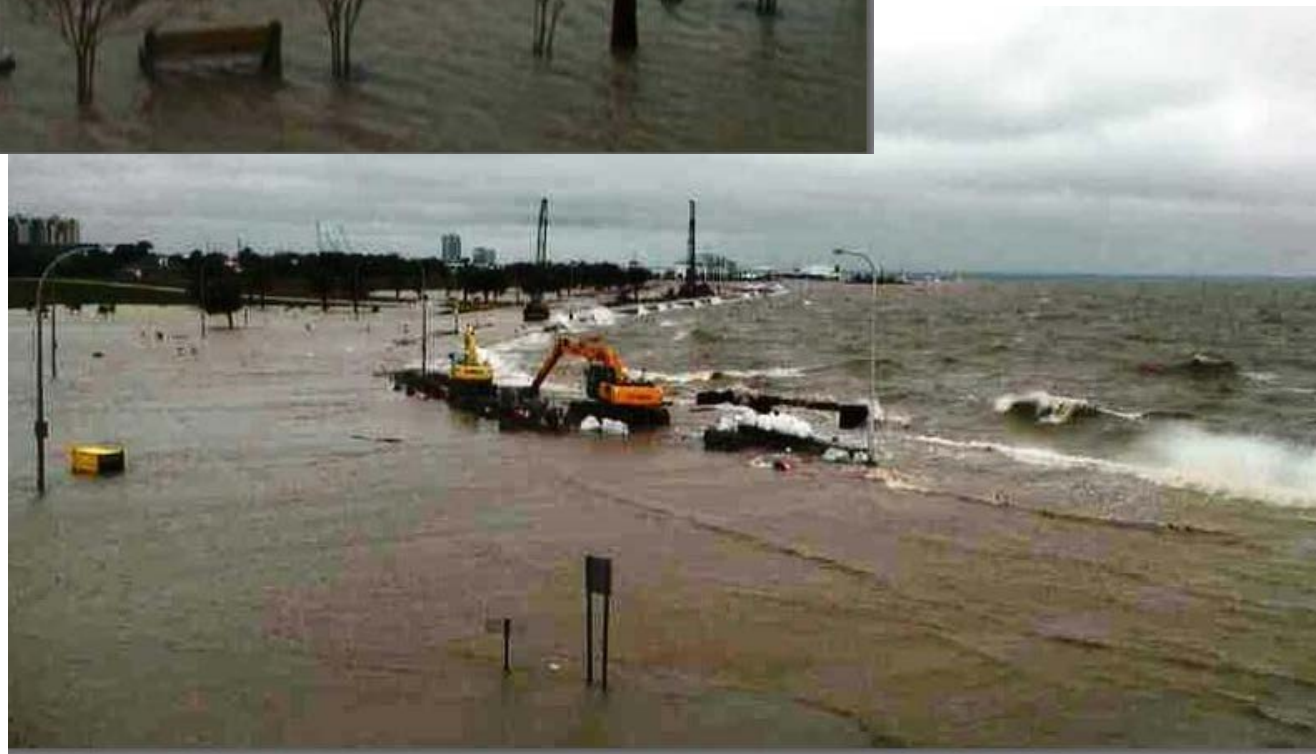
Sea Level Rise and Coastal Louisiana- Rise Trends and Their Effects on Coastal Communities, Projects and Future Landscapes

Standing on a Highway- Old Paris Road- St Bernard Parish



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Associate Editors

A. W. GREELY W J McGEE HENRY GANNETT
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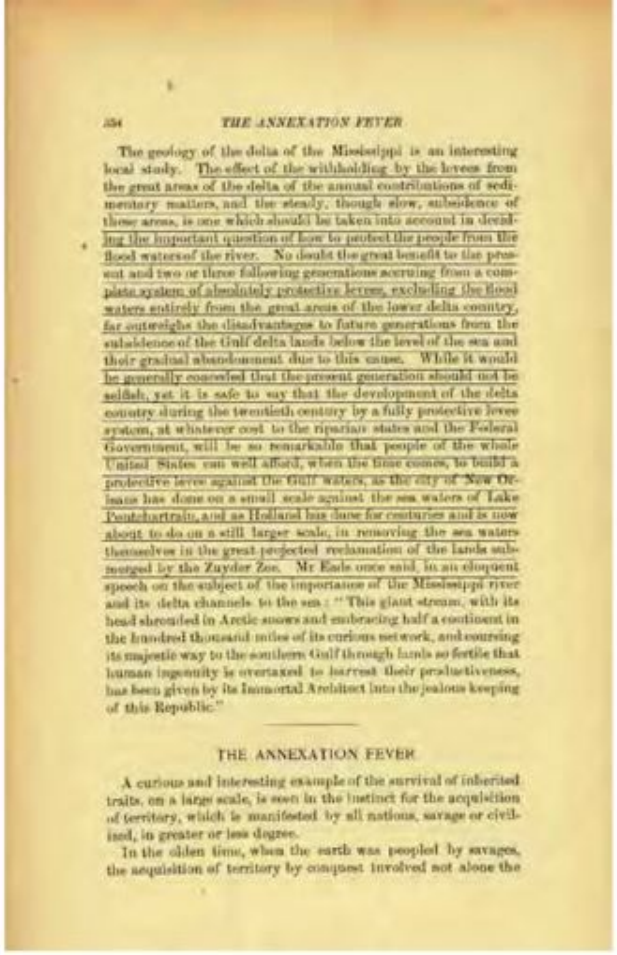


