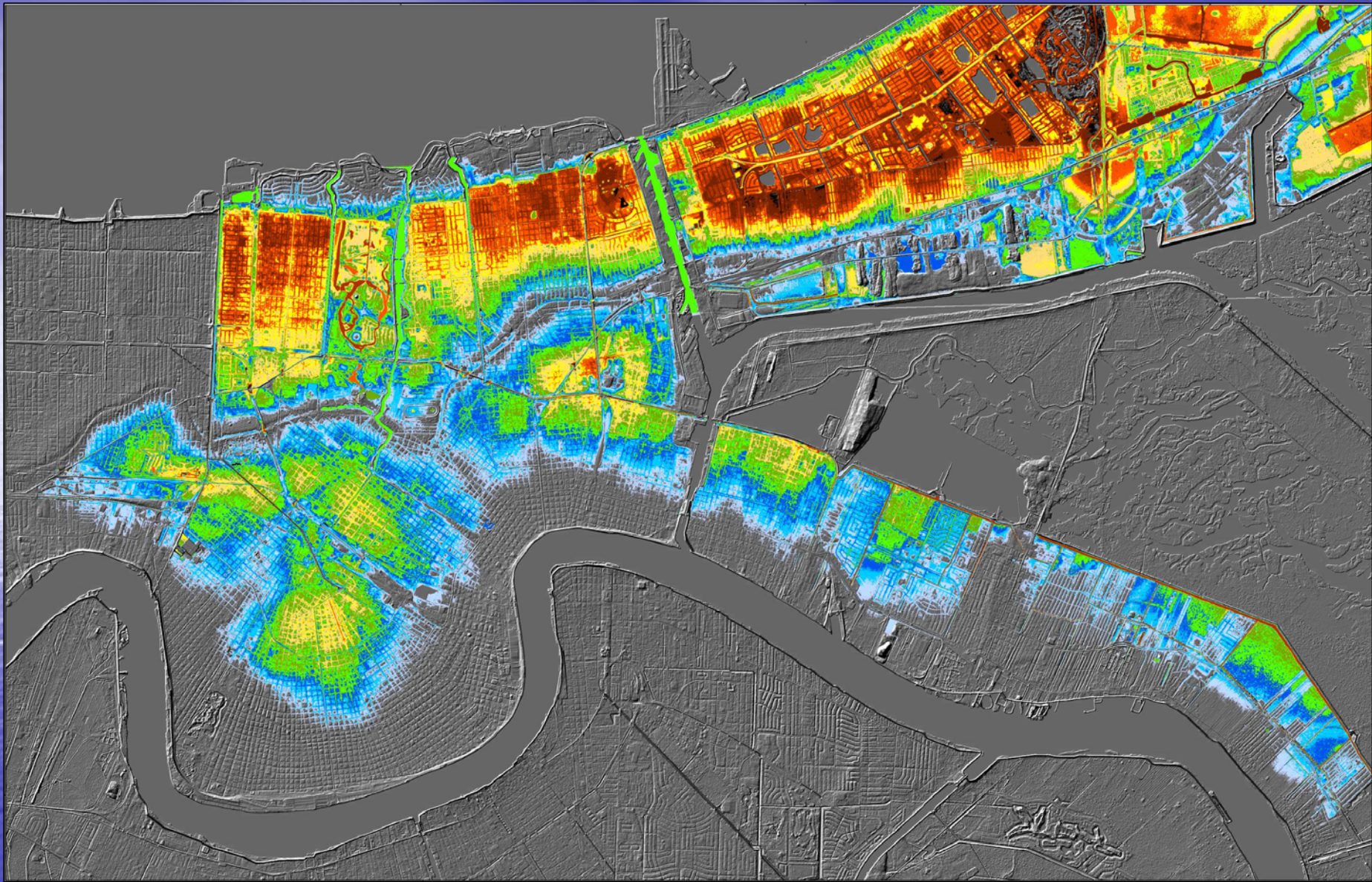


PART 5

MECHANISMS OF GROUND SETTLEMENT IN GREATER NEW ORLEANS



Predicted water depth in New Orleans flood inundation area based on water level of 2.37 ft in Lake Ponchartrain on Sept 2, 2005. Overlay on 2002 5 m LiDAR DEM by USGS-MCGSC in Rolla. The dark red tones >9 ft.

