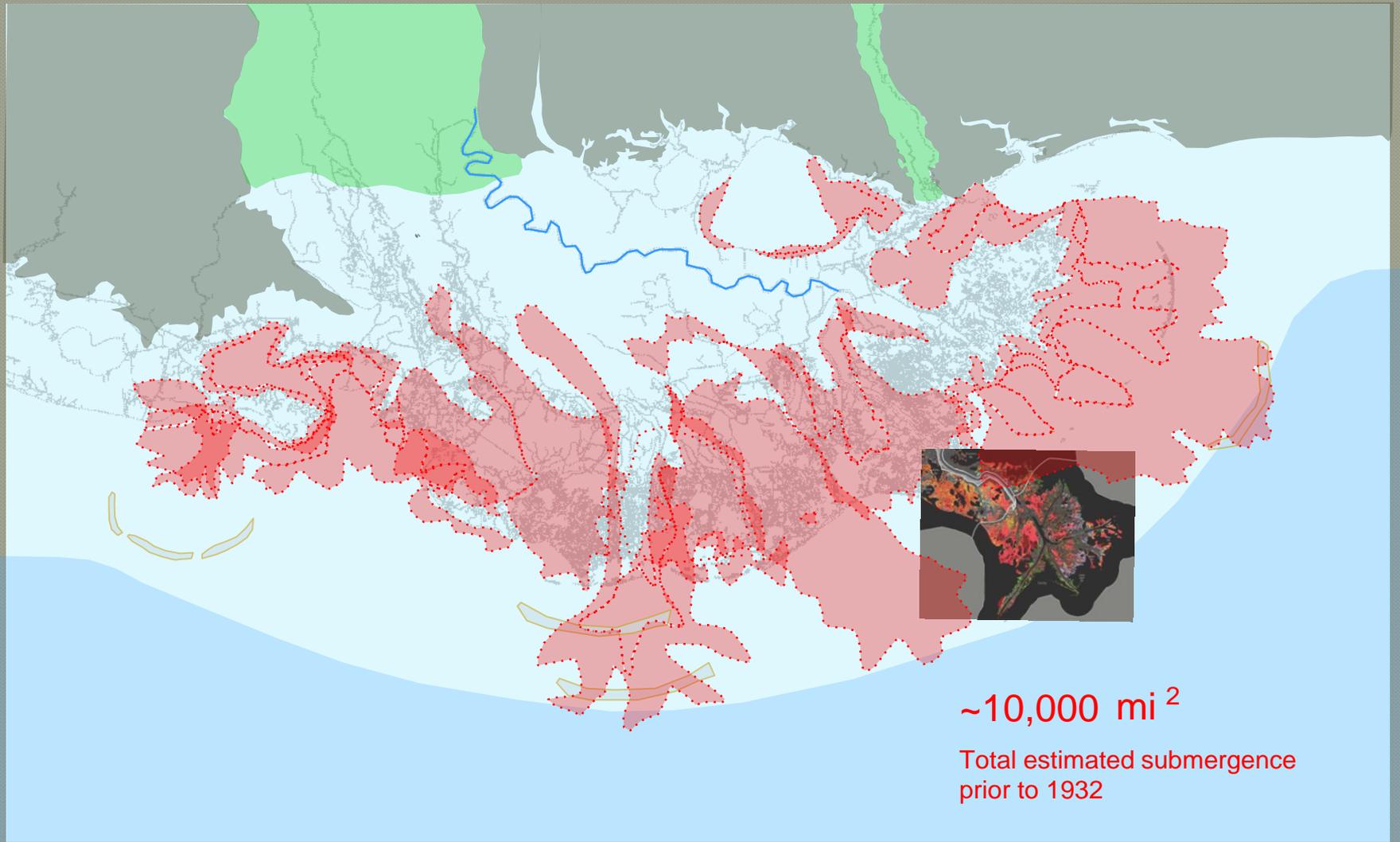
+ 2075 mi²
- 2504 mi²



+ 1342 mi²
 - 1082 mi²

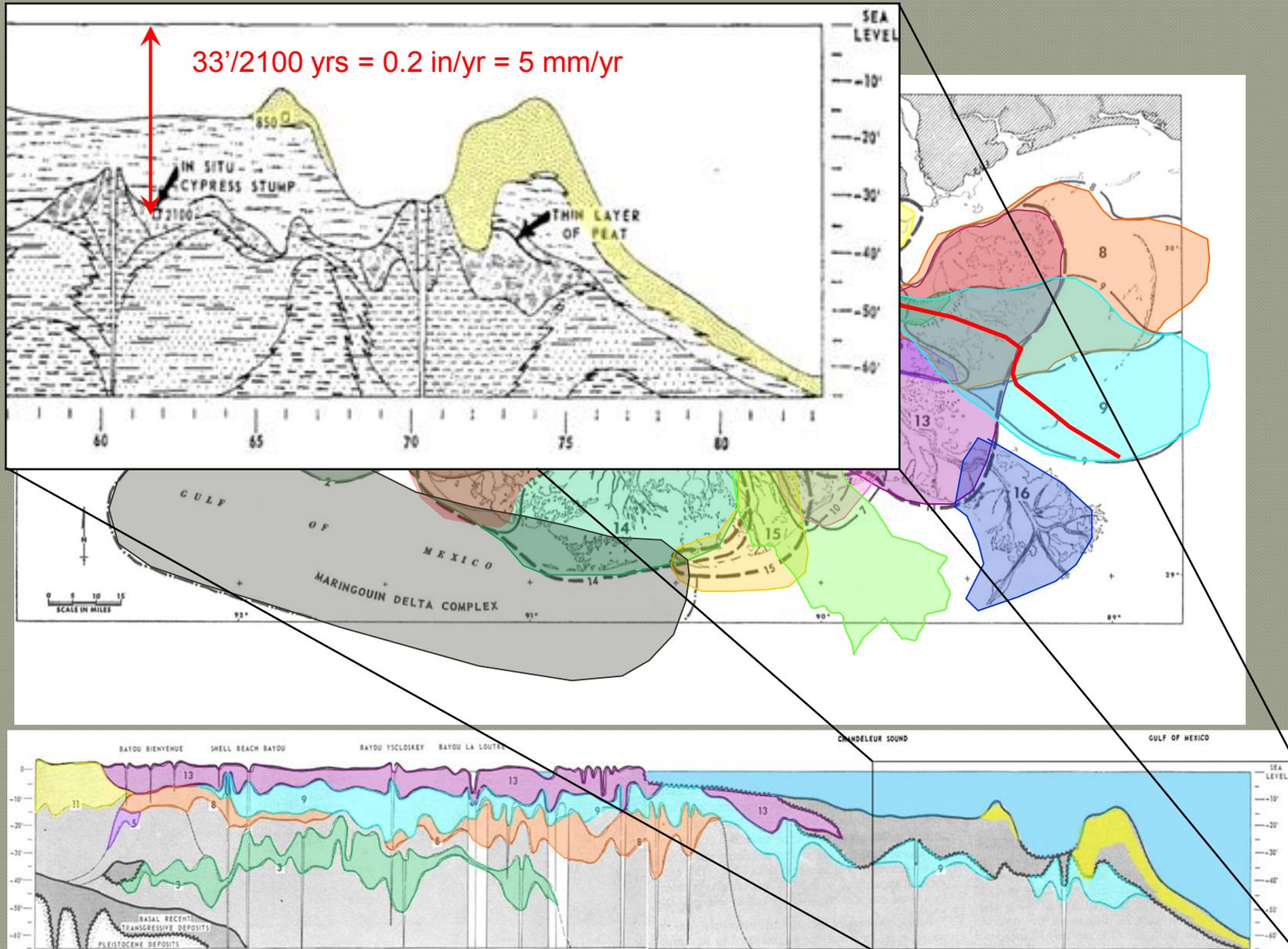


Land Lost before 1932



This land was lost without human intervention

Subsidence and the Delta Cycle



Subsidence Today

- The historic sediment load on the delta causes the subsidence that creates the space for the river to deposit the new sediment – the accommodation space.
- As we have seen, when the river is not putting sediment in an abandoned part of the delta, the subsidence continues and the abandoned lobe sinks below the water.
- This subsidence is drowning the coast.