354 THE ANNEXATION FEVER

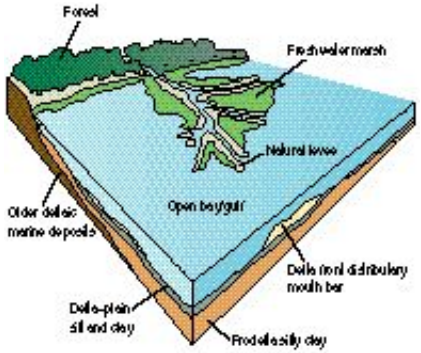
The geology of the delta of the Mississippi is an interesting local study. The effect of the withholding by the levees from the great areas of the delta of the annual contributions of sedimentary matters, and the steady, though slow, subsidence of these areas, is one which should be taken into account in deciding the important question of how to protect the people from the flood waters of the river. No doubt the great benefit to the present and two or three following generations accruing from a complete system of absolutely protective levees, excluding the flood waters entirely from the great areas of the lower delta country, far outweighs the disadvantages to future generations from the subsidence of the Gulf delta lands below the level of the sea and their gradual abandonment due to this cause. While it would be generally conceded that the present generation should not be selfish, yet it is safe to say that the development of the delta country during the twentieth century by a fully protective levee system, at whatever cost to the riparian states and the Federal Government, will be so remarkable that people of the whole United States can well afford, when the time comes, to build a protective levee against the Gulf waters, as the city of New Orleans has done on a small scale against the sea waters of Lake Pontchartrain, and as Holland has done for centuries and is now about to do on a still larger scale, in removing the sea waters themselves in the great projected reclamation of the lands submerged by the Zuyder Zee. Mr Eads once said, in an eloquent speech on the subject of the importance of the Mississippi river and its delta channels to the sea: "This giant stream, with its head shrouded in Arctic snows and embracing half a continent in the hundred thousand miles of its curious net work, and coursing its majestic way to the southern Gulf through lands so fertile that human ingenuity is overtaxed to harvest their productiveness, has been given by its Immortal Architect into the jealous keeping of this Republic."

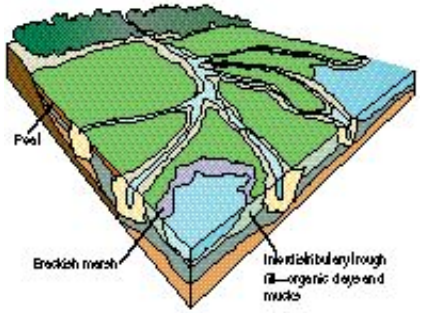
THE ANNEXATION FEVER

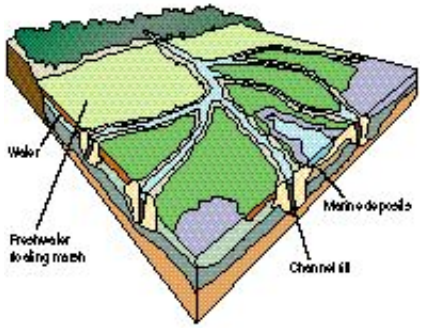
A curious and interesting example of the survival of inherited traits, on a large scale, is seen in the instinct for the acquisition of territory, which is manifested by all nations, savage or civilized, in greater or less degree.

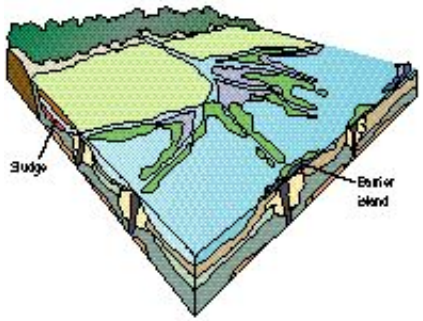
In the olden time, when the earth was peopled by savages, the acquisition of territory by conquest involved not alone the

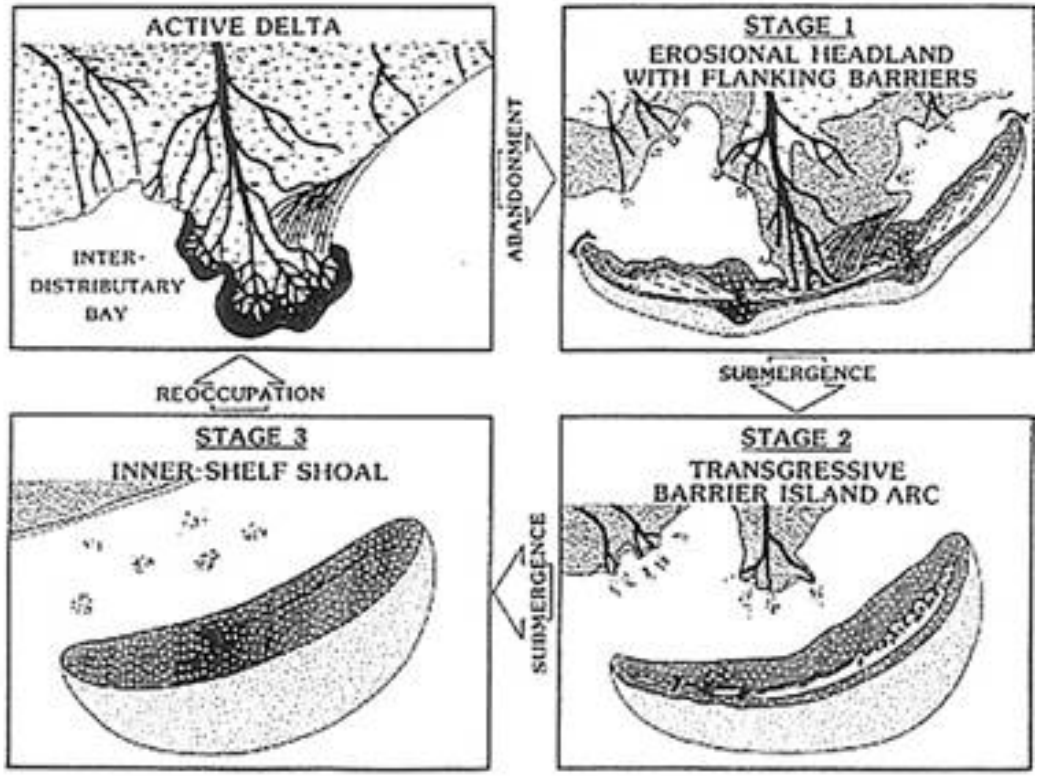
1897—"The effects of the withholding by the levees from the great areas of the delta of the annual contribution of sedimentary matters and the steady, though slow, subsidence of the theses areas, is one which should be taken in account in deciding the important question of how to protect the people from the flood waters of the river....No doubt the great benefit to the present and two or three following generations accruing from a complete system of absolutely protective levees...*far outweighs the disadvantages to future generations from the subsidence of the Gulf delta lands below the level of the sea and their gradual abandonment due to this cause...*"