Digital Elevation Model of the 1895 map relative to Mean Gulf Level

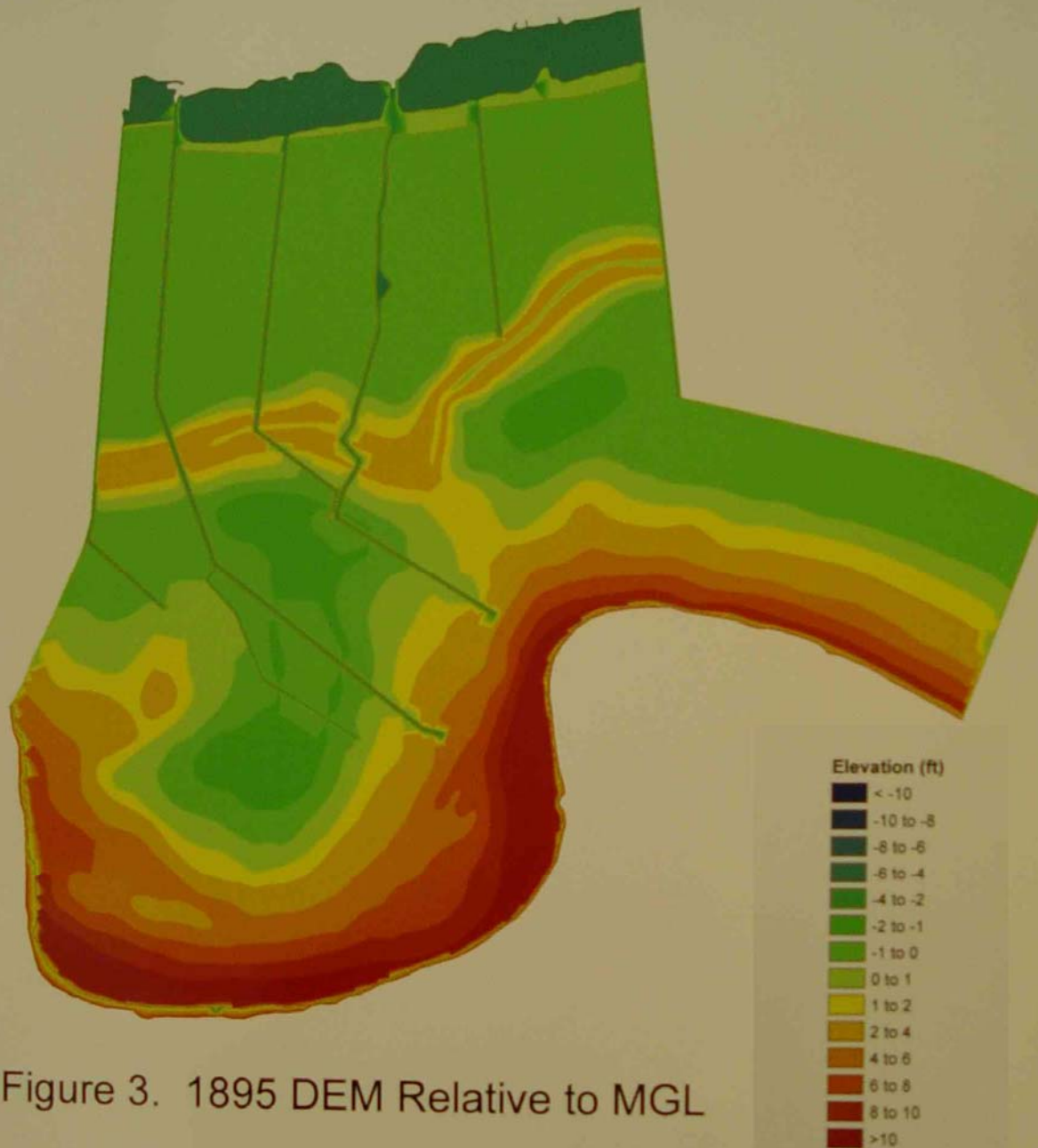


Figure 3. 1895 DEM Relative to MGL

**1999/2002
Digital
elevation