stable

Subsidence and the Sediment Load

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

Stars
0 inch/yr

uplift

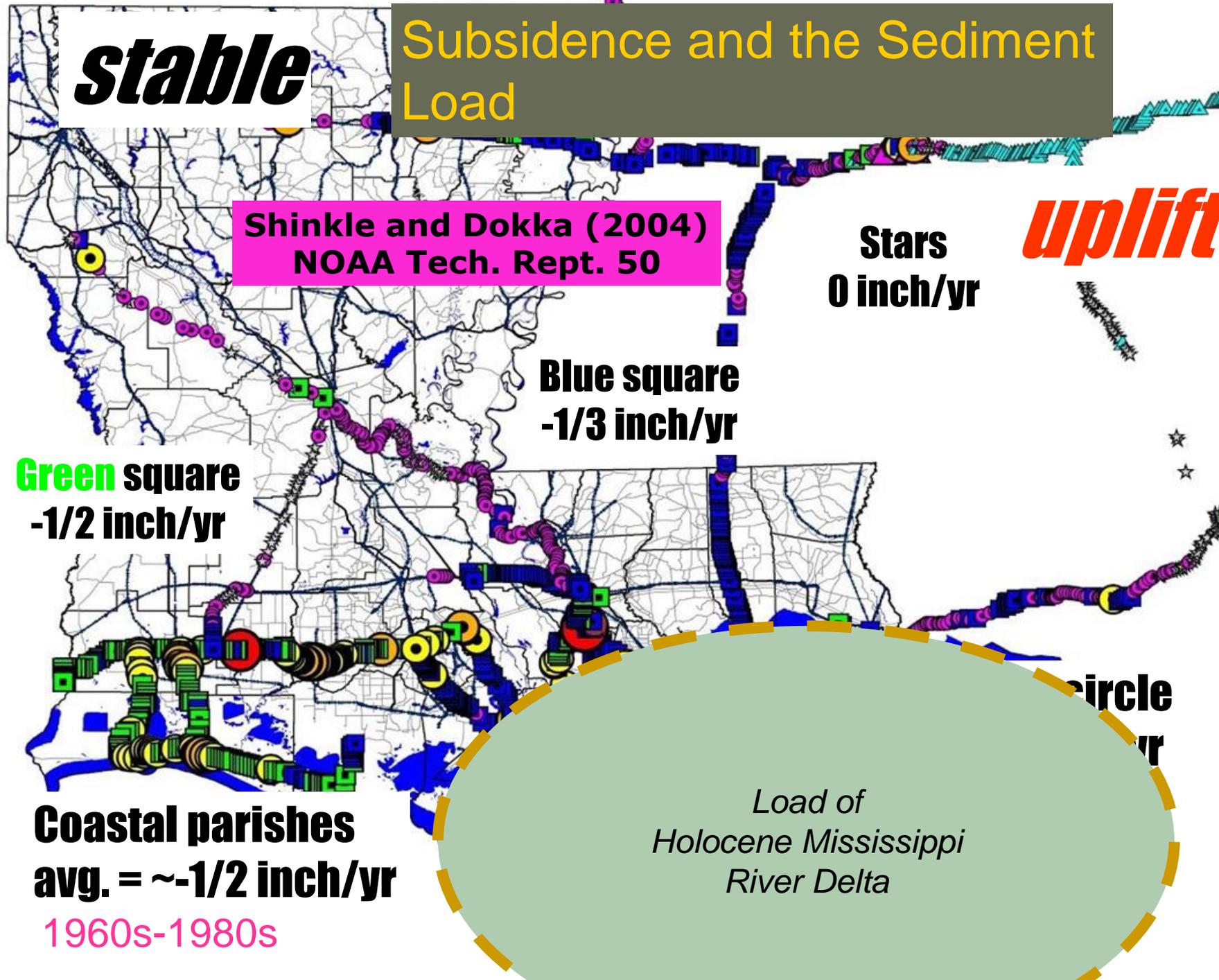
Blue square
-1/3 inch/yr

Green square
-1/2 inch/yr

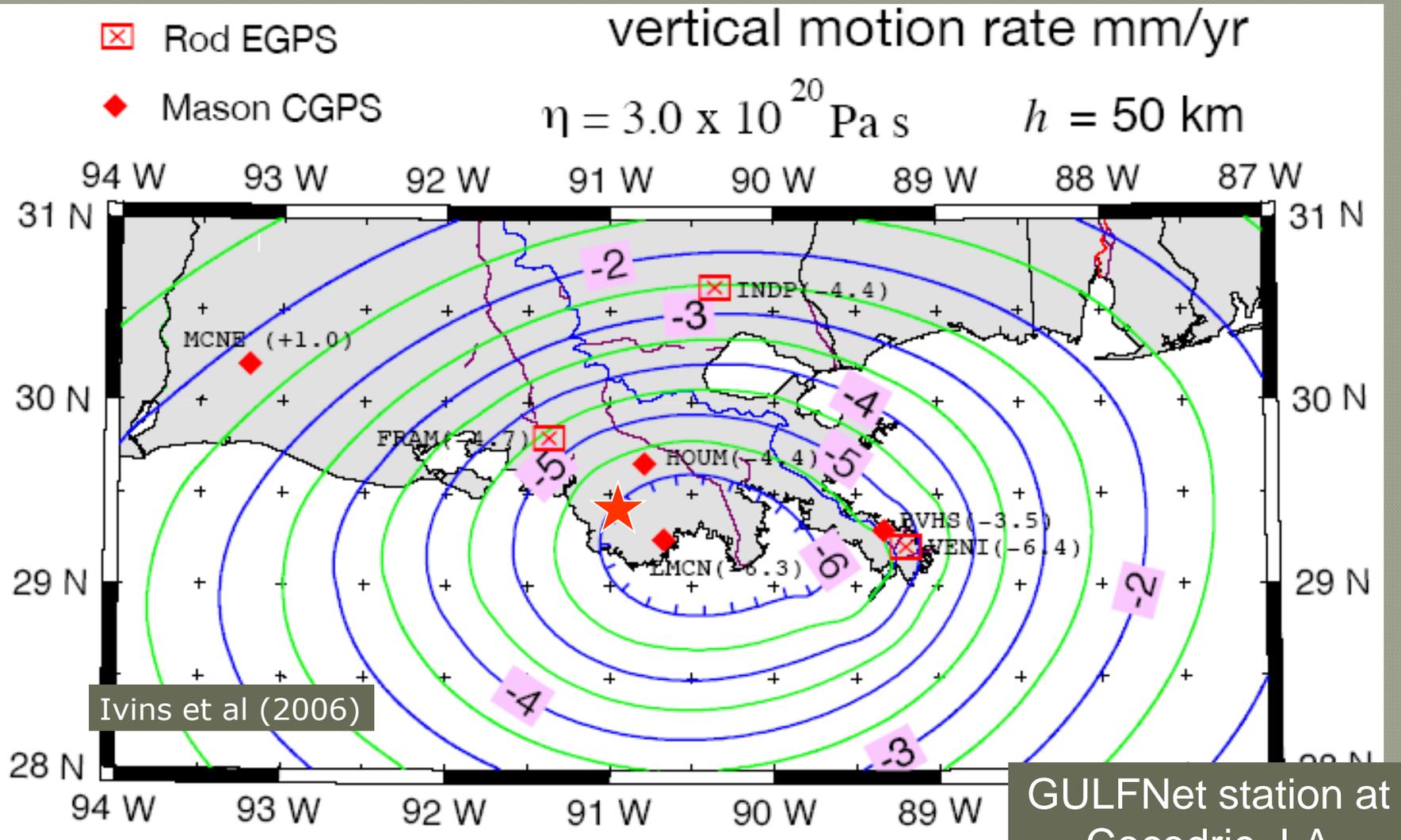
Coastal parishes
avg. = ~-1/2 inch/yr

1960s-1980s

Load of
Holocene Mississippi
River Delta

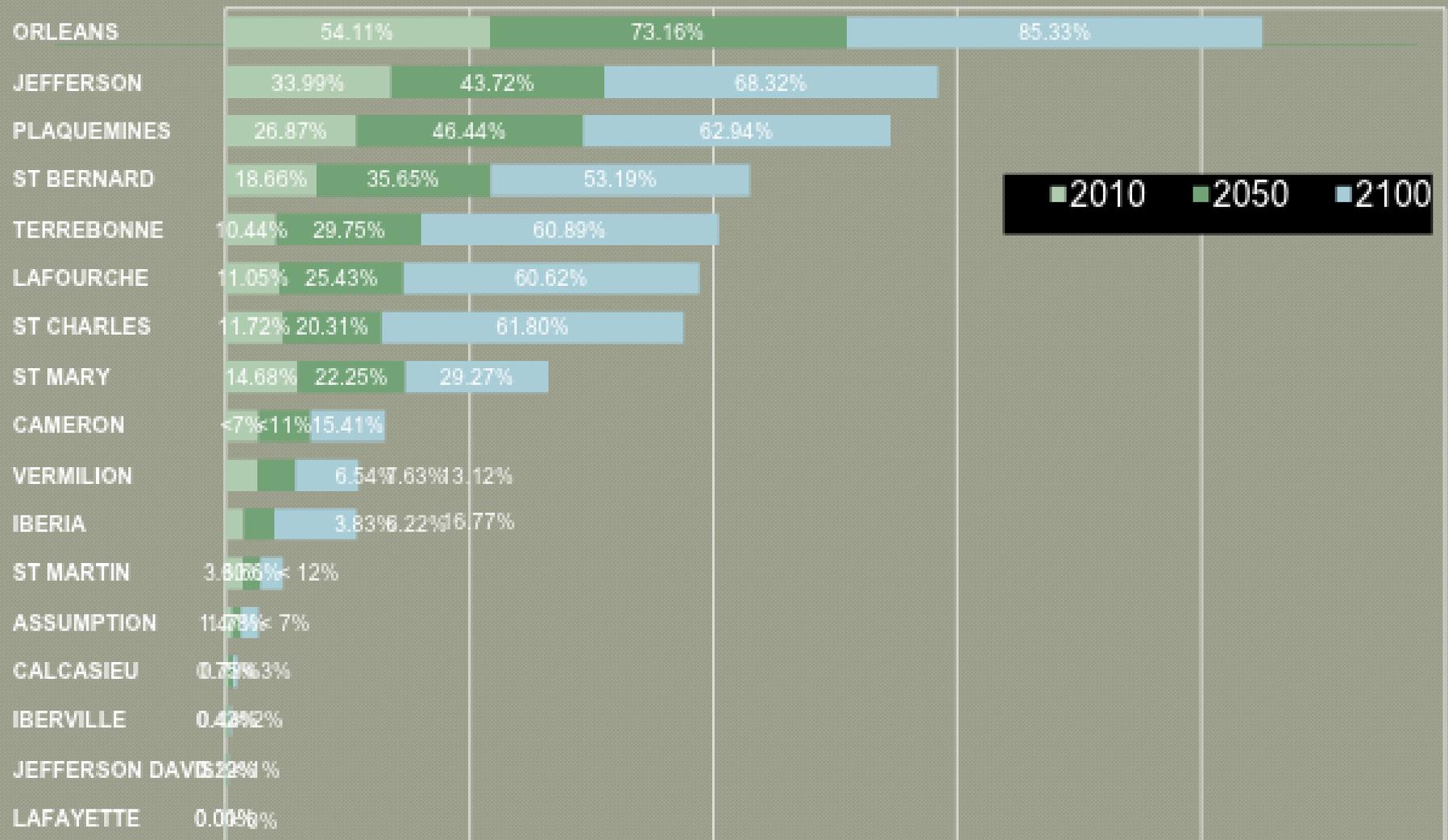


Predicted present-day vertical motions in mm/yr from delta & ocean loads



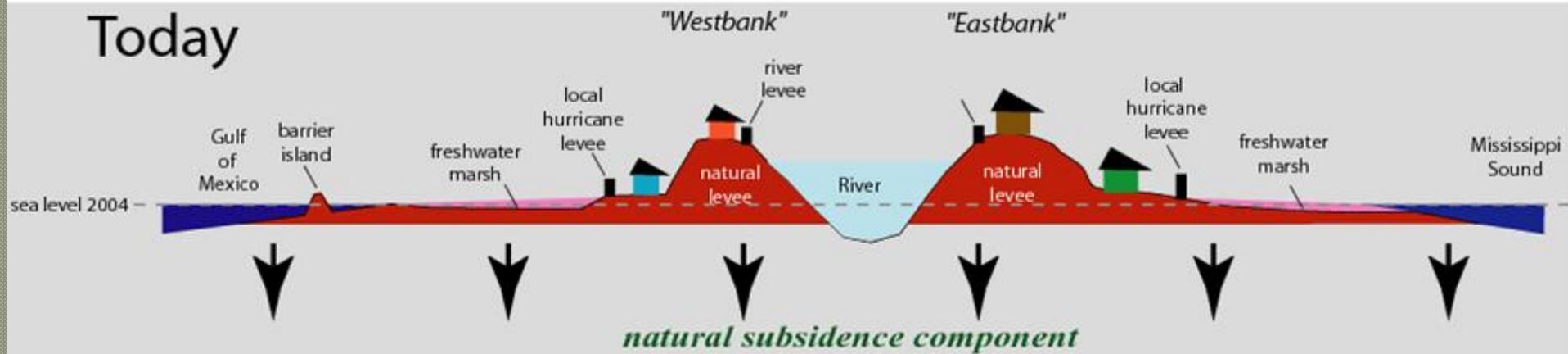
GULFNet station at
Cocodrie, LA
→sinking 6.3 mm/yr

Percent Land Below Sea Level by Parish Through 2100 (assuming no increase in sea level rise)

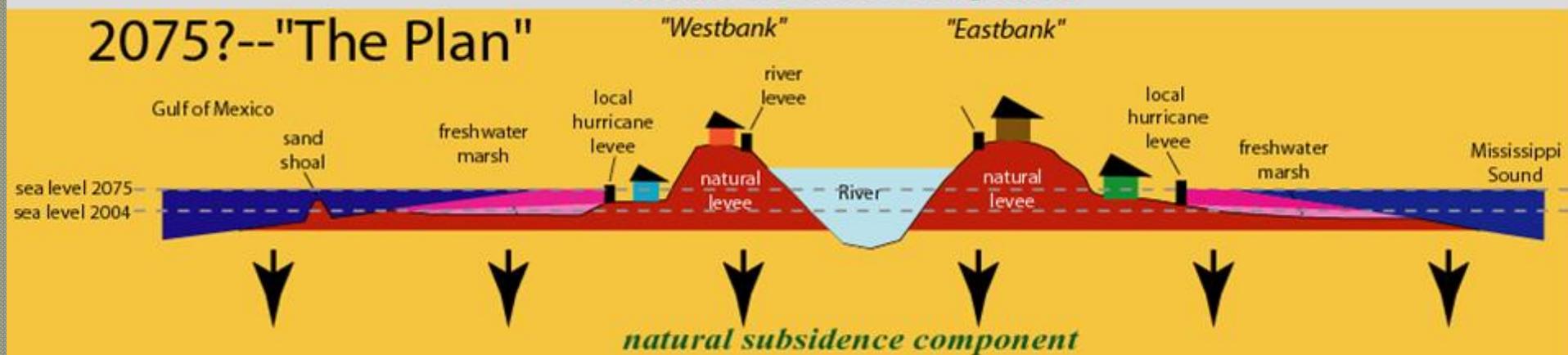


Current plans to save the Coast are focused on fixing the wetlands

Today



2075?--"The Plan"



Even if the wetlands could be restored, the coastal communities will continue to sink below sea level. Storms will ultimately make these communities uninhabitable.

Development of the Coastal Erosion Model

The Standard Accepted Model for Land
Loss on which the Lawsuit is Based is
fundamentally flawed

Causes of Wetland Loss in the Coastal Central Gulf of Mexico

Volume II: Technical Narrative

OCS Study
MMS 87-0120

Two Foundational Studies

Edited by

R. Eugene Turner
Donald R. Cahoon

Coastal Ecology Institute
Center for Wetland Resources
Louisiana State University

Published by

Minerals Management Service
New Orleans, Louisiana

“Total canal area is estimated to be 10% of the Louisiana coastal region in 1978 and directly accounts for approximately 6.3% of the total wetlands loss from circa 1955 to 1978. However a strong **statistical relationship** exists between canal density and total wetlands loss indicates that the indirect impacts of canals account for a substantially larger percentage of total wetlands loss.”

Page 56

Prepared under MMS Contract 14-12-0001-30252

Process Classification of Coastal Land Loss 1932 – 1990

Penland, et. al., 1990

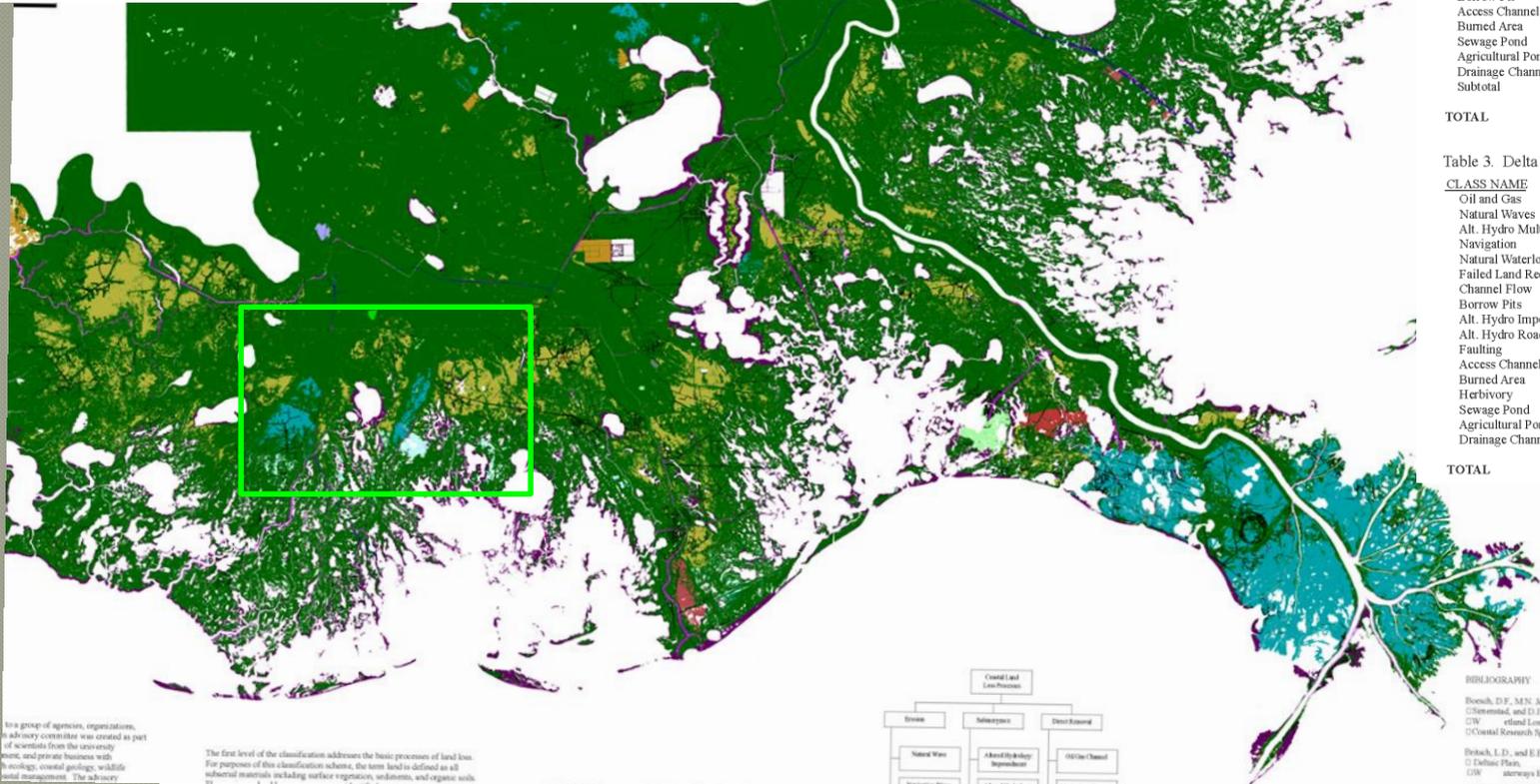
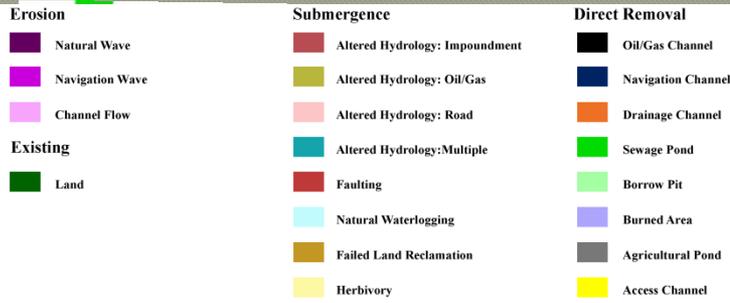


Table 2. Coastal Land Process- Delta Plain

CLASS NAME	ACREAGE	PERCENT
EROSION		
Natural Wave	181,090	26.21%
Navigation Wave	21,821	3.16%
Channel Flow	10,369	1.50%
Subtotal	213,280	30.87%
SUBMERGENCE		
Alt. Hydro Oil/Gas	172,174	24.92%
Alt. Hydro Multiple	148,666	21.52%
Natural Waterlogging	21,069	3.05%
Failed Land Reclamation	16,403	2.37%
Alt. Hydro Impoundment	7,992	1.16%
Alt. Hydro Roads	4,825	0.70%
Faulting	3,921	0.57%
Herbivory	561	0.08%
Subtotal	375,612	54.36%
DIRECT REMOVAL		
Oil/Gas Channel	76,978	11.14%
Navigation Channel	11,293	1.63%
Borrow Pit	11,130	1.61%
Access Channel	1,312	0.19%
Burned Area	729	0.11%
Sewage Pond	308	0.04%
Agricultural Pond	179	0.03%
Drainage Channel	109	0.02%
Subtotal	102,039	14.77%
TOTAL	690,931	100.00%

Table 3. Delta Plain Coastal Land Loss Ranking

CLASS NAME	ACREAGE	PERCENT
Oil and Gas	249,152	36.06%
Natural Waves	181,090	26.21%
Alt. Hydro Multiple	147,442	21.34%
Navigation	33,114	4.79%
Natural Waterlogging	21,069	3.05%
Failed Land Reclamation	16,403	2.37%
Channel Flow	15,668	2.27%
Borrow Pits	11,130	1.61%
Alt. Hydro Impoundment	7,992	1.16%
Alt. Hydro Road	4,825	0.70%
Faulting	3,921	0.57%
Access Channel	1,312	0.19%
Burned Area	729	0.11%
Herbivory	561	0.08%
Sewage Pond	308	0.04%
Agricultural Pond	179	0.03%
Drainage Channel	109	0.02%
TOTAL	690,931	100.00%

to a group of agencies, organizations, and advisory committee was created as part of scientists from the university, and private business with geology, coastal geology, wildlife and management. The advisory