Forest
Freshwater marsh
Natural levee
Open bay/gulf
Older deltaic marine deposits
Delta front distributary mouth bar
Delta-plain silt and clay
Prodelta silty clay

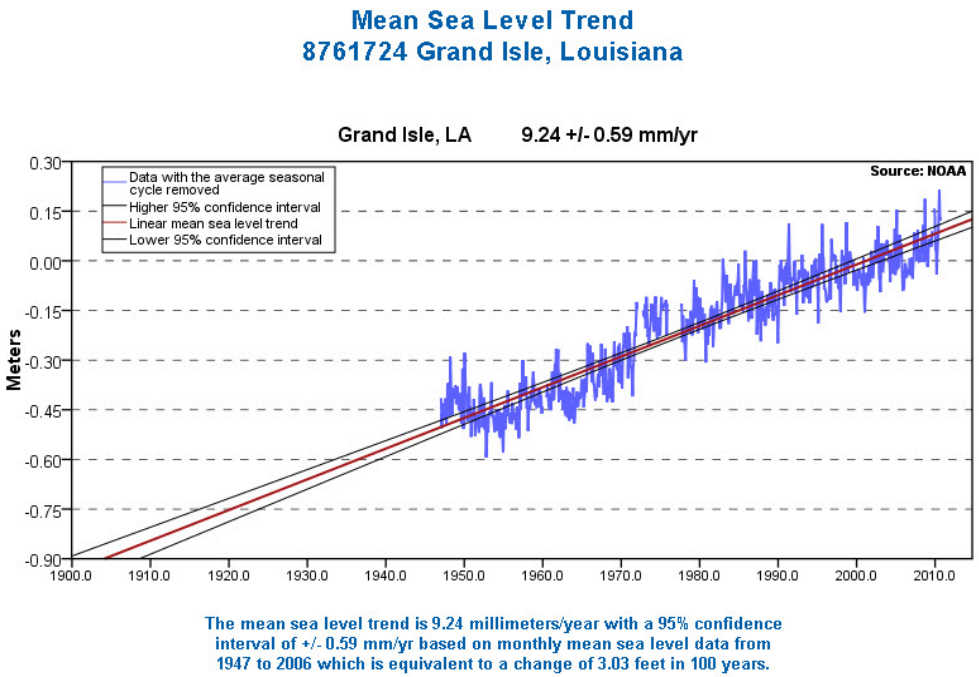

Peat
Brackish marsh
Interdistributary trough fill—organic clays and muds


Water
Freshwater/ brackish marsh
Marine deposits
Channel fill


Sludge
Barrier island

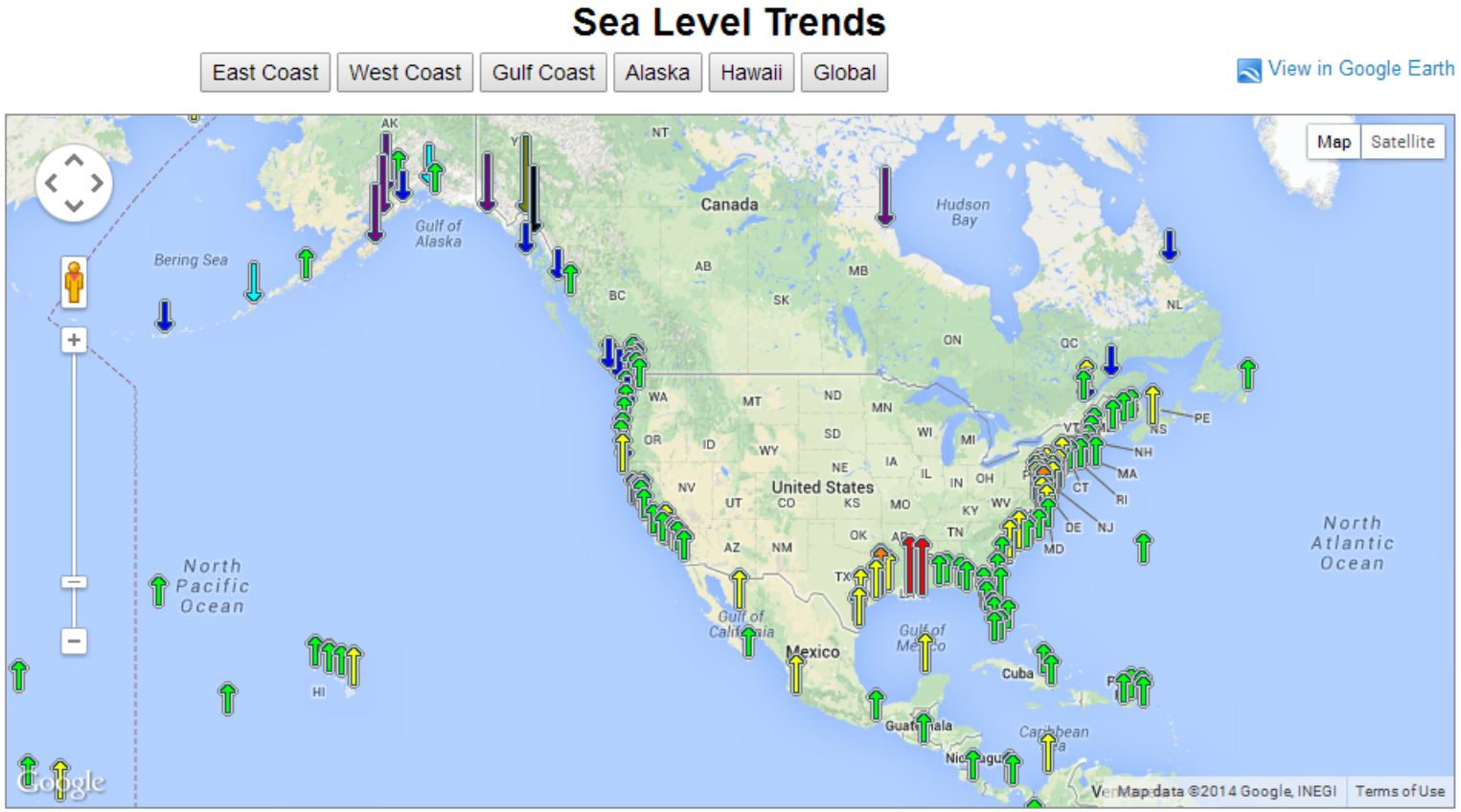

ACTIVE DELTA
INTER-DISTRIBUTARY BAY
ABANDONMENT
STAGE 1
EROSIONAL HEADLAND WITH FLANKING BARRIERS
SUBMERGENCE
REOCCUPATION
STAGE 3
INNER-SHELF SHOAL
SUBMERGENCE
STAGE 2
TRANSGRESSIVE BARRIER ISLAND ARC
REGRESSIVE ENVIRONMENTS
Distributary
Fresh Marsh
Beach Ridge
TRANSGRESSIVE ENVIRONMENTS
Subaerial Barrier Sands