model
relative to
Mean Gulf
Level
extracted
from LiDAR
data and New
Orleans
benchmarks.**

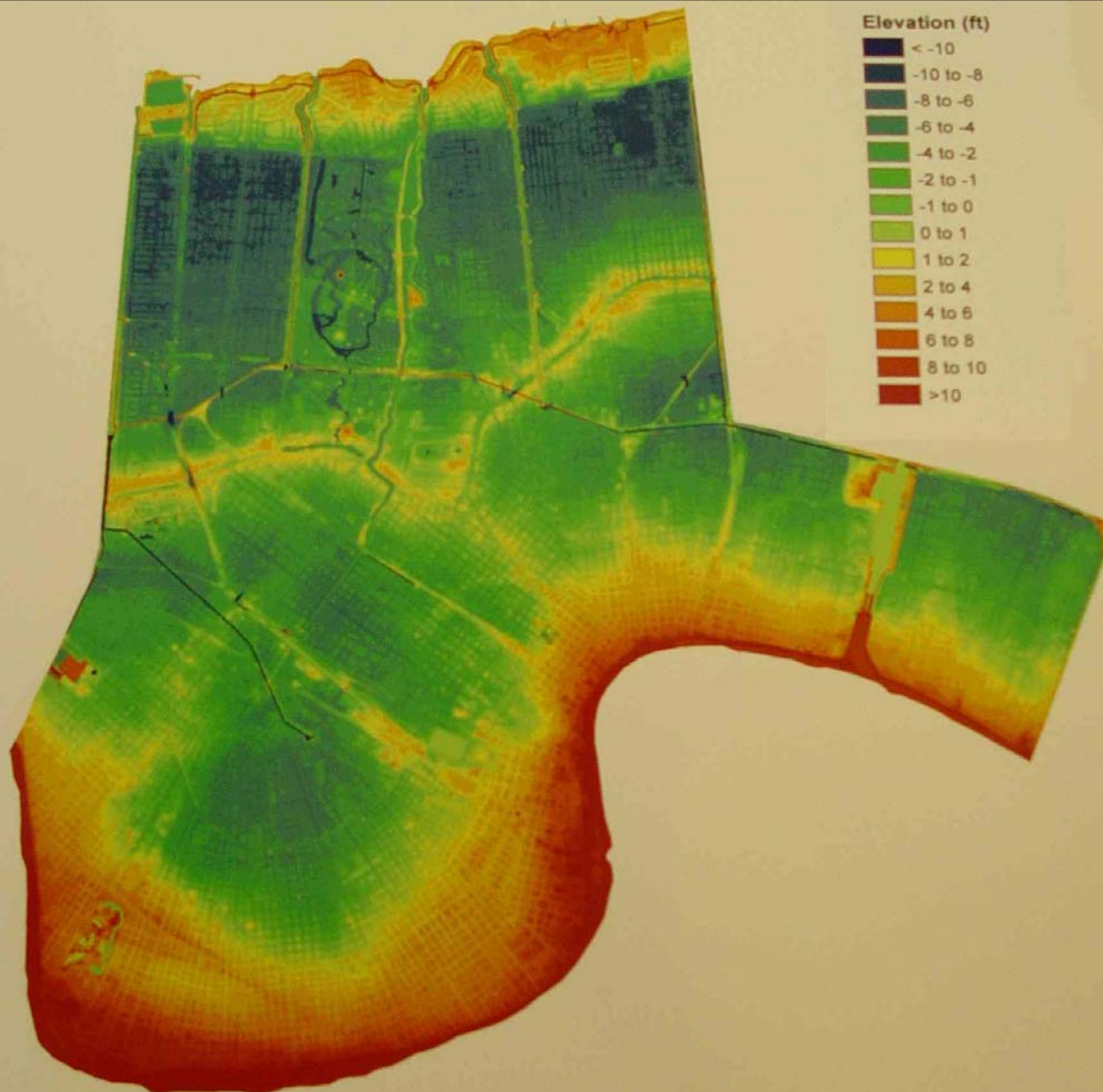
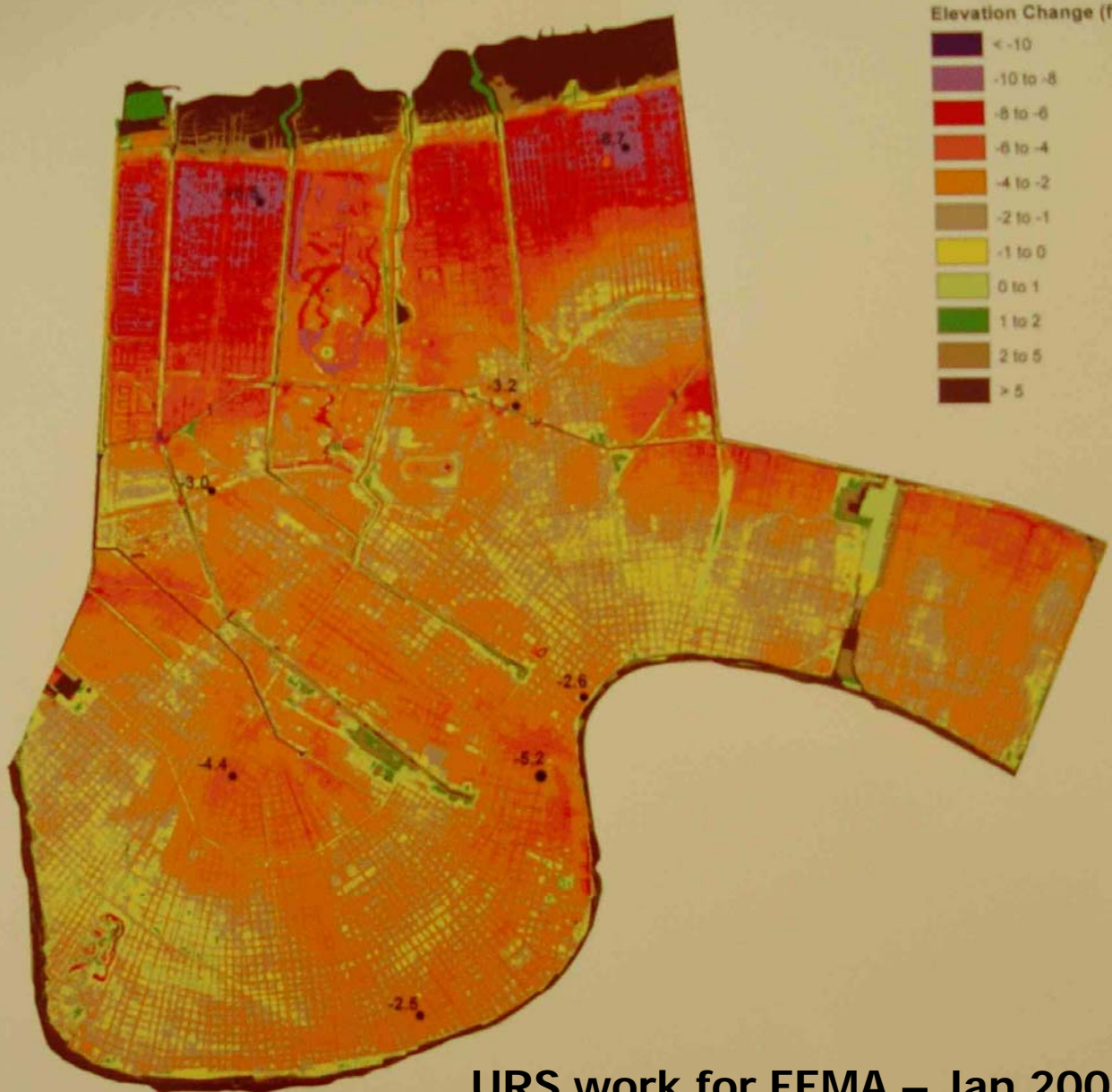