The first level of the classification addresses the basic processes of land loss. For purposes of this classification scheme, the term land is defined as all natural materials including surface vegetation, sediments, and organic with

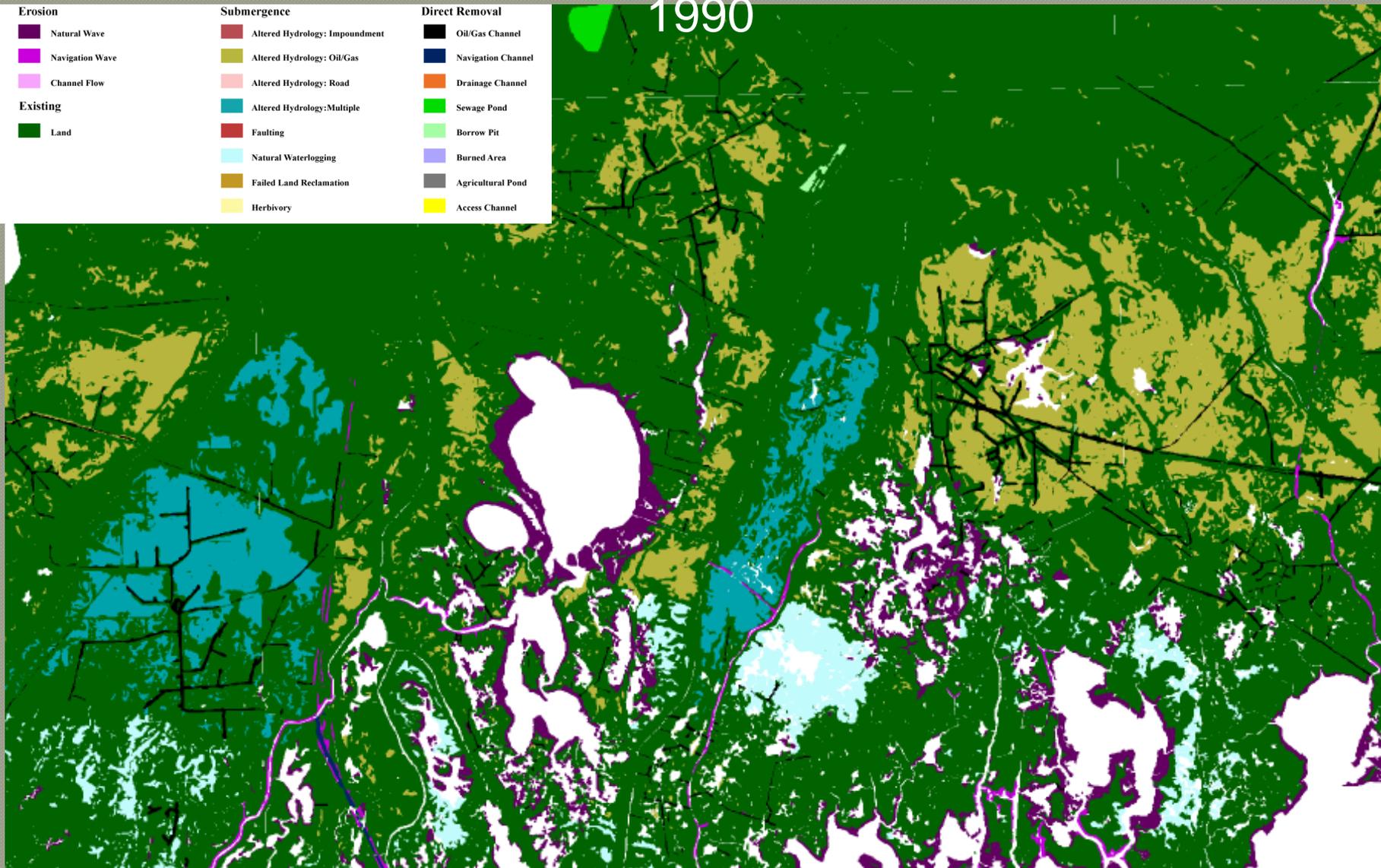


BIBLIOGRAPHY

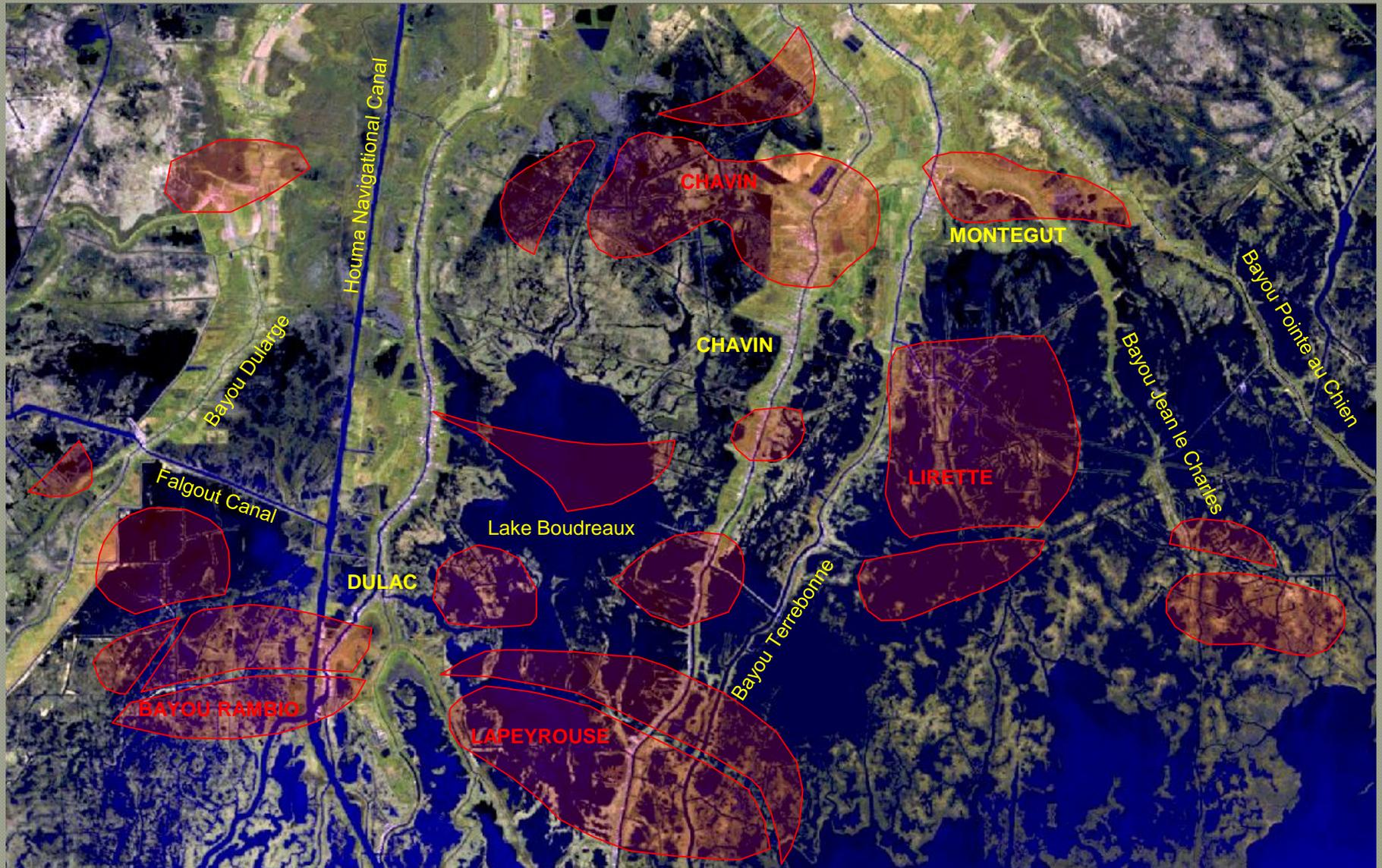
- Dowdy, D.F., M.N. Jewell, A.J. Miller, J.T. Morris, W.K. Nuttle, C.A. Chatterfield, and D.J.P. Swell. 1984. Scientific Assessment of Coastal Wetland Loss, Restoration and Management in Louisiana. *Journal of Coastal Research Special Issue No. 20*, 103 p.
- Britsch, L.D., and E.H. Kemp. 1990. Land Loss Rates, Mississippi River Deltaic Plain. Technical Report GL-90-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 23 p.
- Britsch, L.D., and J.R. Dunbar. 1993. Land Loss Rates, Louisiana Coastal Wetlands. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 23 p.

Penland's Coastal Land Loss 1932 – 1990

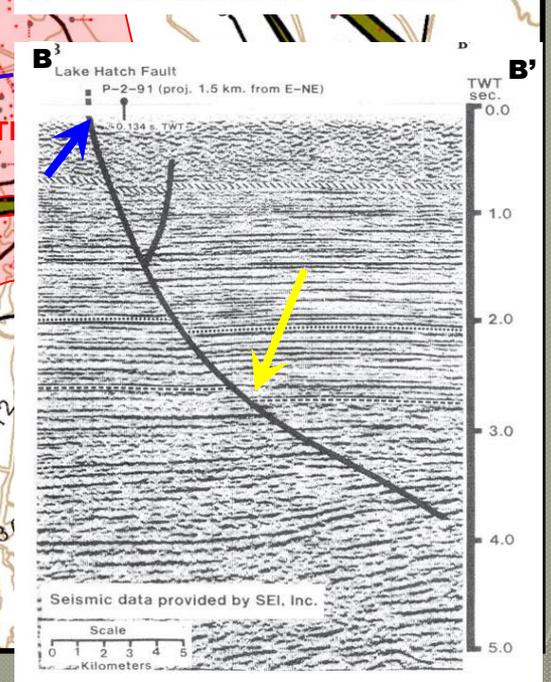
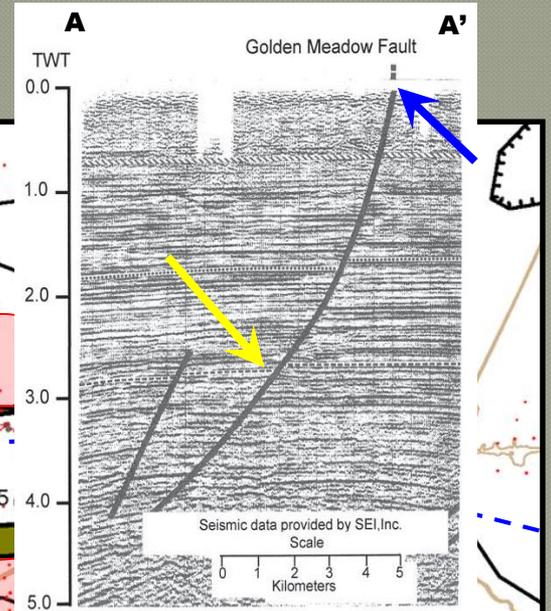
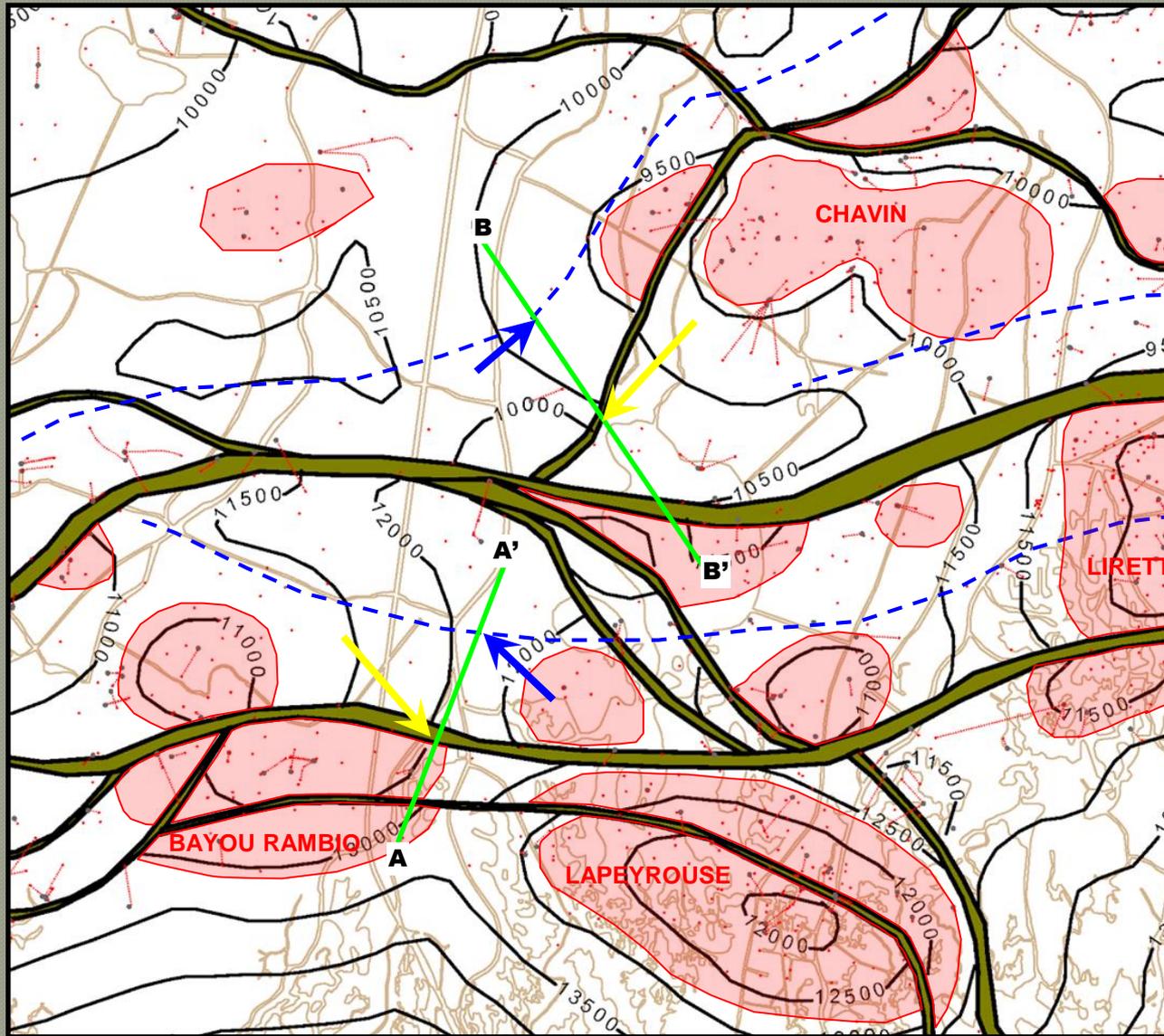
Erosion	Submergence	Direct Removal
Natural Wave	Altered Hydrology: Impoundment	Oil/Gas Channel
Navigation Wave	Altered Hydrology: Oil/Gas	Navigation Channel
Channel Flow	Altered Hydrology: Road	Drainage Channel
Existing	Altered Hydrology: Multiple	Sewage Pond
Land	Faulting	Borrow Pit
	Natural Waterlogging	Burned Area
	Failed Land Reclamation	Agricultural Pond
	Herbivory	Access Channel