Subaqueous Barrier Sands
Sand Sheet
Salt Marsh
Recurved Spit
Shell Reef
Tidal Channel

Sea Level in Lousiana is Rising Relative to the Land at a Rapid Rate

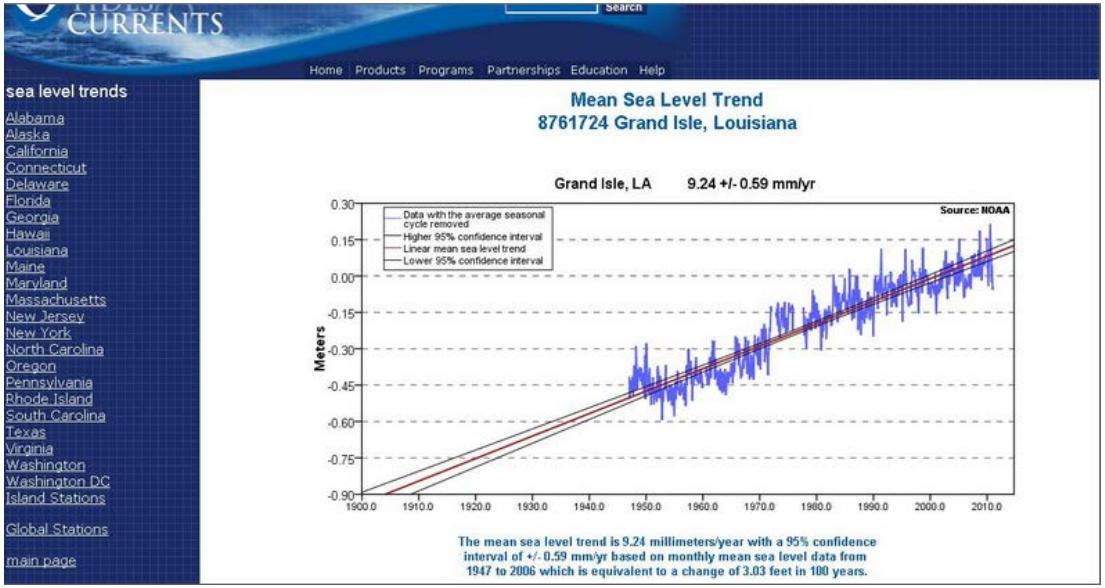


Note: The tide gauge record at Grand Isle contains components of global sea level rise, regional oceanographic change, and regional local vertical land motion.

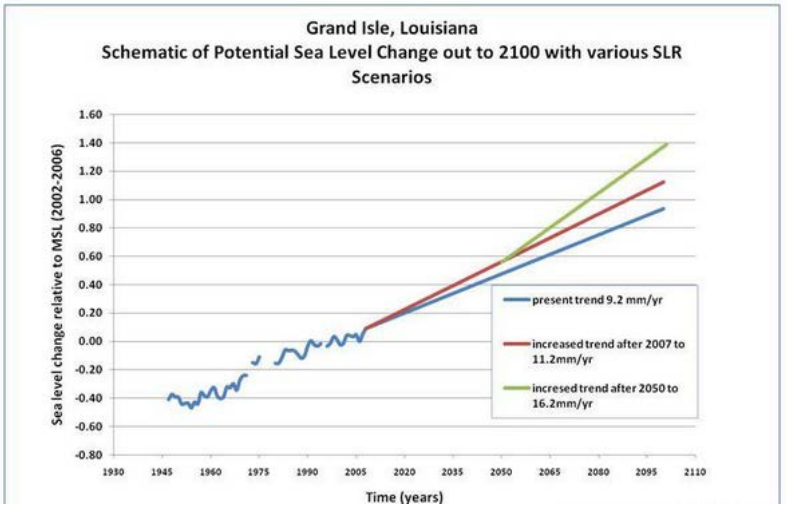
NOAA's Resources in the Measuring and Reporting of Sea Level Rise Trends is a National Effort Joined into an International Collaboration to Observe and Report on Sea Level Trends



The map above illustrates regional trends in sea level, with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that station.