Figure 4. 1999/2002 DEM Relative to MGL

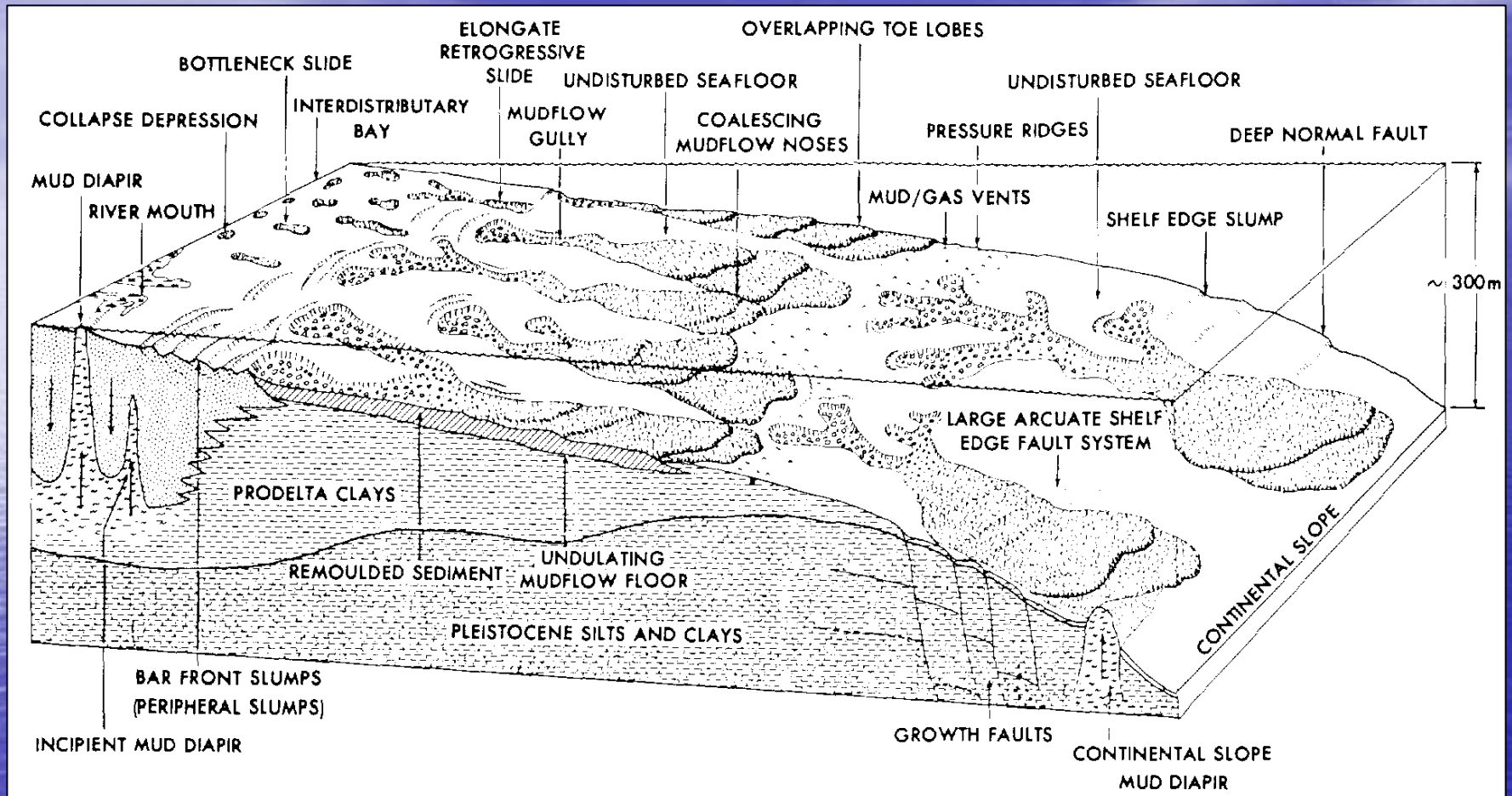


Change in elevation between 1895 and 1999, in feet. The entire city has settled between 2 and 10 feet. Sea level has risen 12 inches.

URS work for FEMA – Jan 2006

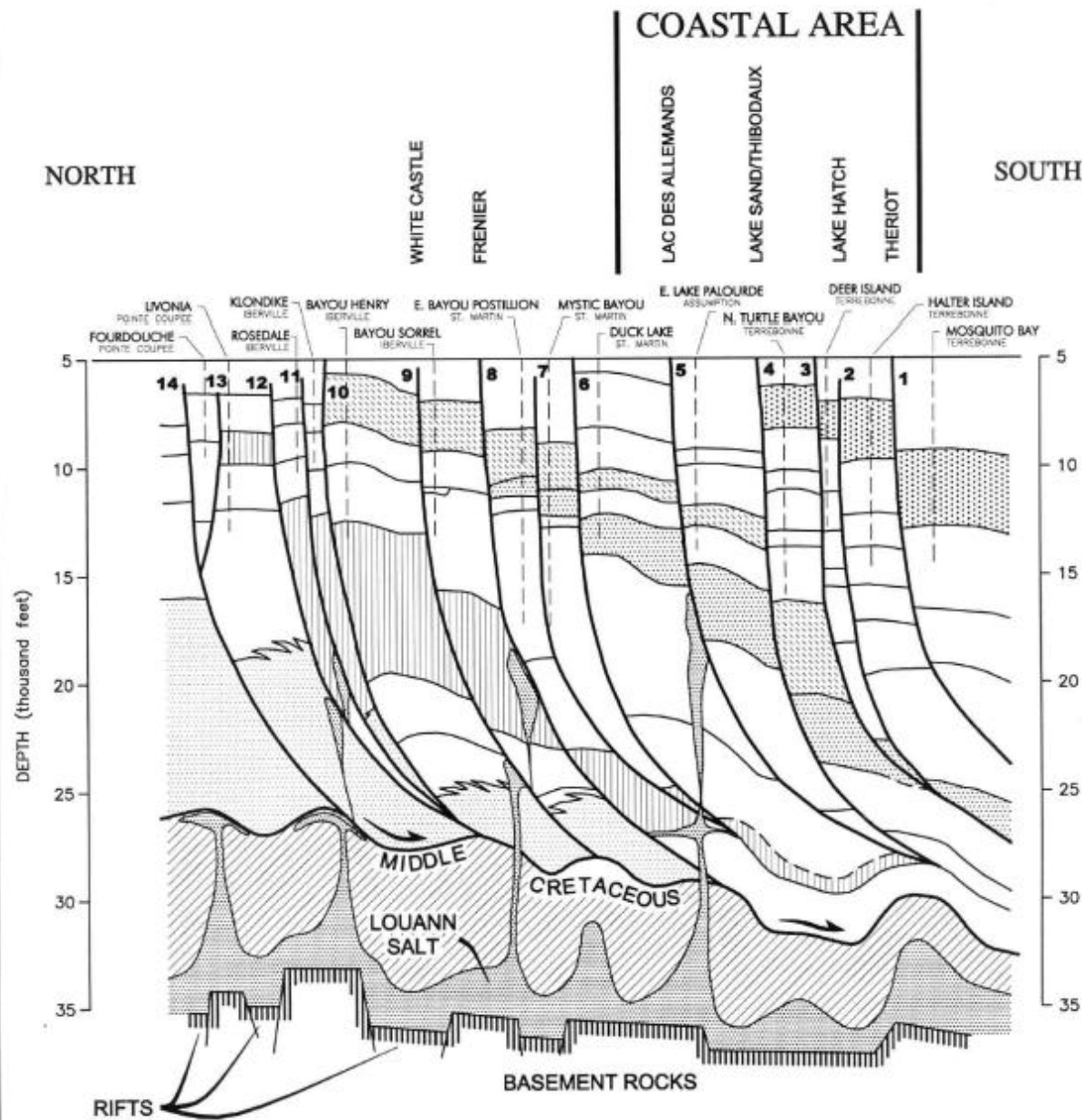
Figure 5. Change in DEMs Relative to MGL

TECTONIC SUBSIDENCE



Tectonic subsidence is caused by sediment compaction at great depths. Salt and muds flow towards the continental shelf. Pressure ridges and fold belts develop; akin to sitting on a peanut butter and jelly sandwich and watching material ooze out and shift.