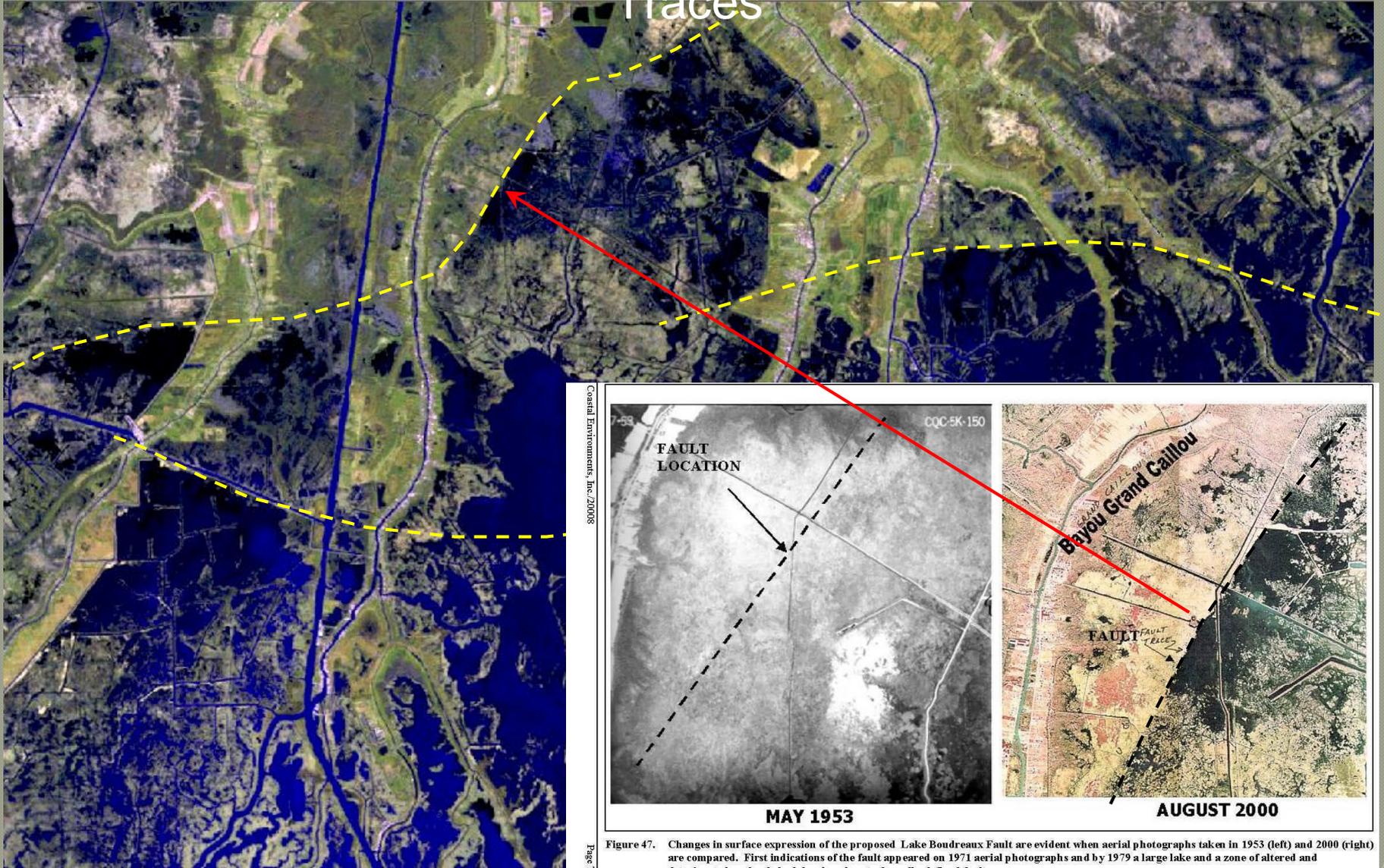
Energy Industry Operations in the Wetlands



Middle Miocene Fields



Surface Fault Traces

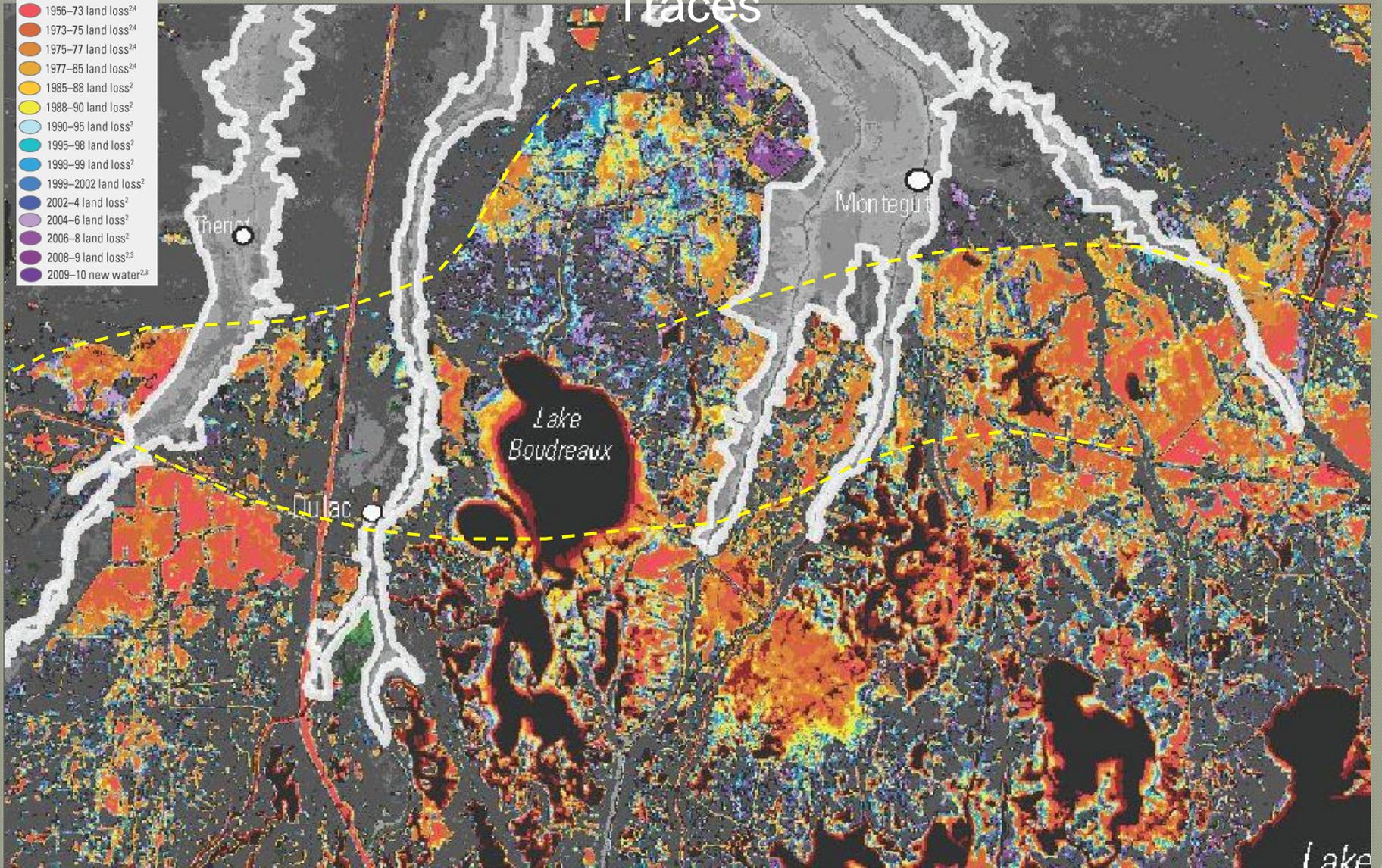


Coastal Environments, Inc./2008

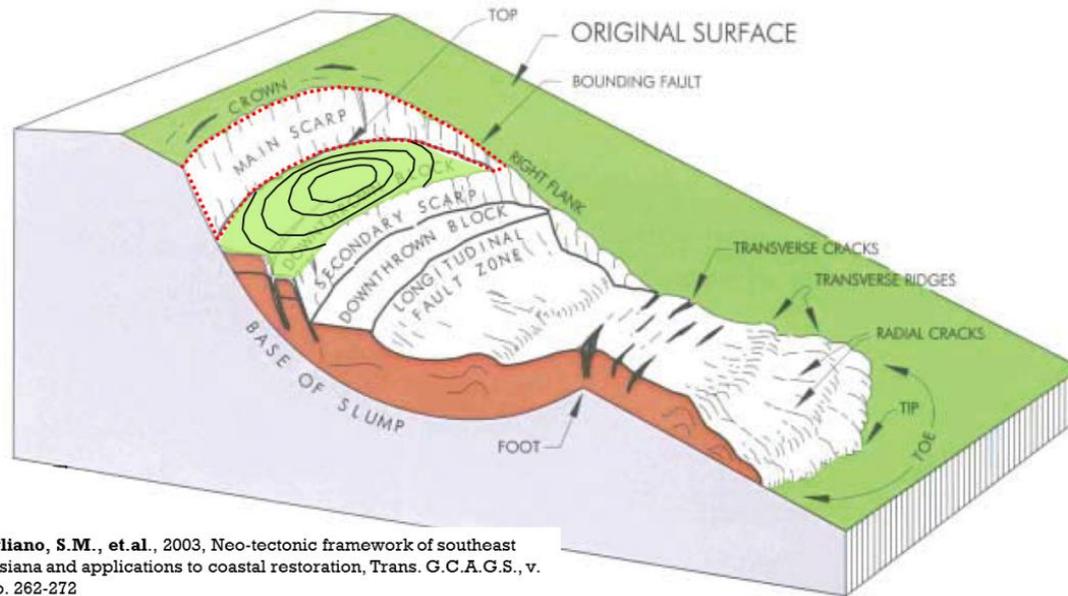
Page 79

Figure 47. Changes in surface expression of the proposed Lake Boudreaux Fault are evident when aerial photographs taken in 1953 (left) and 2000 (right) are compared. First indications of the fault appeared on 1971 aerial photographs and by 1979 a large lake and a zone of altered and deteriorated wetlands had developed east of a well-defined fault scarp.

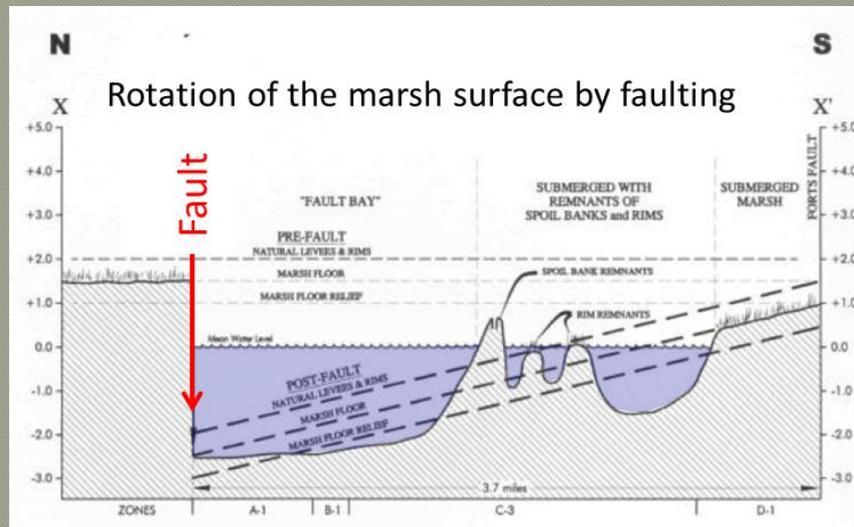
Surface Fault Traces



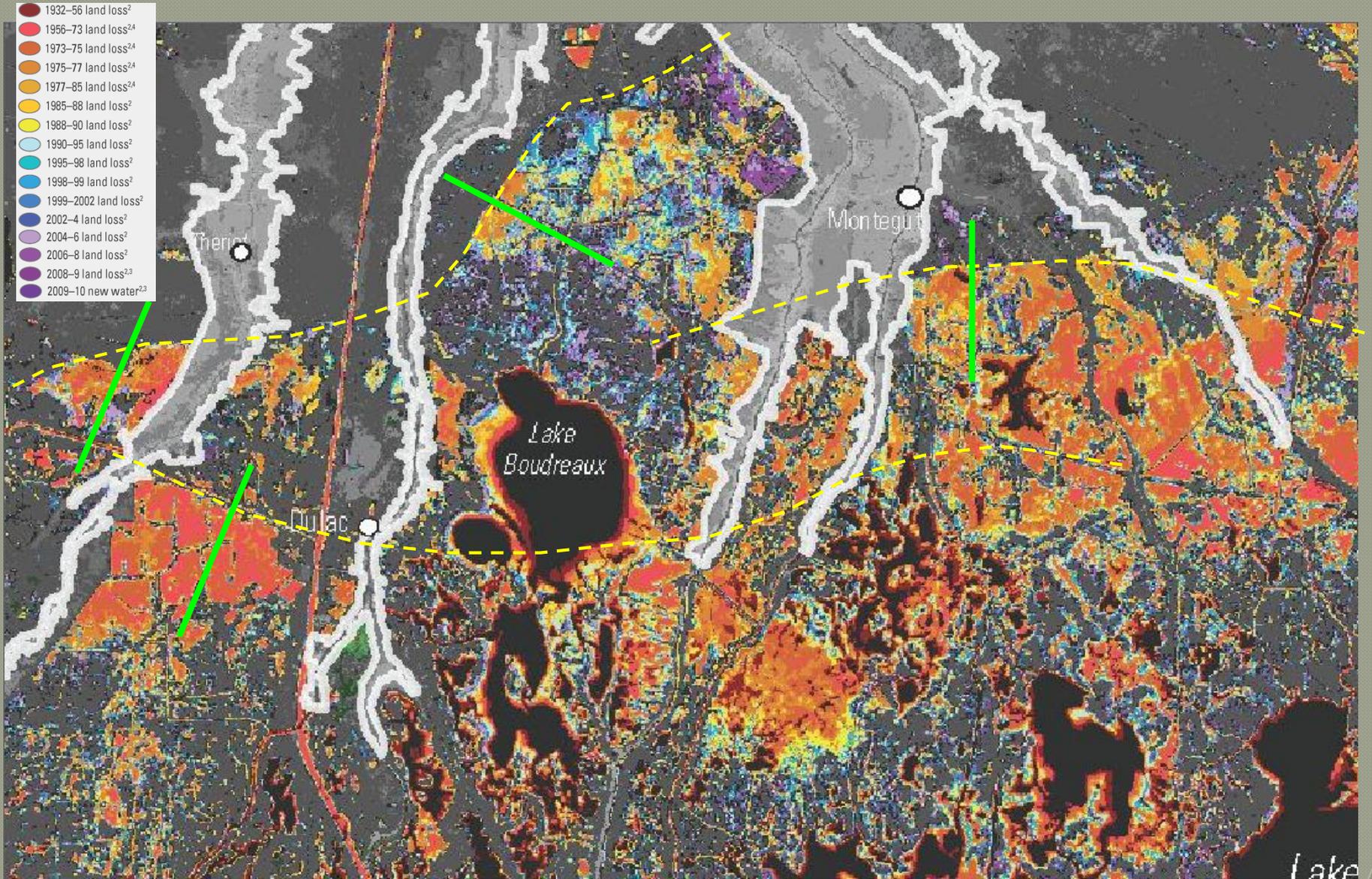
Subsidence Due to Faulting



Gagliano, S.M., et al., 2003, Neo-tectonic framework of southeast Louisiana and applications to coastal restoration, *Trans. G.C.A.G.S.*, v. 53, p. 262-272