Present Trends Shown with Two Possible Trend Increases that Both NOAA and USACE have Reported for the Grand Isle and SE Louisiana Area



ER 1100-2-8162
31 Dec 13

USACE- Sea Level Trends and Anaylysis for Grand Isele and SE Coastal Louisiana- Rates Resulting in ~4 to 8.9 Feet of Relative Sea Level Rise by 2112 for SE Coastal Louisiana including Terrebonne, Lafourche, Orleans, Plaquemines, Jefferson and others

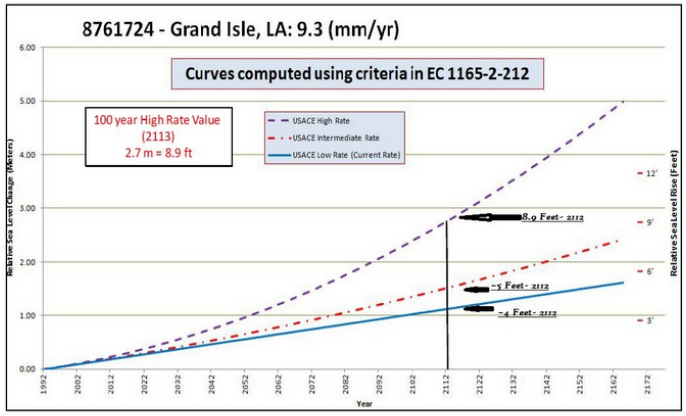
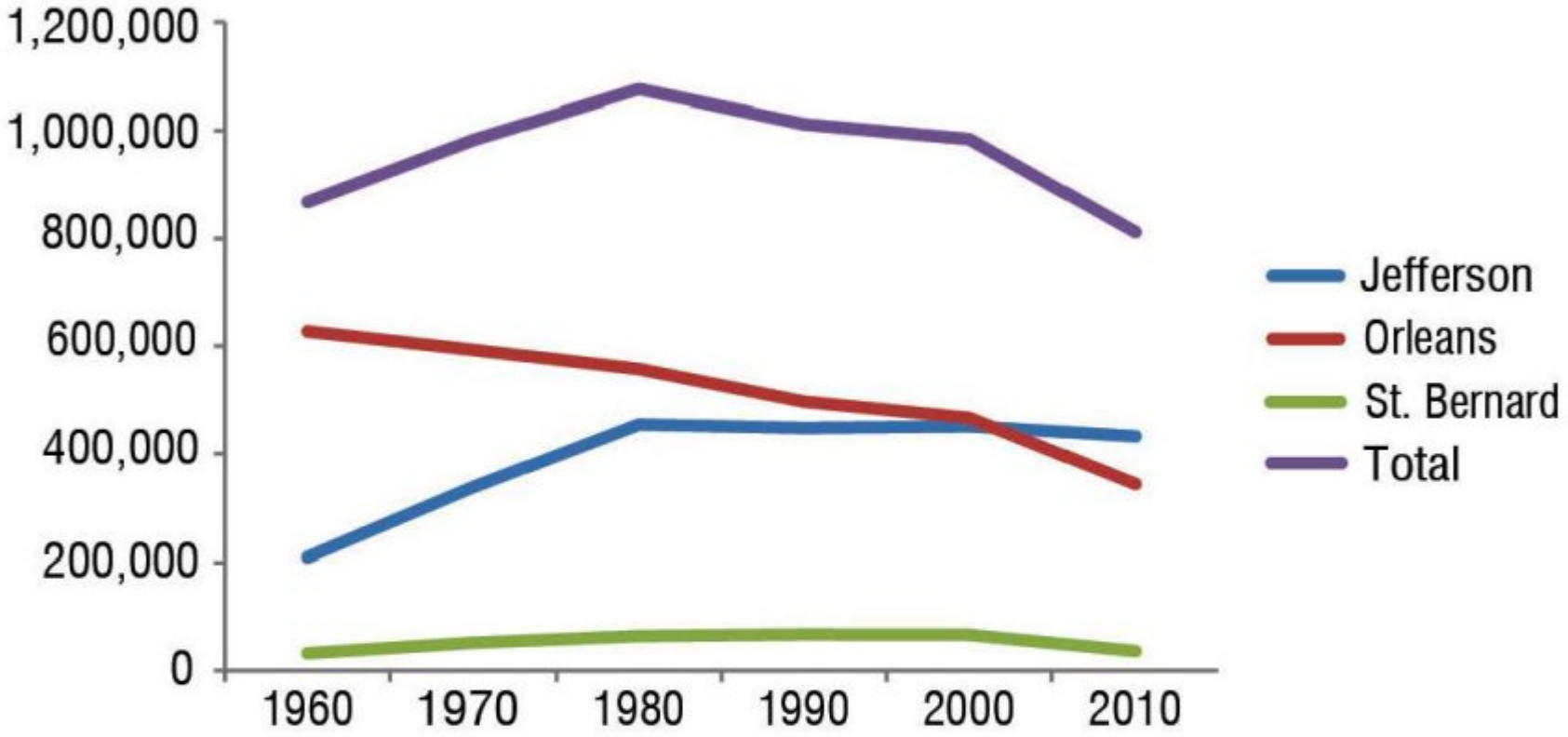


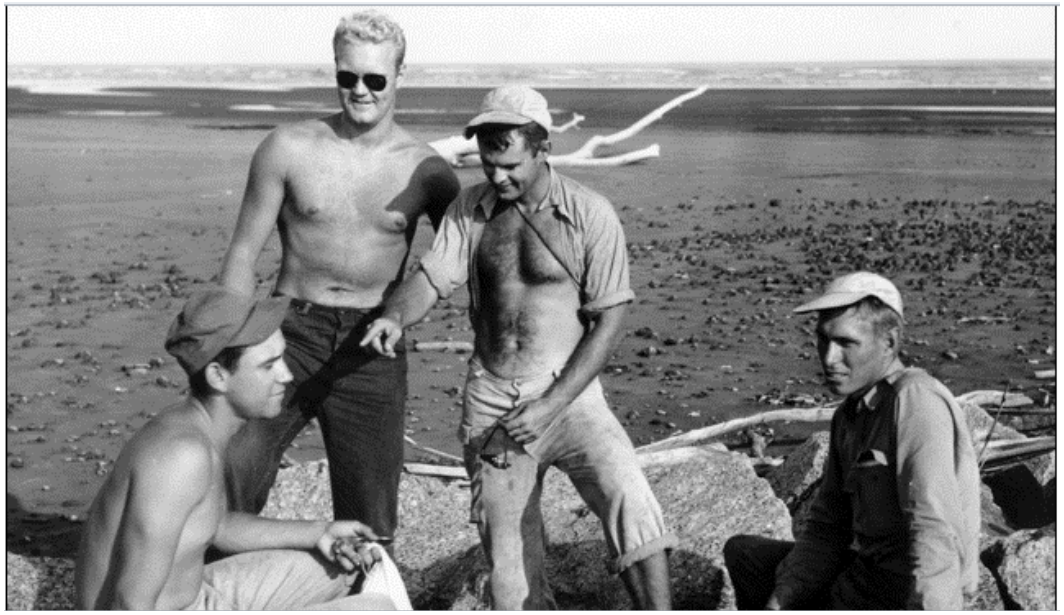
Figure B-10. Example USACE SLC curves for Grand Isle, Louisiana.