Lystric Growth Faults



As compacting materials move seaward, the ground surface drops. If sediment is not added at the ground surface, the coast subsides below sea level.

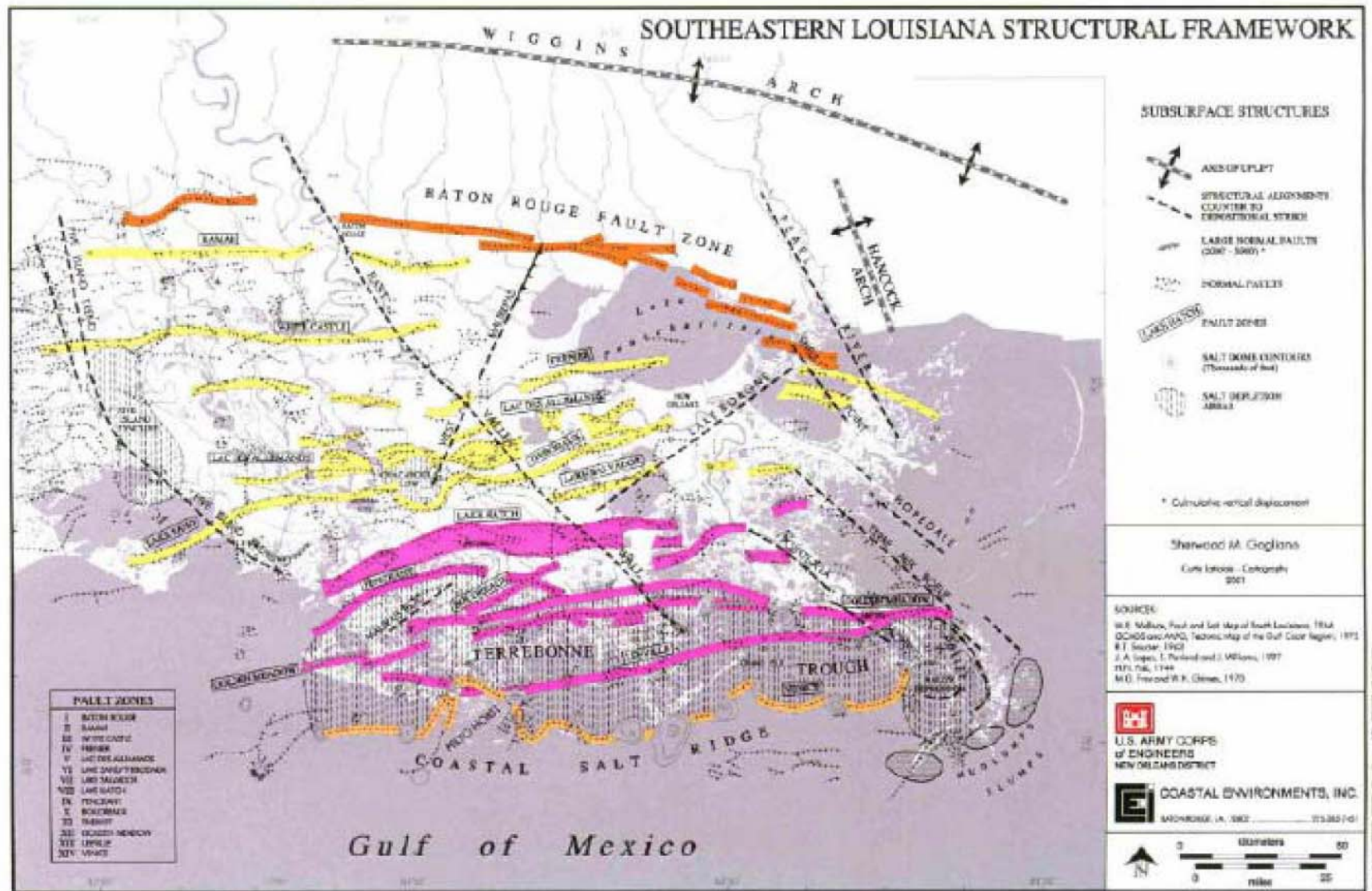


Figure 6. Southeastern Louisiana structural framework, with major faults and salt domes identified.

The delta's lystric growth faults have been grouped into bands thought to be more or less related to one another. Note Baton Rouge Fault Zone.