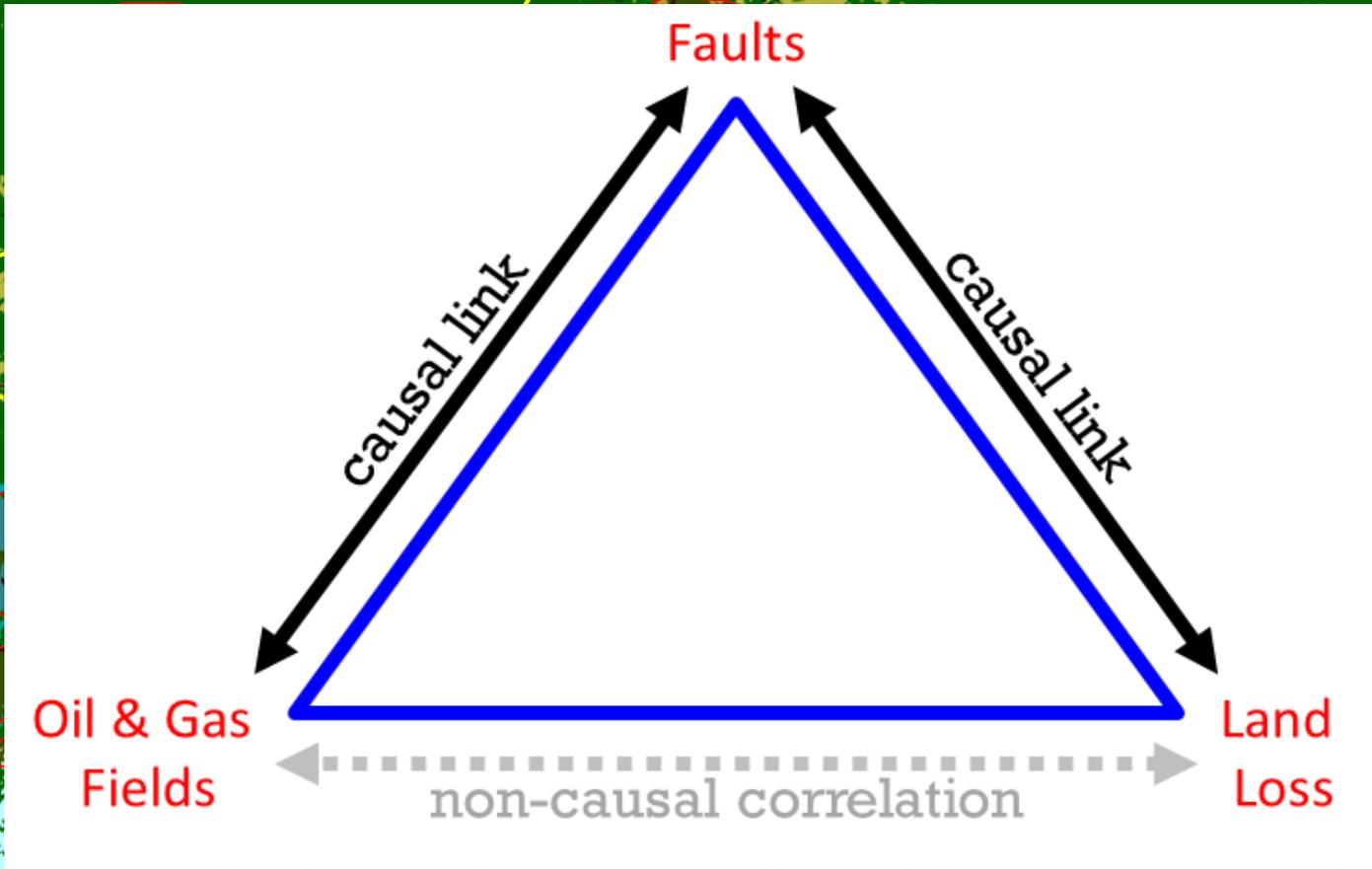


Land Loss Due to Faulting

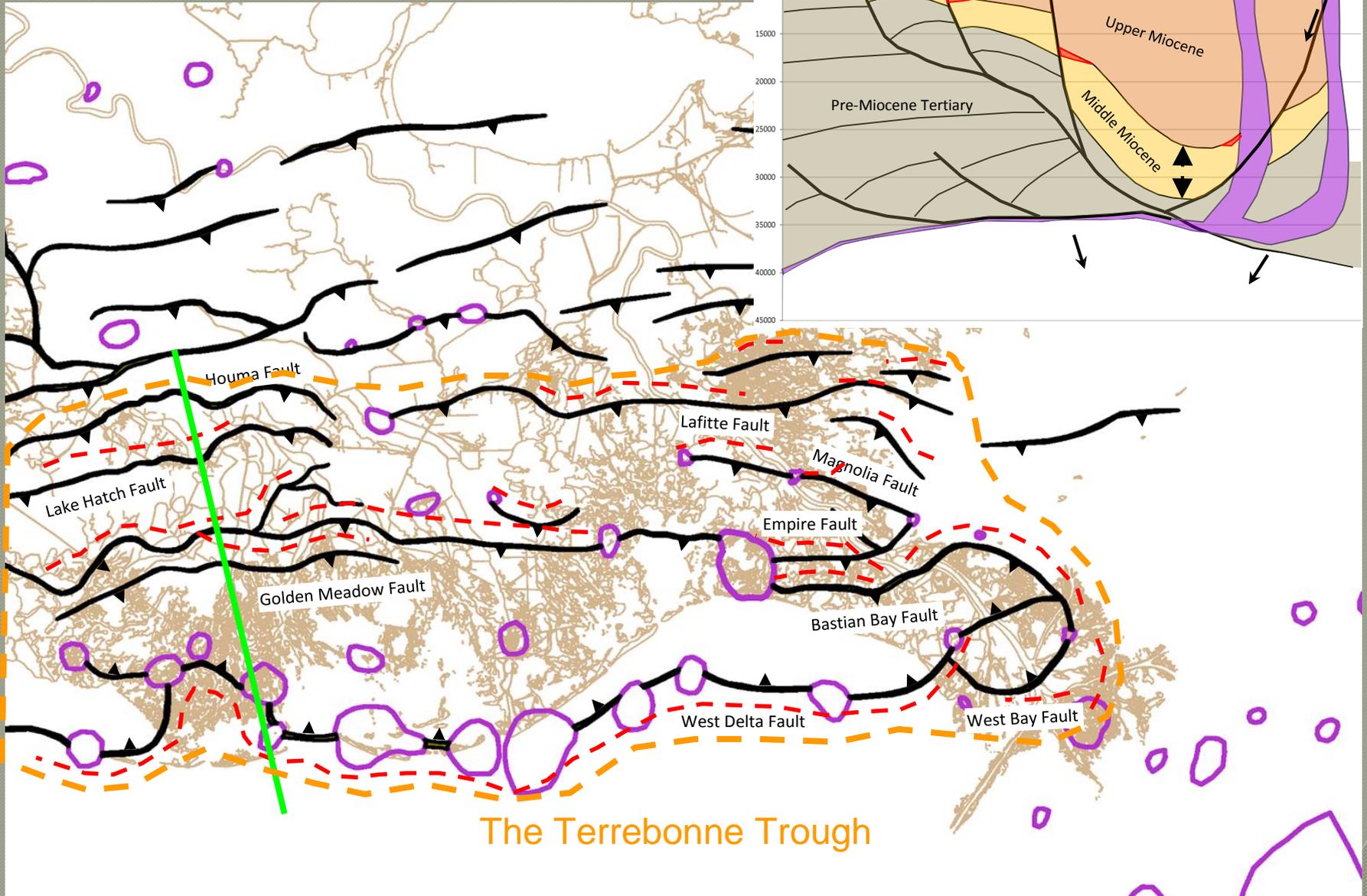


Causal and Non-causal correlations

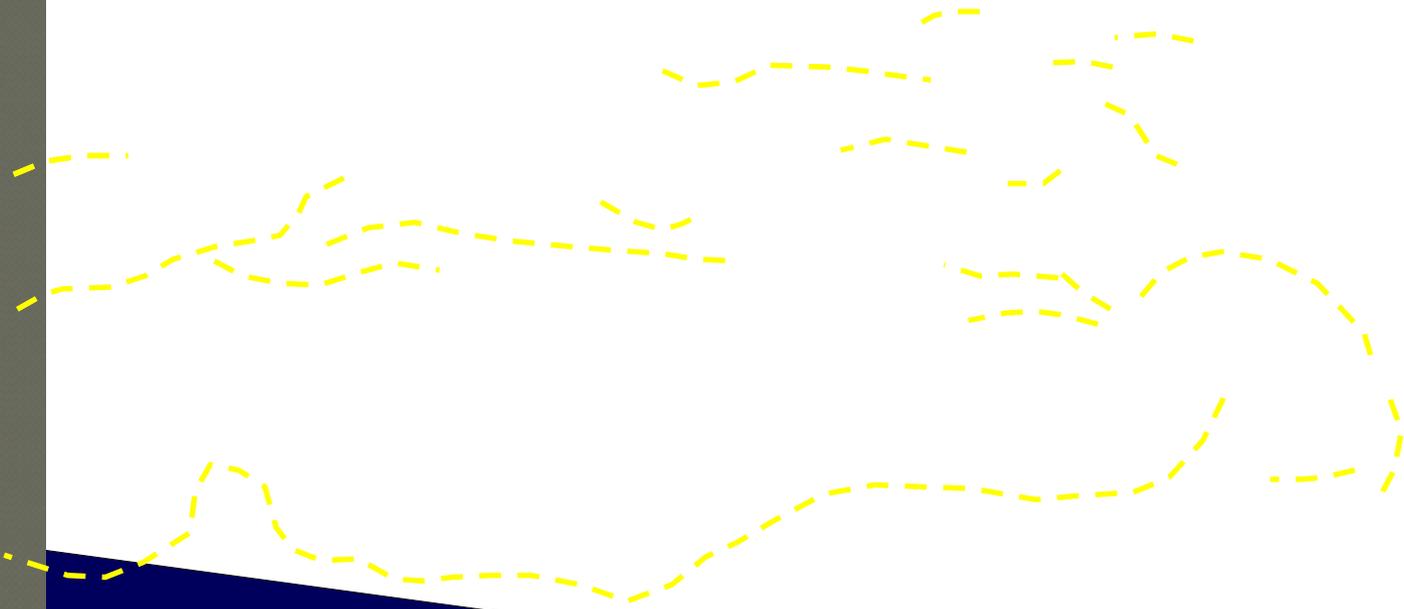
Erosion	Submergence	Direct Removal
Natural Wave	Altered Hydrology: Impoundment	Oil/Gas Channel
Navigation Wave	Altered Hydrology: Oil/Gas	Navigation Channel
Channel Flow	Altered Hydrology: Road	Drainage Channel
Existing	Altered Hydrology: Multiple	Sewage Pond
Land	Faulting	Barren Pit
	Natural Waterlogging	Barren Area
	Failed Land Reclamation	Agricultural Pond
	Herbivory	Access Channel