Population Trends

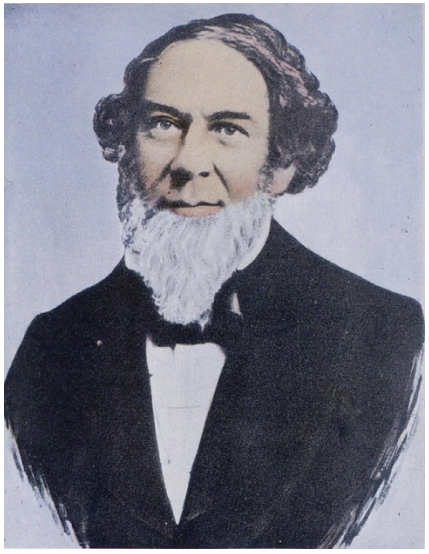


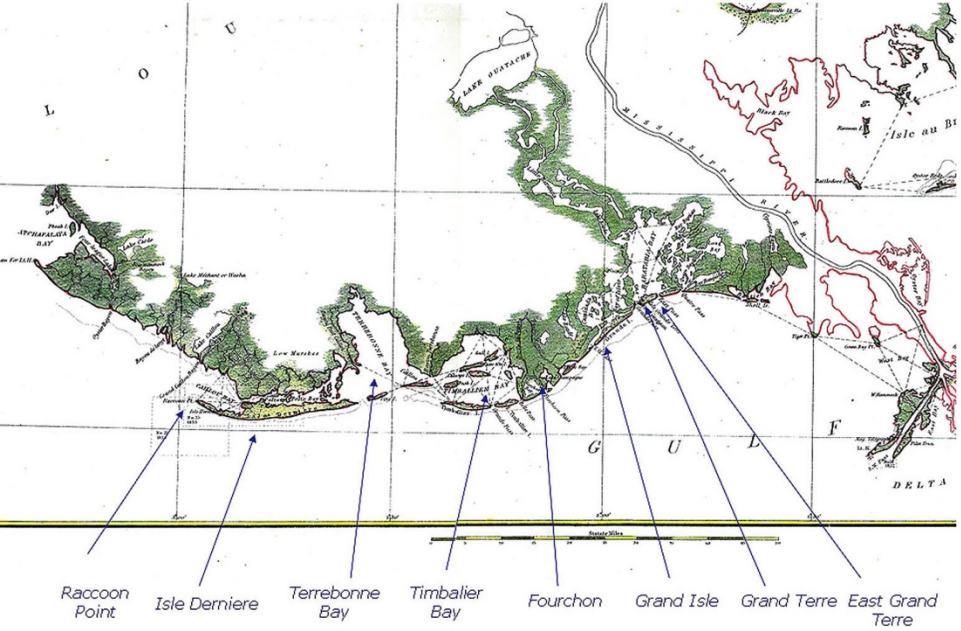
	1960	1970	1980	1990	2000	2010
Jefferson Parish	208,769	337,568	454,592	448,306	451,109	432,552
Orleans Parish	627,525	593,471	557,515	496,938	467,033	343,829
St. Bernard Parish	32,186	51,185	64,097	66,631	66,441	35,897
Total	870,440	982,224	1,076,204	1,011,875	984,583	812,278

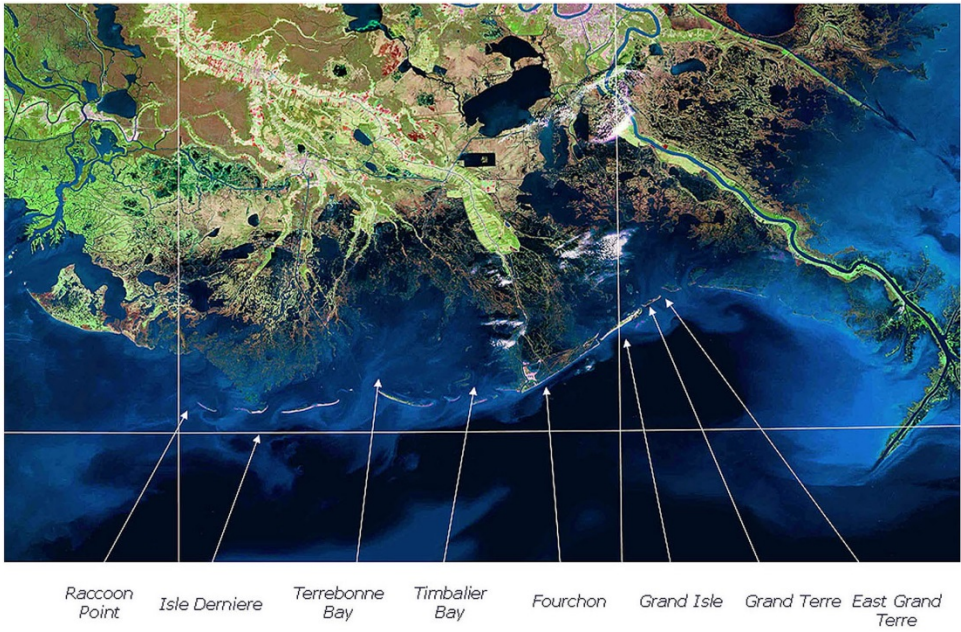
Harold N. Fisk (far left), revolutionized geological studies of the Mississippi River Valley