Compaction of Surficial Sediments



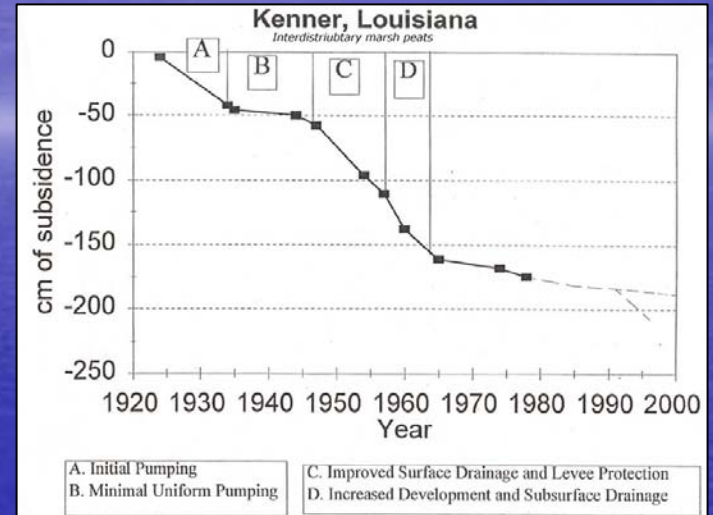
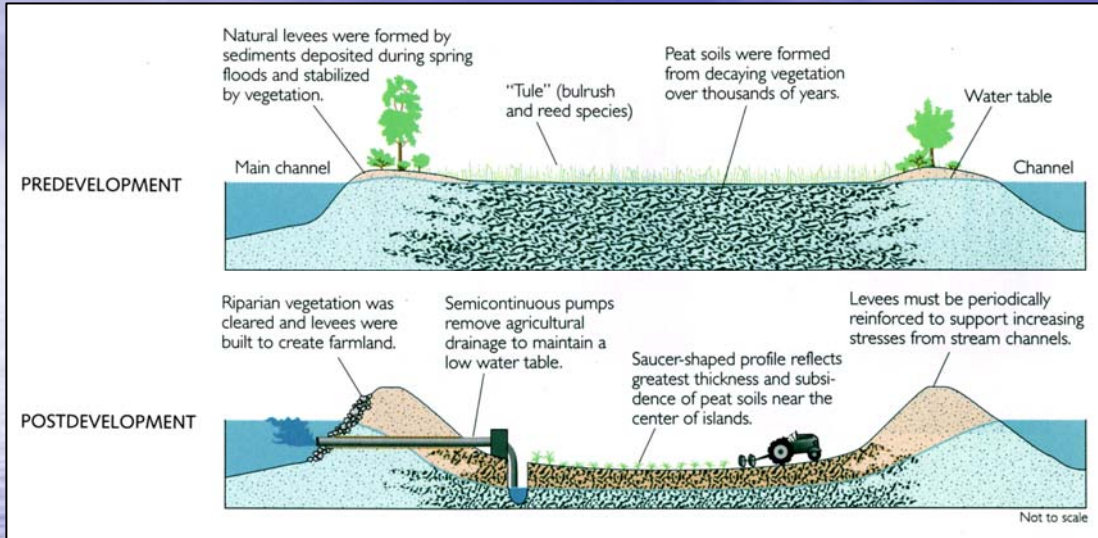
The interdistributary sediment package covering the old back swamps around New Orleans are under consolidated, and exhibit gross settlements in all the Lakeshore and Gentilly neighborhoods. These examples are from the Lakeview area adjacent to the 17th St. Canal failure, where the ground appears to have settled 10 to 16 inches since 1956.



Most residential structures are founded on wood pilings 6 to 8 inches in diameter, driven 30 feet deep. From inspection, it appears that the ground beneath the foundations has settled 10 to 16 inches since these homes were constructed, from the mid-1950s onward.

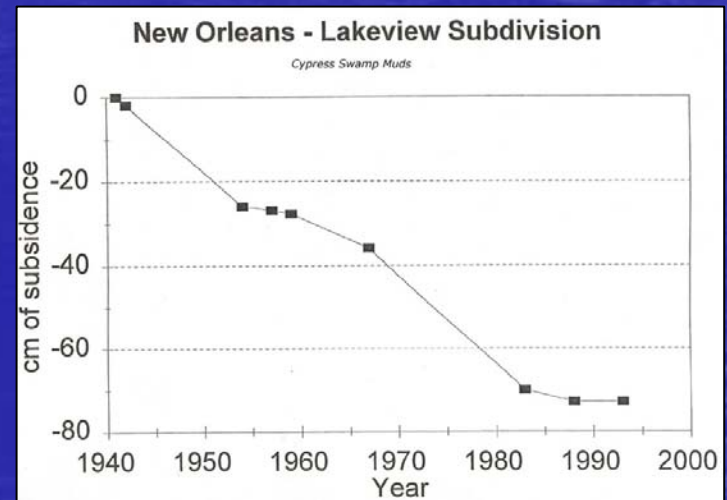
The mechanisms driving this settlement are thought to be drainage of the near surface soils, through simple near-surface dewatering and the storm water collection system.

Oxidation of Organic Soils



As organic rich peat soils are oxidized, the ground settles, creating a depressed area below the grade of adjacent channels.

Both structural and earthen surcharges exacerbate ground settlement.