Regional Geology



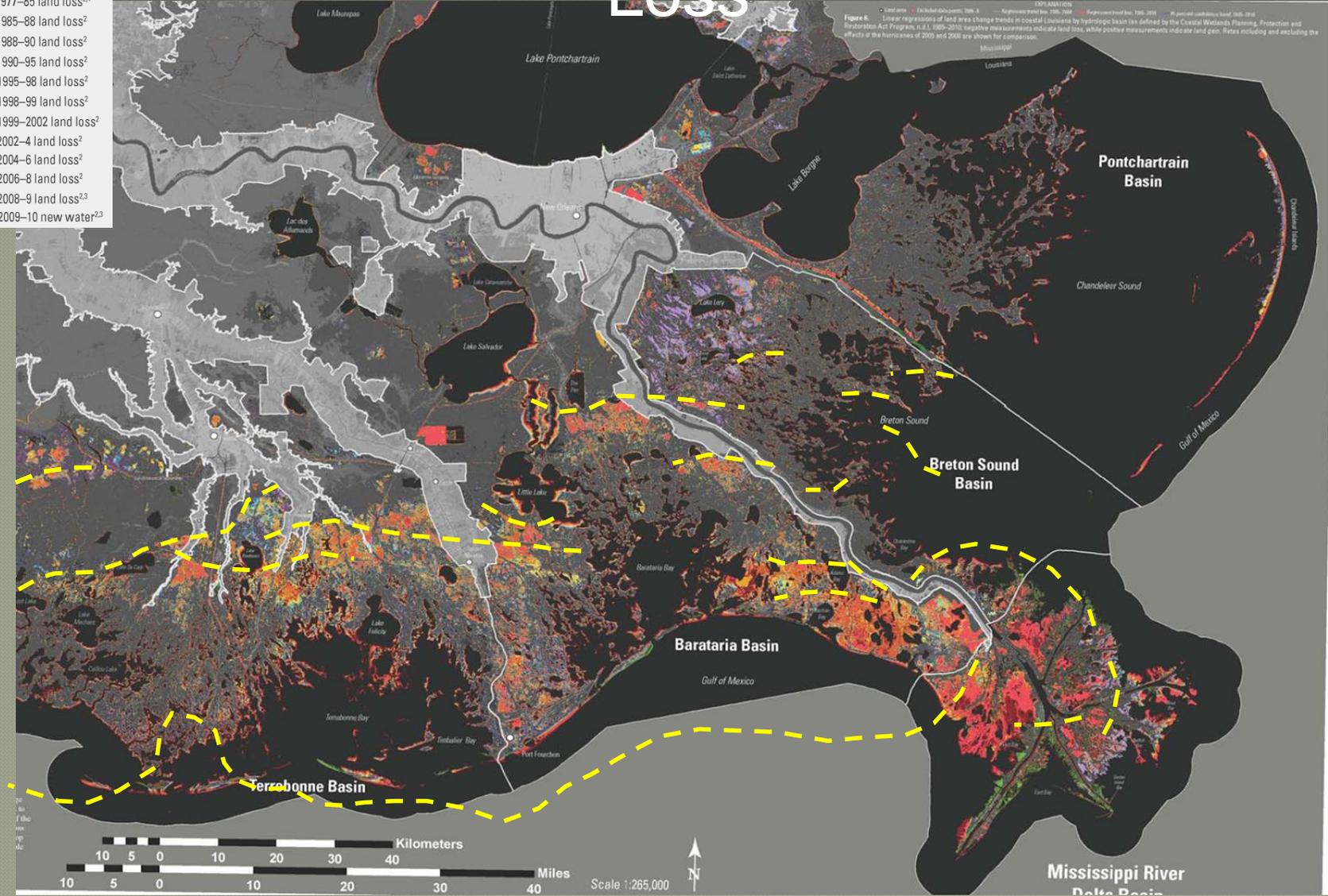
1



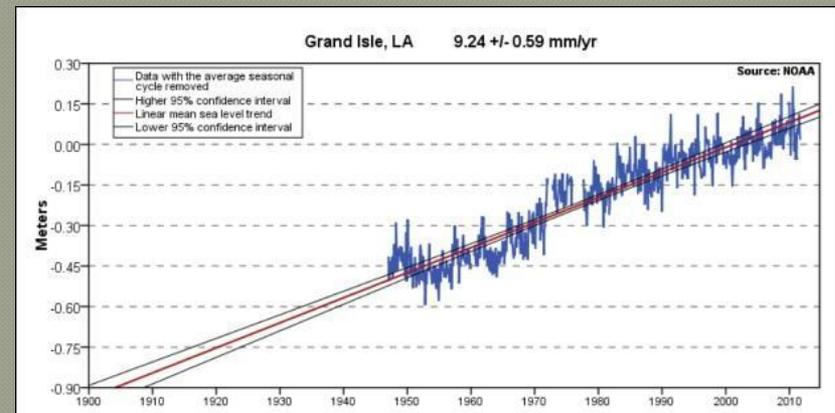
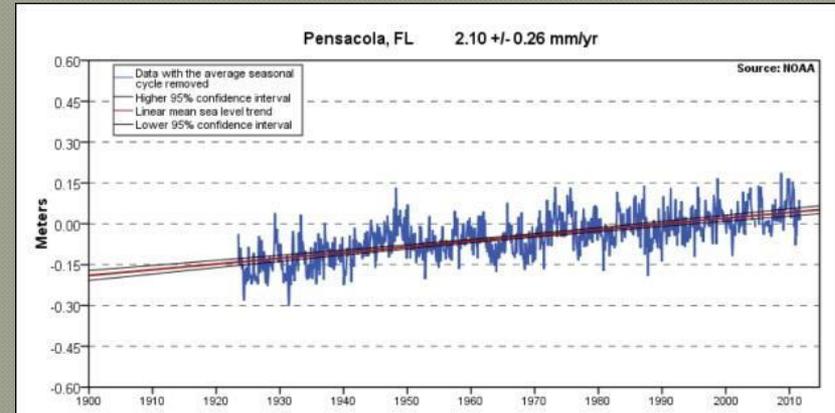
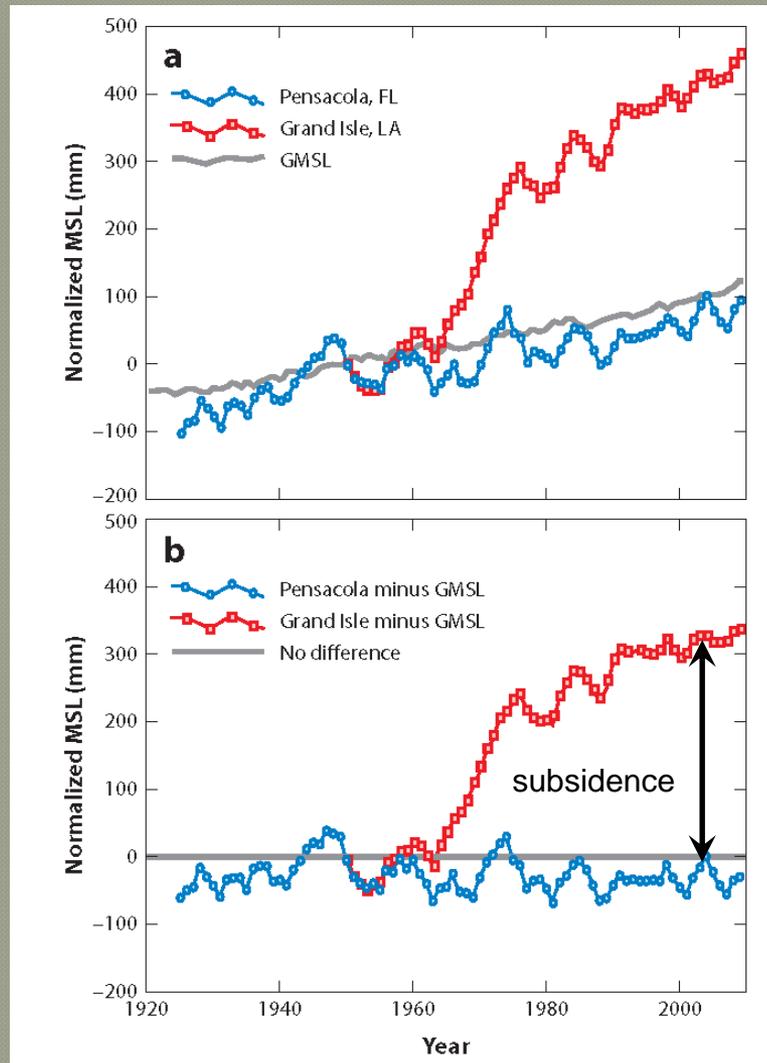
Faults and Land Loss

- 1932-56 land loss²
- 1956-73 land loss^{2,4}
- 1973-75 land loss^{2,4}
- 1975-77 land loss^{2,4}
- 1977-85 land loss^{2,4}
- 1985-88 land loss²
- 1988-90 land loss²
- 1990-95 land loss²
- 1995-98 land loss²
- 1998-99 land loss²
- 1999-2002 land loss²
- 2002-4 land loss²
- 2004-6 land loss²
- 2006-8 land loss²
- 2008-9 land loss^{2,3}
- 2009-10 new water^{2,3}

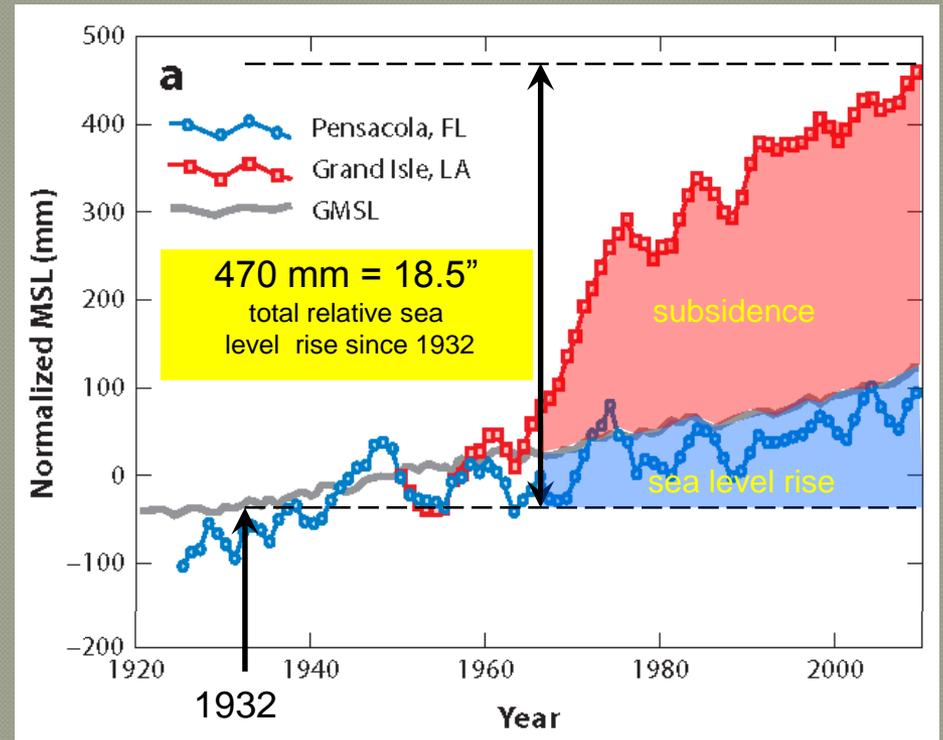
Figure 6. Linear regressions of land area change trends in coastal Louisiana by hydrologic basin (as defined by the Coastal Wetlands Planning, Protection and Restoration Act Program, 1981). 1969-2008 negative measurements indicate land loss, while positive measurements indicate land gain. Rates including and excluding the effects of the hurricanes of 2005 and 2006 are shown for comparison.



Measuring Subsidence

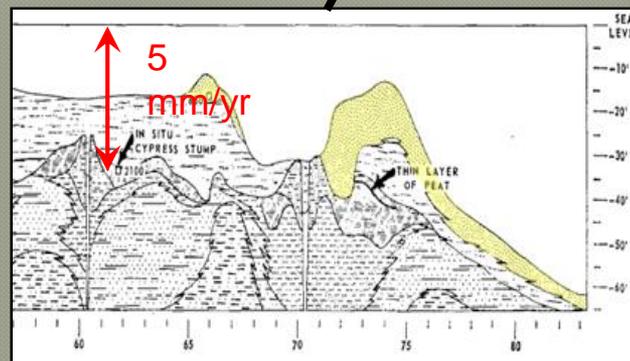
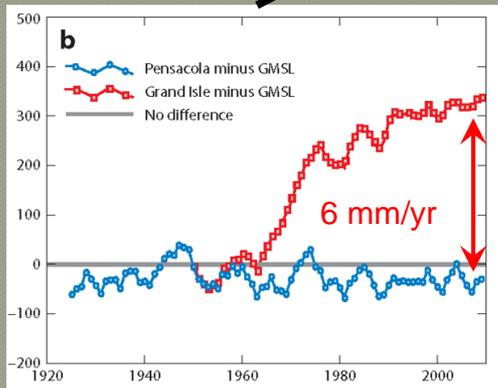
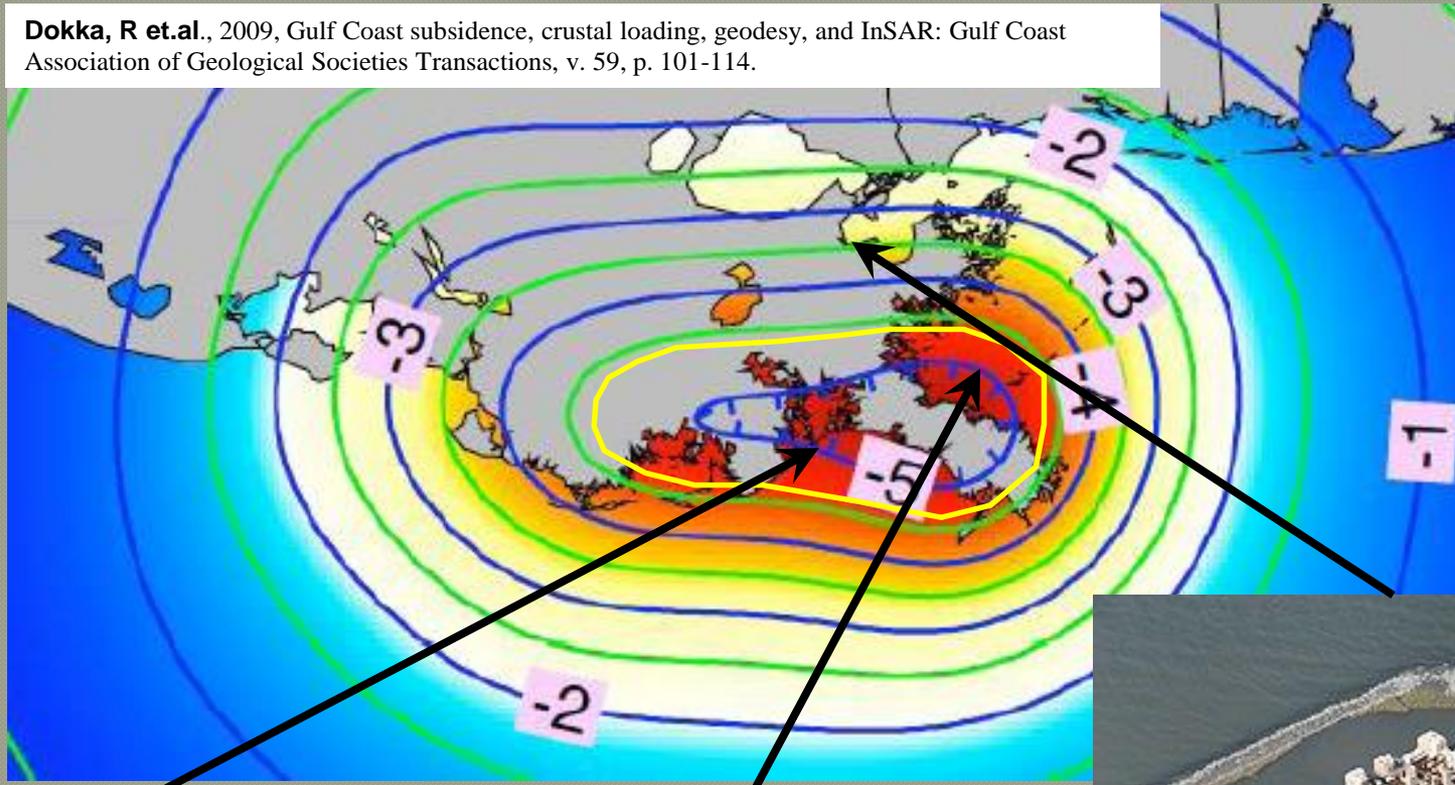


Effects of Subsidence and Sea Level Rise



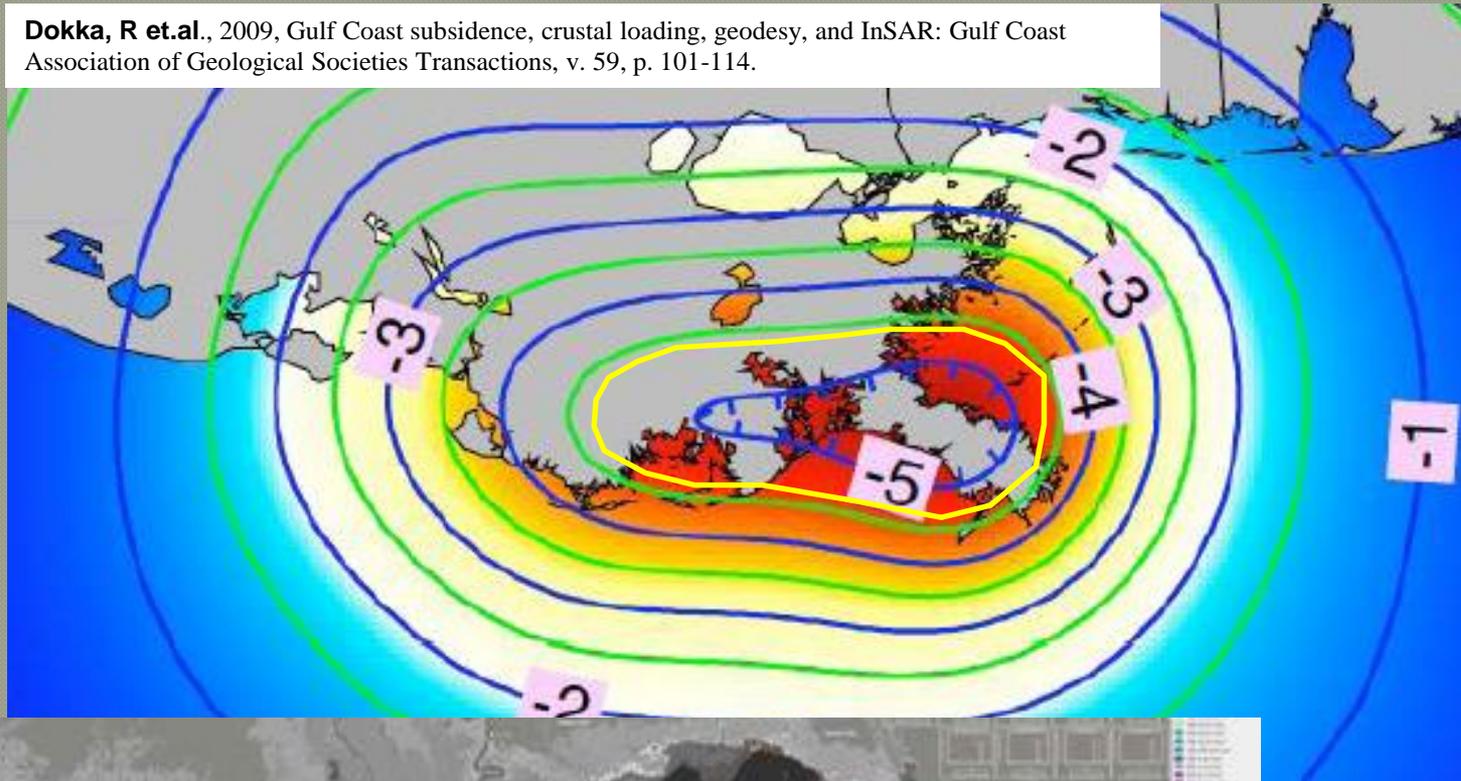
Subsidence in mm/yr

Dokka, R et.al., 2009, Gulf Coast subsidence, crustal loading, geodesy, and InSAR: Gulf Coast Association of Geological Societies Transactions, v. 59, p. 101-114.



Subsidence in mm/yr

Dokka, R et.al., 2009, Gulf Coast subsidence, crustal loading, geodesy, and InSAR: Gulf Coast Association of Geological Societies Transactions, v. 59, p. 101-114.