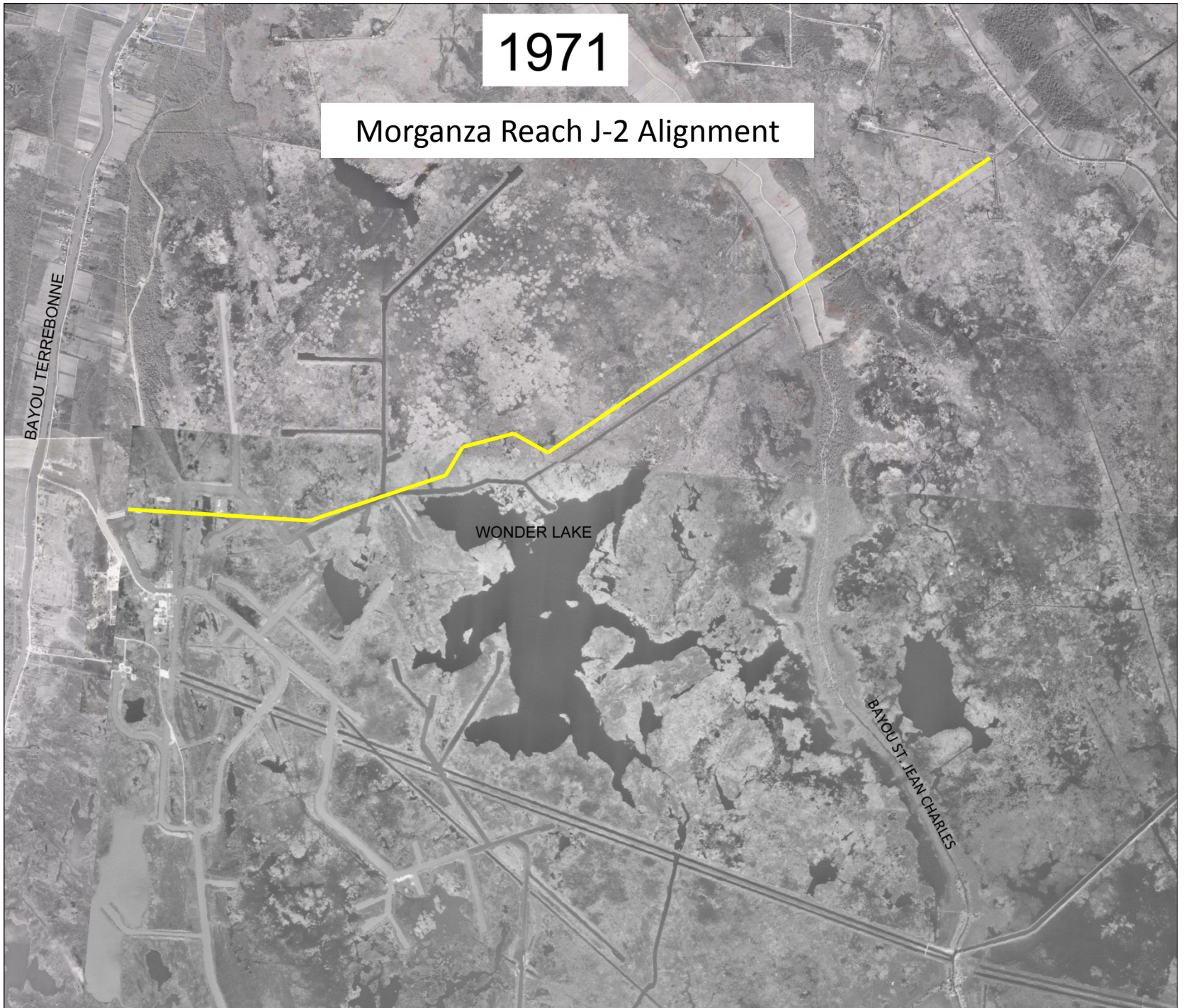


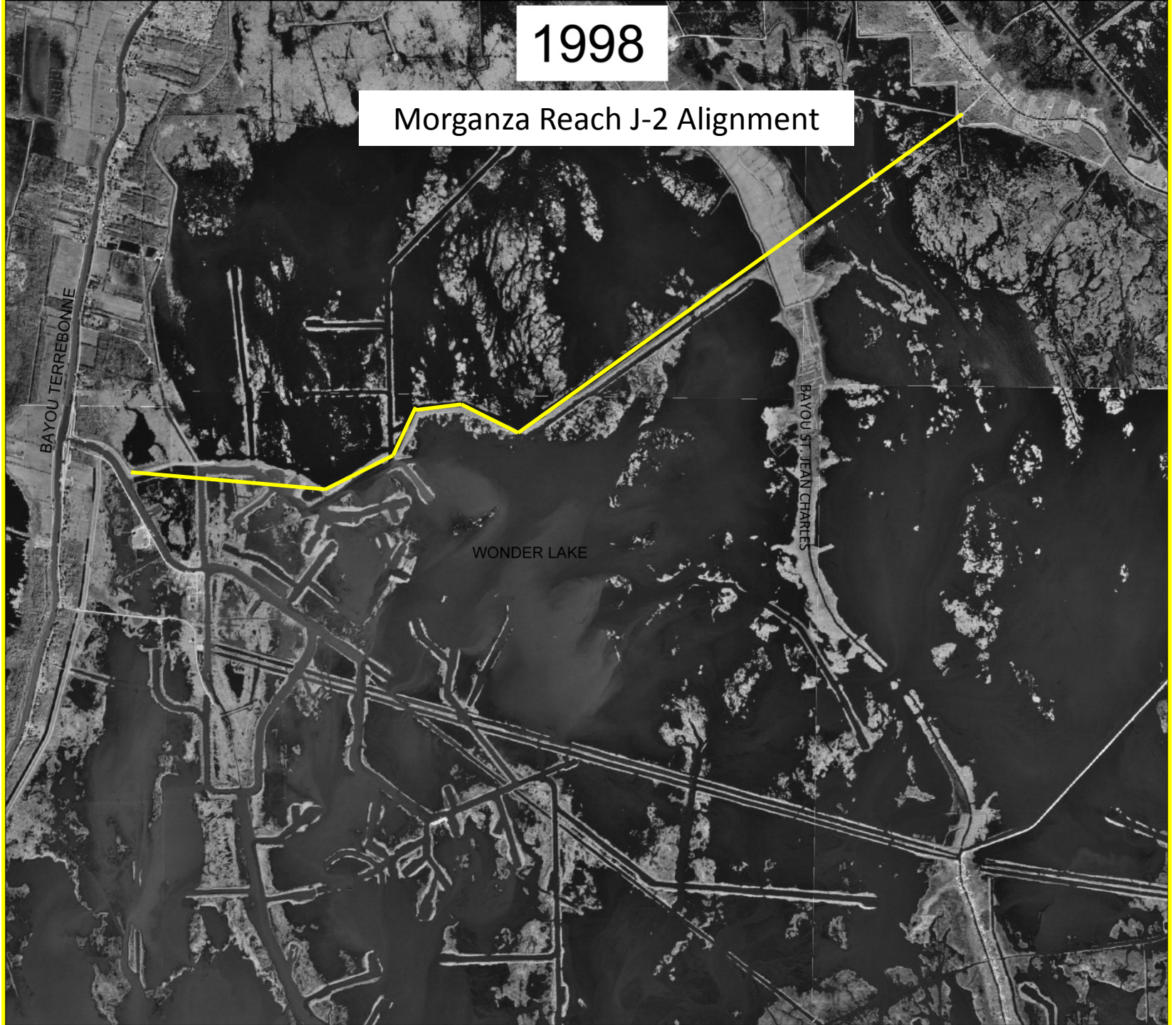
In Memory of Dr. Frank Welder, LSU Coastal Studies