STRUCTURAL SURCHARGING

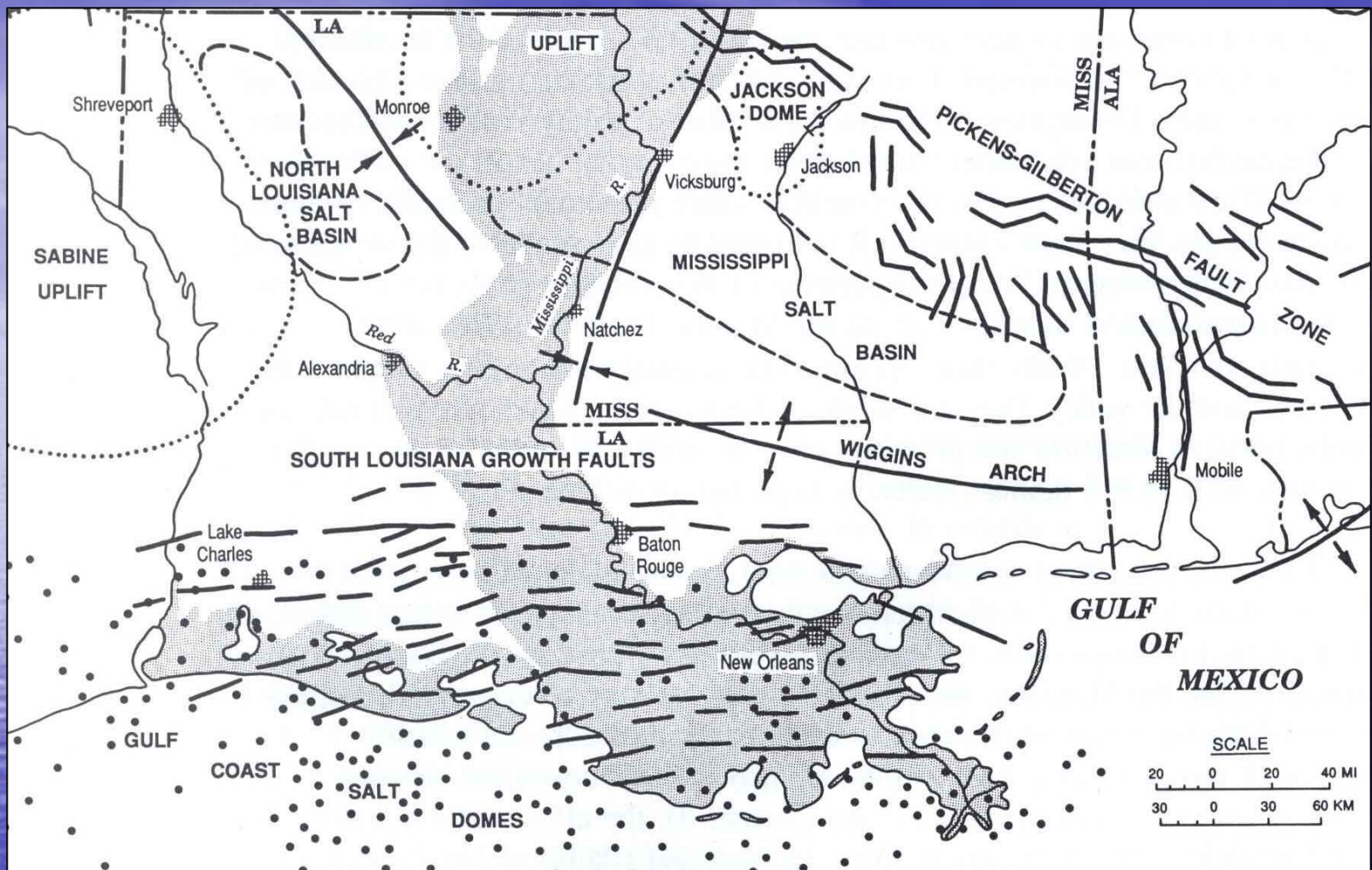
- An interesting aspect of the recent URS-FEMA study is the marked increase in settlement noted in the Central Business District, where tall structures are founded on deep piles. This area settled 5 inches in 100 years, but was much less away from the large structures
- Even the sandy river levees have settled 2 inches; likely due to surcharging by MR&T levee heightening between 1928-60



FLUID EXTRACTION OF OIL, GAS, AND WATER

R.A. Morton of the USGS has blamed oil and gas extraction for the subsidence of the Mississippi Delta. Morton has constructed convincing correlations between petroleum

withdrawal and settlement rates on the southern fringes of the delta, near the mouth of the Mississippi, but this single theory fails to account for marked settlement further north, where little or no deep withdrawal has been undertaken.



Saucier's 1994 structural geology map of the Mississippi Delta, published by the Corps of Engineers. This shows salt basins, salt domes, and active growth faults that pervade the delta region.

Solutioning of salt diapirs and seaward migration of low density contrast materials