Board of Commissioners of SLFPA-E

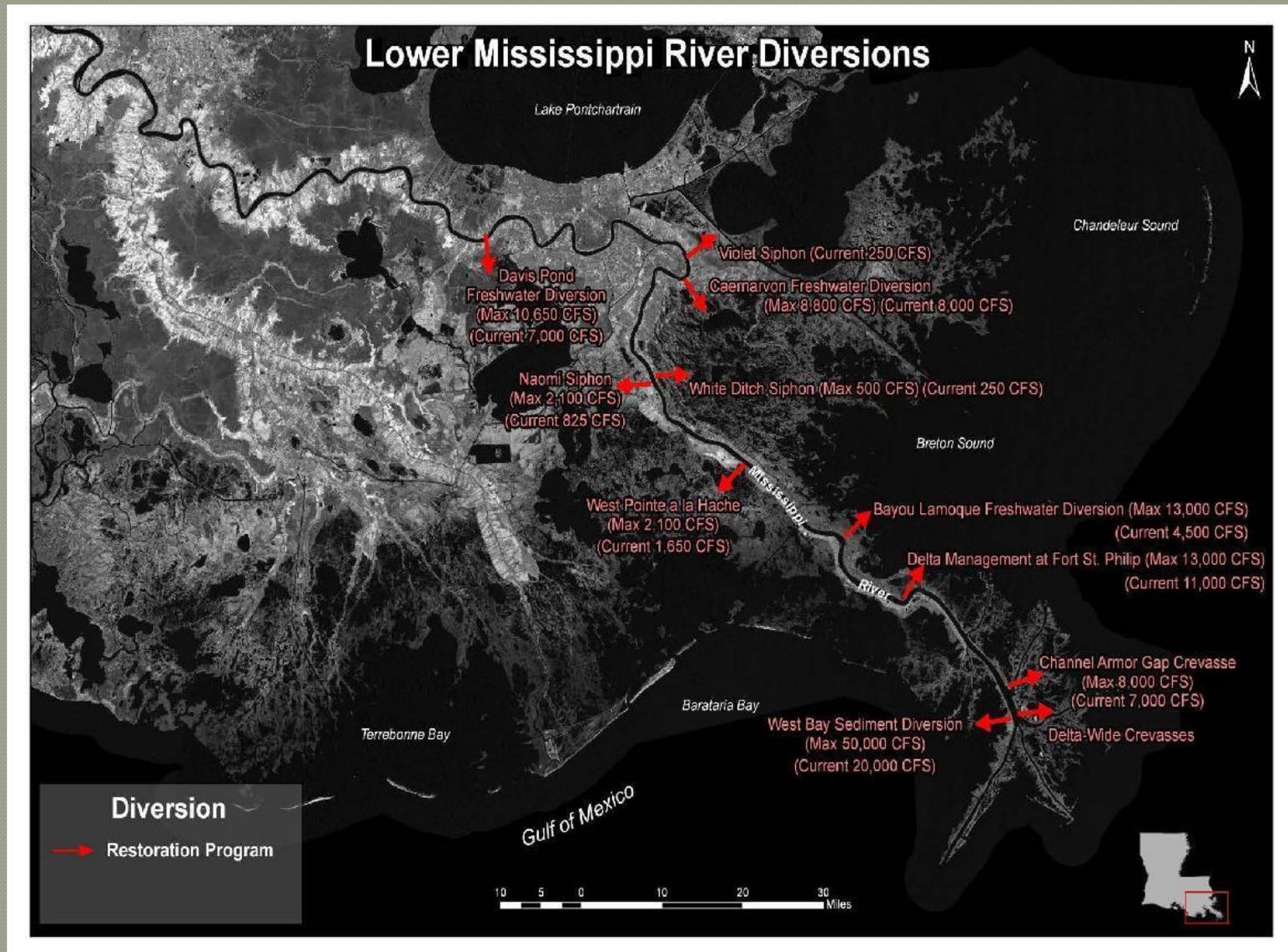
vs.

Tennessee Gas Pipeline Co., et.al.

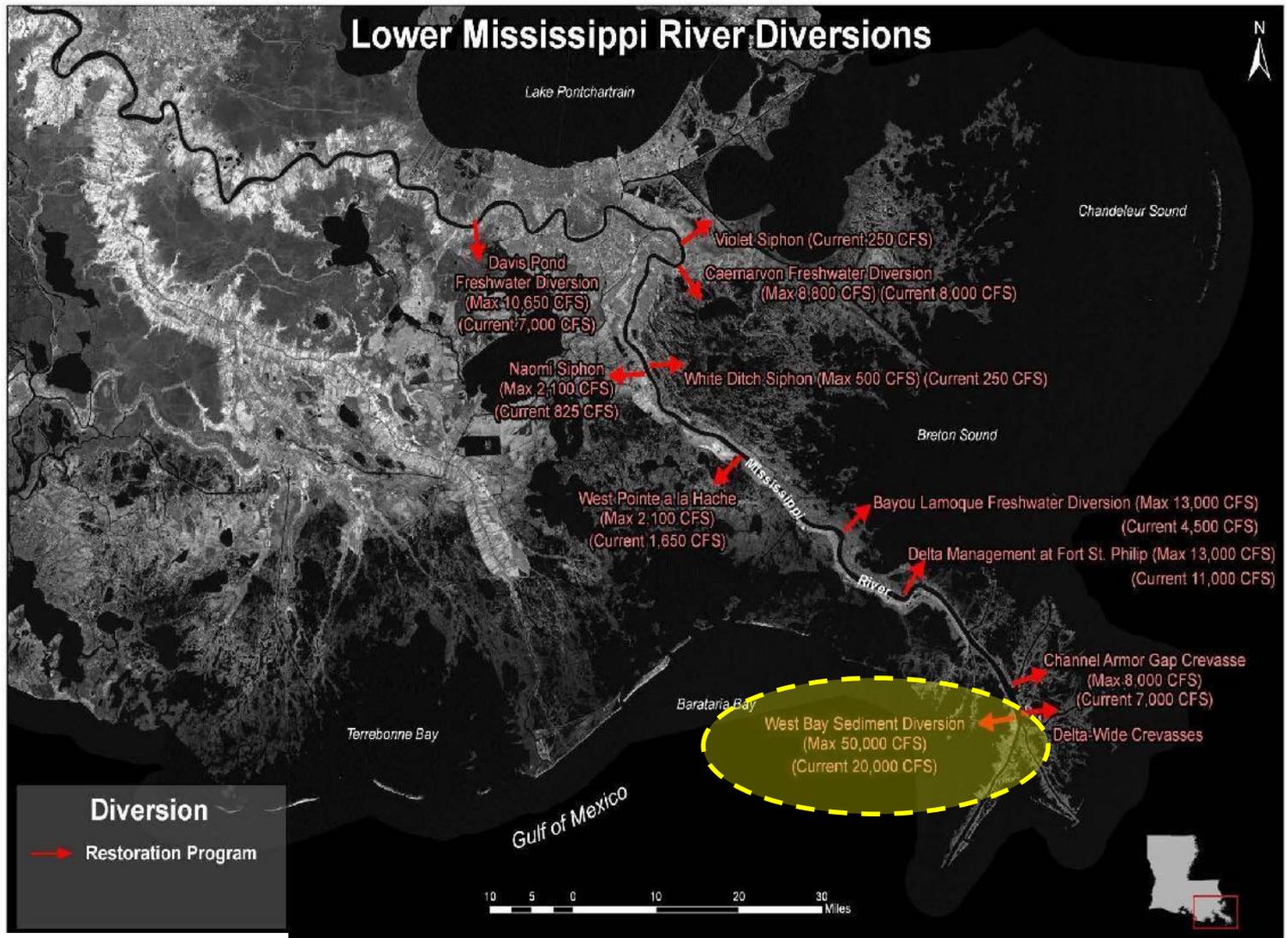
Assertions

- 6,000 Year Steady State Hypothesis
- 1930's Represent A Baseline Of Normality
- Oilfield Canals Destroyed Wetlands
- Oil Extraction Causes Subsidence
- Coastal Wetlands Protect Against Storm Surge
- Coastal Restoration Is Possible

“Reconnecting the River to the Marsh”



Lower Mississippi River Diversions



West Bay Sediment Diversion

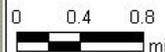


“... it would appear unlikely that large areas of new land would develop in West Bay over a time scale of less than a few decades.”

Kolker, et.al., 2012



West Bay Sediment Diversion



Absolute Scale: 1:53,148

Relative Scale: 1 inch = 4,429 feet

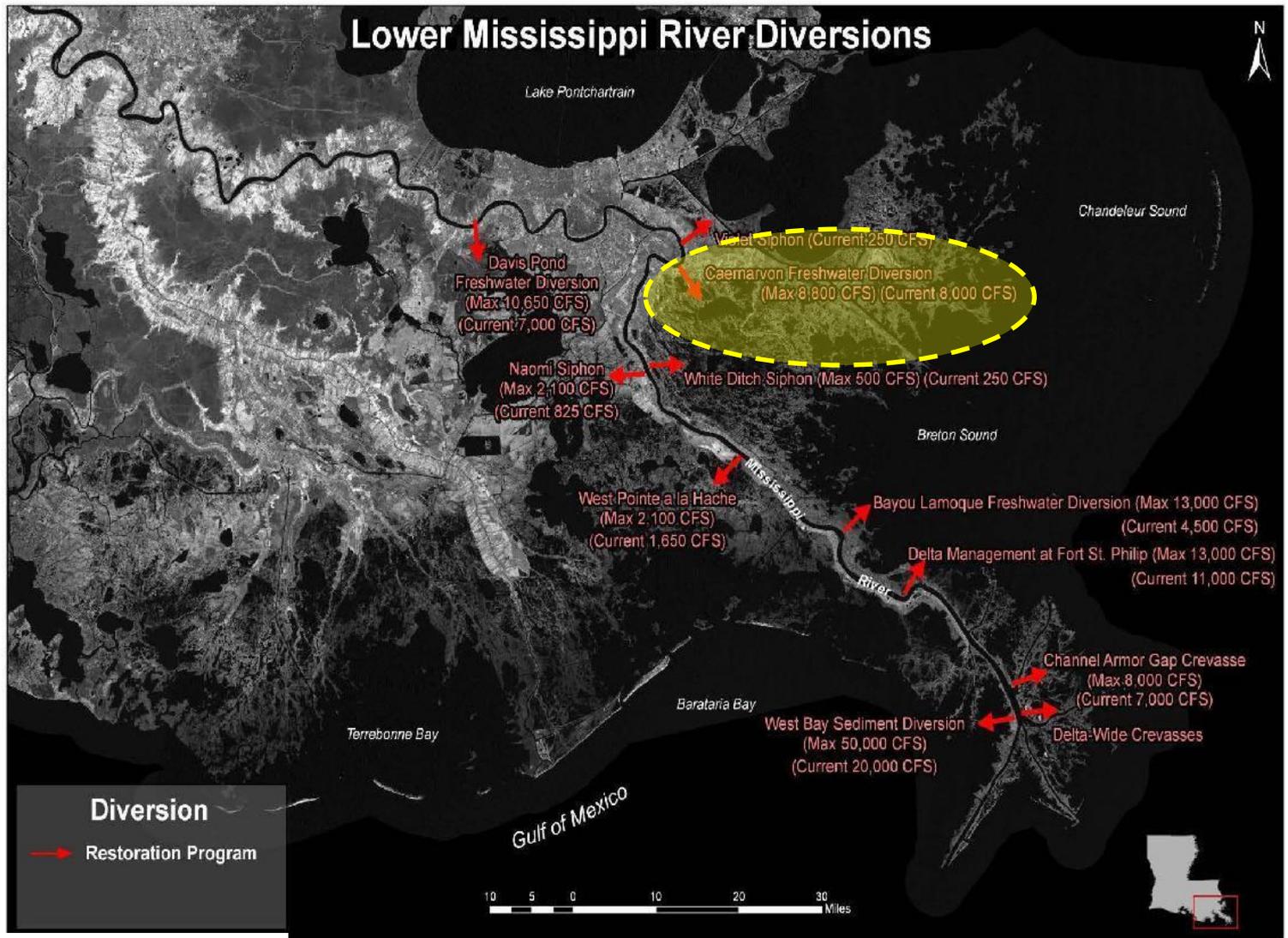
West Bay Sediment Diversion 2012

Disclaimer: This data is not to be used for legal purposes.

Date: 12/26/2013



Lower Mississippi River Diversions



Caenarvon Freshwater Diversion

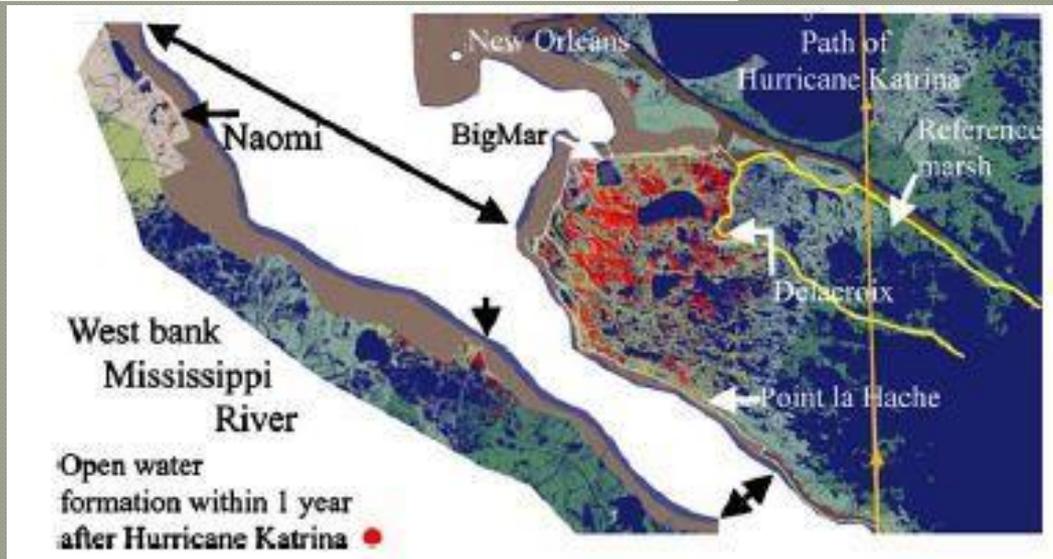
Caenarvon Outfall
Marsh (photo taken
after Gustav 2008)



Control marsh
east of
Delacroix road
in direct path of
Katrina

“The evidence indicates that diversions not only fail to conserve mature brackish and tidal freshwater marshes, but disrupt plant physiology in ways that endanger individual plant vigor and overall marsh survival.”