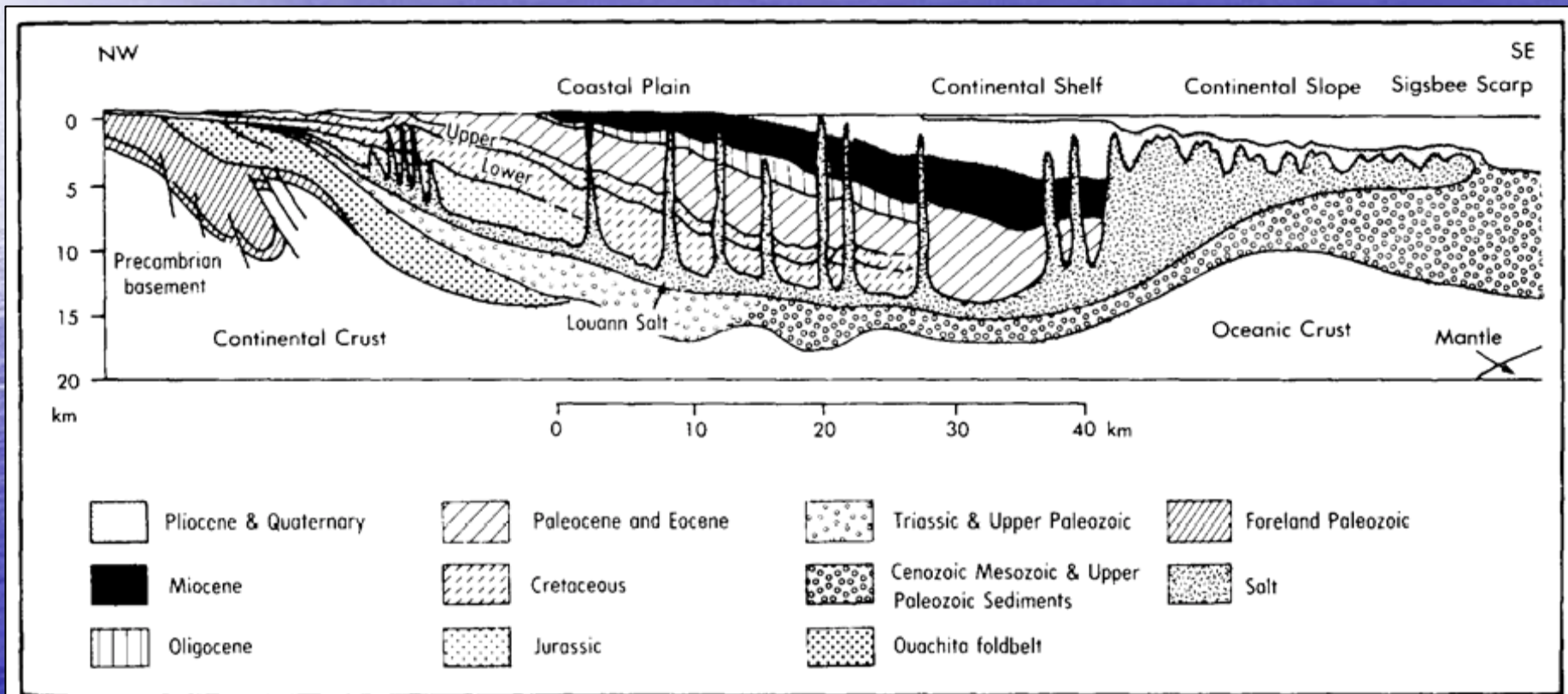
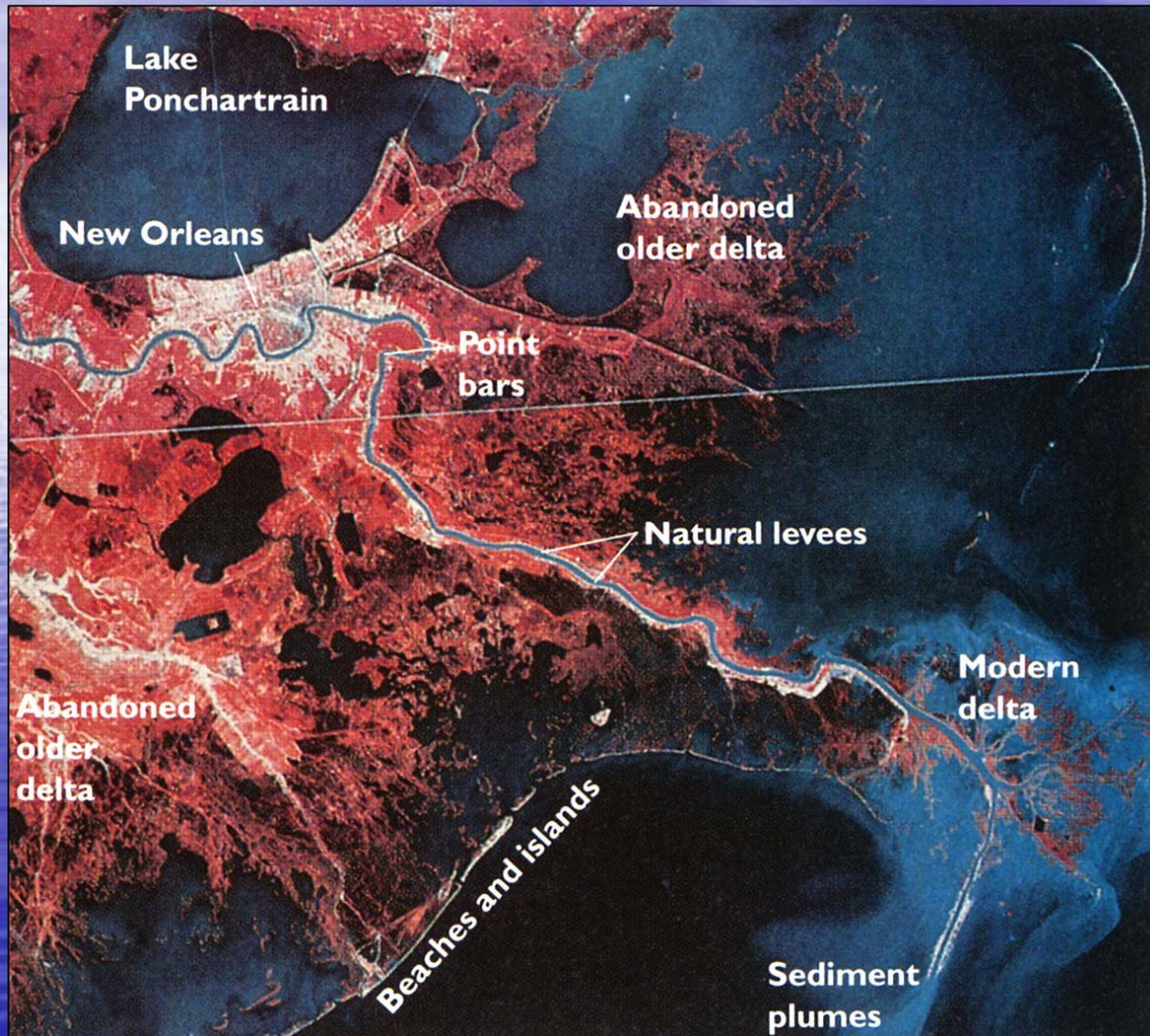


Figure 2. Generalized north-south cross section of the Gulf of Mexico basin in the vicinity of the Louisiana coast. After Buffler (1981).

Loss of Silt Replenishment



- Since 1973, satellites have allowed monitoring of sediment expulsion from the delta and the nefarious shoreline, which is continuously sinking.

COASTAL LOSS STATISTICS

- USGS and NGS say the **rate of subsidence** is between 1/3" to 1/2" per year; or 4.2 ft/100 yrs
- **Sea level rise** is running about 1 ft/100 yrs
- **15% of New Orleans** is already more than - 10 ft below sea level
- The **average current rate of coastal land loss** is between 14 and 30 mi² per year
- The **2050 Reclamation Plan** would restore 25 to 30 mi² over the next 40 to 50 yrs at a cost of \$14 billion



NEW STANDING WATER CREATED BY HURRICANE KATRINA

- The **USGS National Wetlands Research Center** has determined that Hurricane Katrina created as much new standing water area in the Mississippi Delta (below sea level) as occurred naturally over the previous 50 years! This was due to increased traction shear, which tore out large tracts of peat bogs, to depths of several feet.

The Populace Reaction



Hold the Corps
Accountable!

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