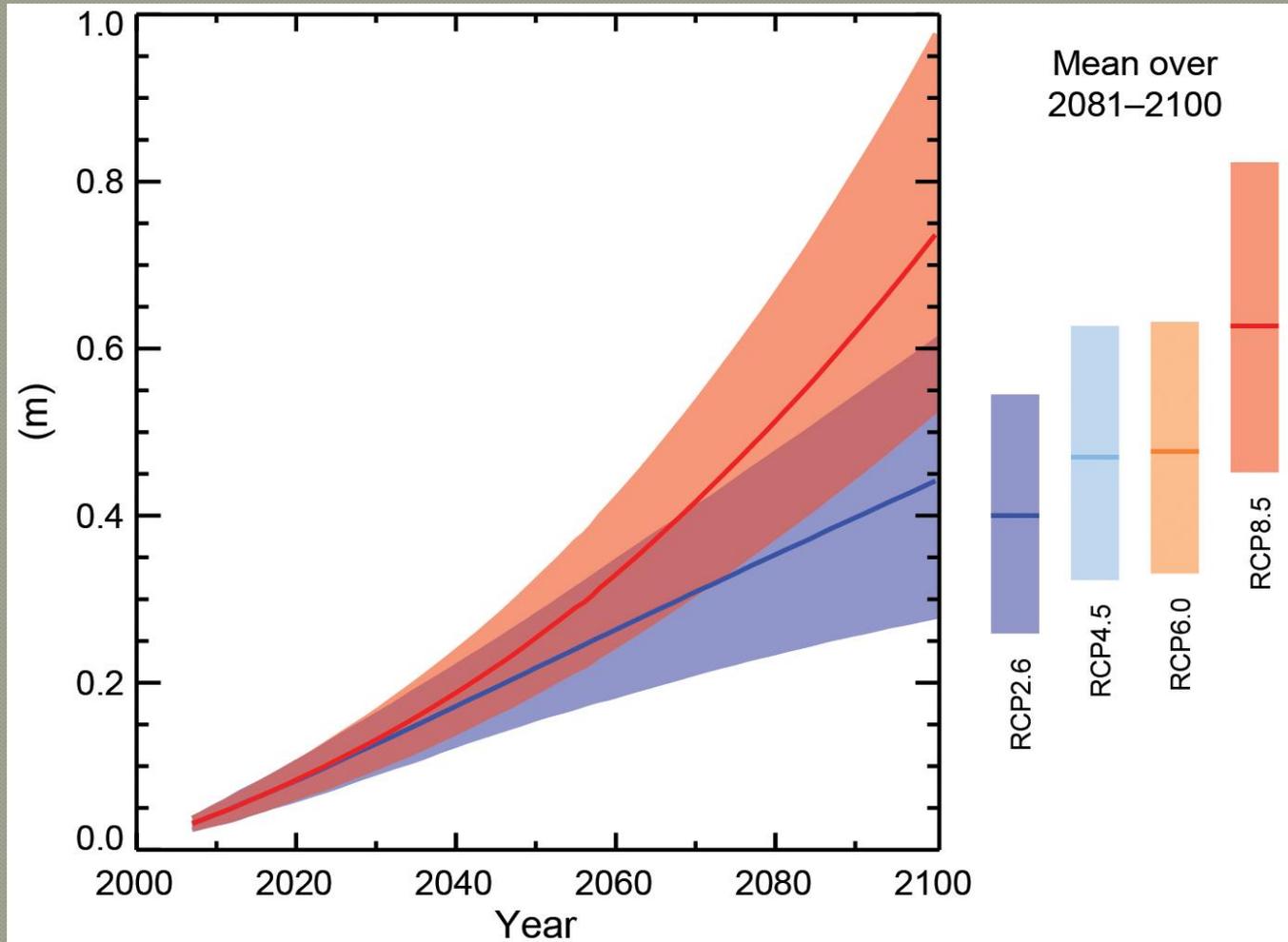
Kearney, et.al., 2011



Relative Sea Level Rise

The Interplay of Subsidence and
Sea Level Rise

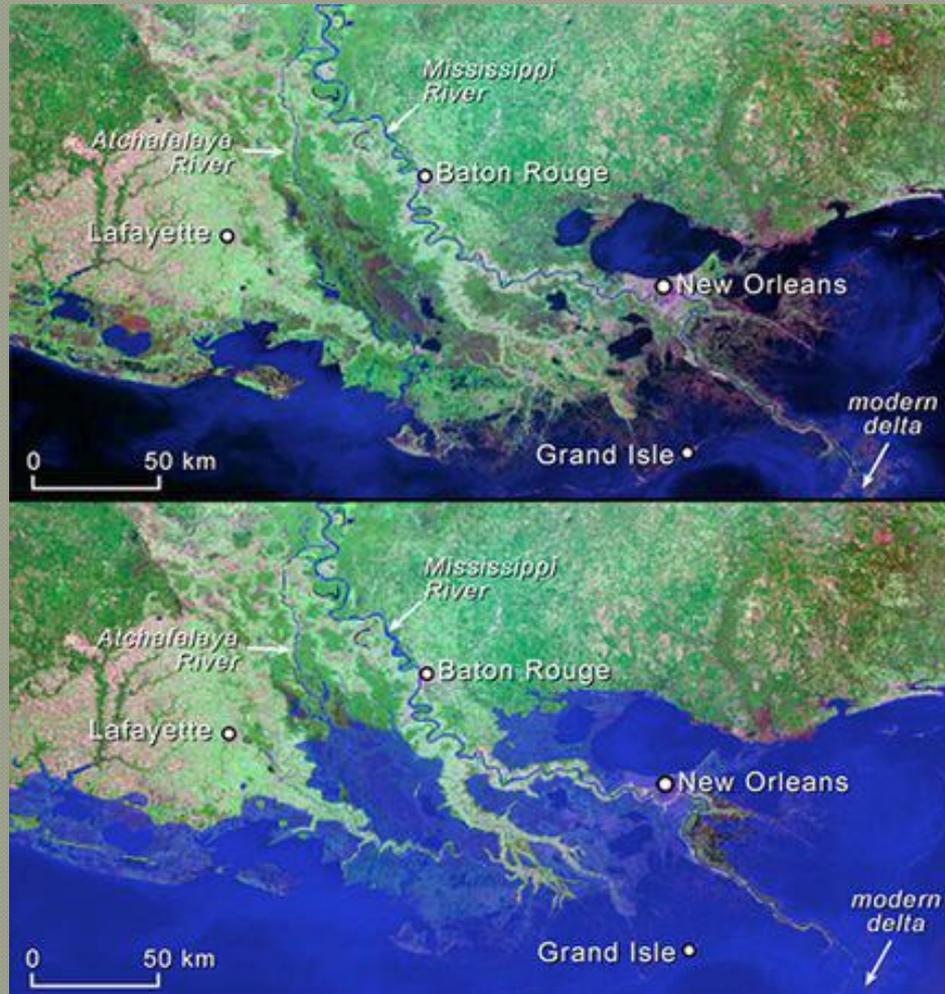
IPCC Sea Level Projections



The Impact of Sea Level Rise

- Without sea level rise, it would be technically, if not politically, possible to increase sediment and slow the delta loss.
 - This would require removing the levees and dams.
- With increasing sea level rise, the coast line will rapidly retreat inland, no matter what is done.

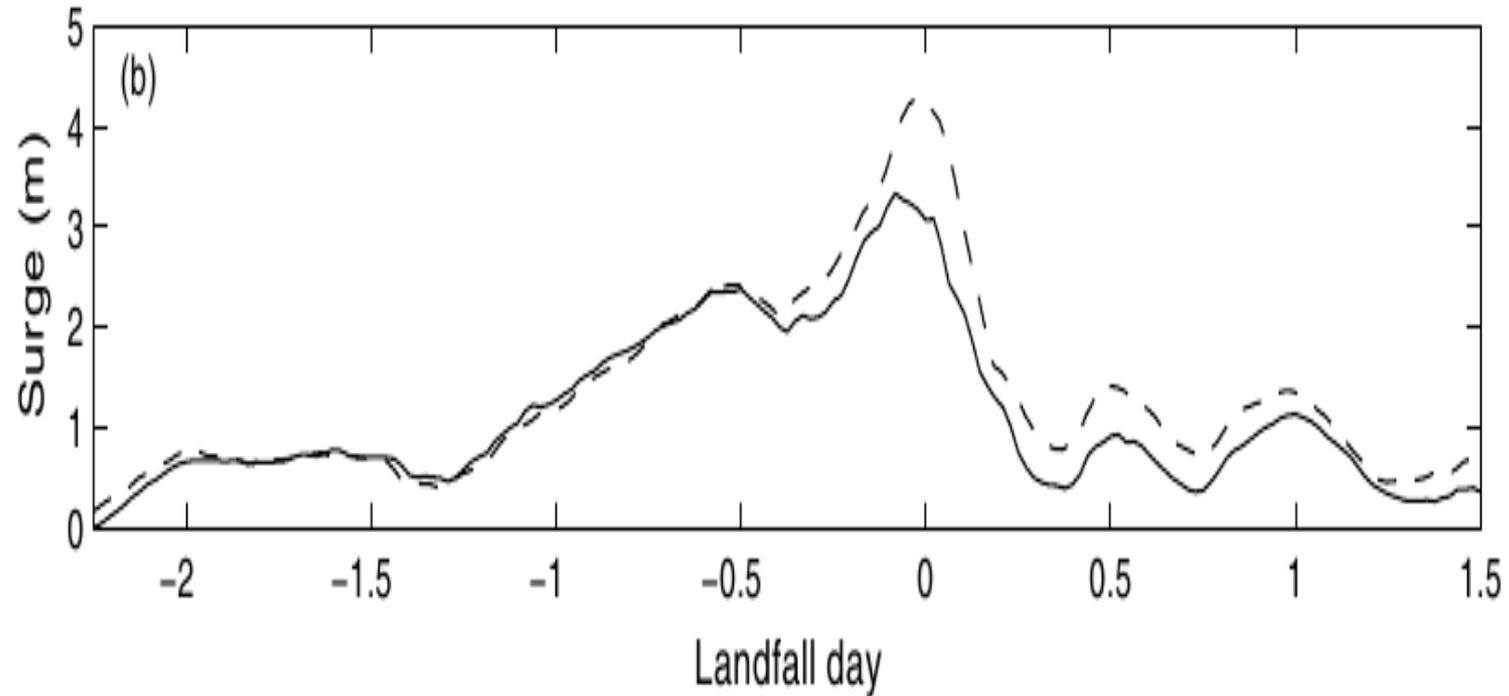
2100 – Minimum Sea Level Rise + Subsidence (subsidence + sea level rise = 1 meter)



Do Wetlands Reduce Flooding?

- Mangroves and tsunamis
 - Tall, dense
 - Fast pulse, then gone
- Fresh and Salt Marsh
 - Not tall.
 - Hurricanes have time to flow through the wetlands and equilibrate.
 - Wave attenuation falls off once the plants are submerged.
- Forerunner Surge – Next Slide

Forerunner Surge on Bolivar from Ike



- This submerges the marshes before the storm.

Wetlands do not Reduce Flooding in Louisiana

- Coastal wetlands have other values, and canals may have done real damage to salt marsh.
- But wetlands do not reduce hurricane surge on the Louisiana coast.
- Thus, for the purposes of this lawsuit, it does not matter whether canals destroyed the wetlands.
- It also means that even if the wetlands could be restored, it would not change flood risk.

Back Good Science!

- Stop supporting groups like America's Wetlands and CPRA that deny the effects of subsidence and climate change (sea level rise).
- Create a public forum for discussions of accurate coastal science, especially geology and climate change.
- Fund research on key points such as the effect of oil production on subsidence.

Admit Your Own Vulnerabilities

The Economic Impacts of Port Fourchon on the National and Houma MSA Economies



Released April 2008

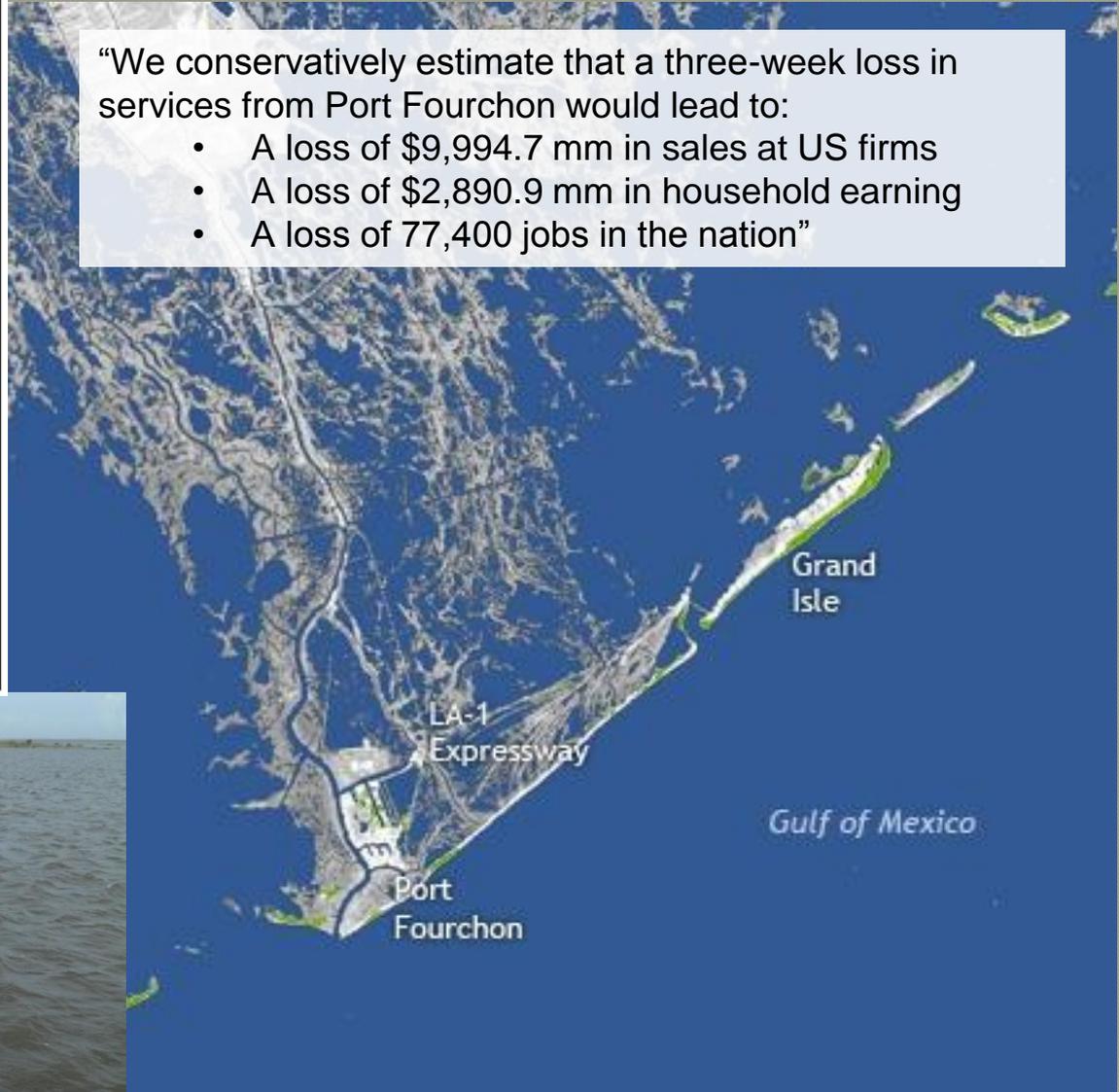
Prepared By:
Loren C. Scott & Associates

In Cooperation with



“We conservatively estimate that a three-week loss in services from Port Fourchon would lead to:

- A loss of \$9,994.7 mm in sales at US firms
- A loss of \$2,890.9 mm in household earning
- A loss of 77,400 jobs in the nation”



Take Climate Change, Sea Level Rise, and Geology Seriously

- Start moving critical infrastructure inland out of high risk areas such as Port Fourchon, Houma, and New Orleans.
- Encourage employees and suppliers to relocate inland.
- This will support retreat and will increase resilience.
- It will save money and disruptions in the long term

Get the Rhetoric Right!

● False concepts

- Erosion, restoration, crumbling into the Gulf, losing the land of our heritage, and reconnecting the river to the marsh.

● Correct concepts

- The delta cycle, global warming, sea level rise, retreat, subsidence, living in harmony with nature.

● The levee board and Parish lawsuits are just the beginning.

- As long as people believe in restoration, they will expect the oil industry to pay for it.