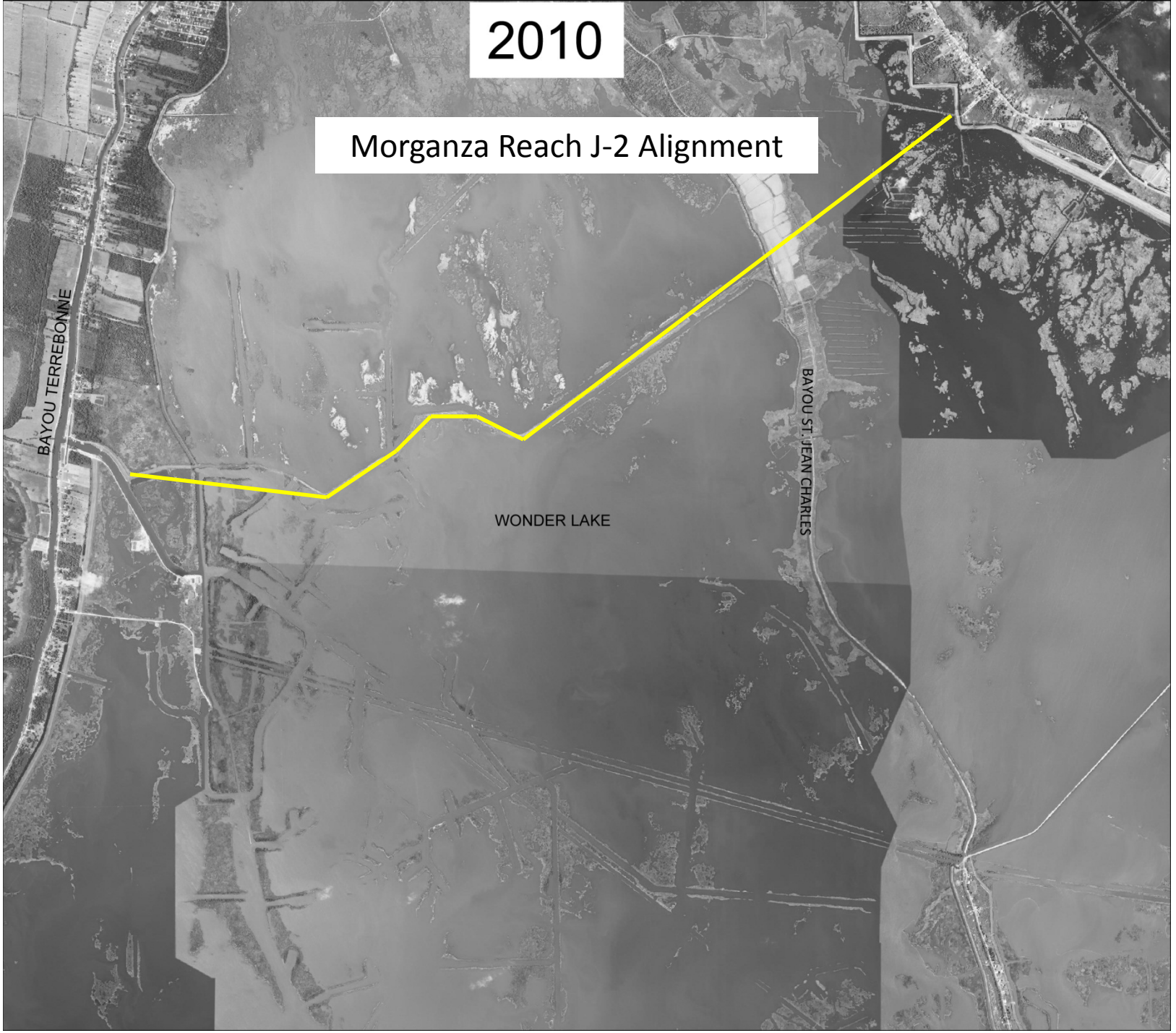



LAKE PONTCHE
Isle au Br
DELTA
Raccoon Point
Isle Derniere
Terrebonne Bay
Timbalier Bay
Fourchon
Grand Isle
Grand Terre
East Grand Terre


Raccoon Point
Isle Derniere
Terrebonne Bay
Timbalier Bay
Fourchon
Grand Isle
Grand Terre
East Grand Terre


1971
Morganza Reach J-2 Alignment
BAYOU TERREBONNE
WONDER LAKE
BAYOU ST. JEAN CHARLES

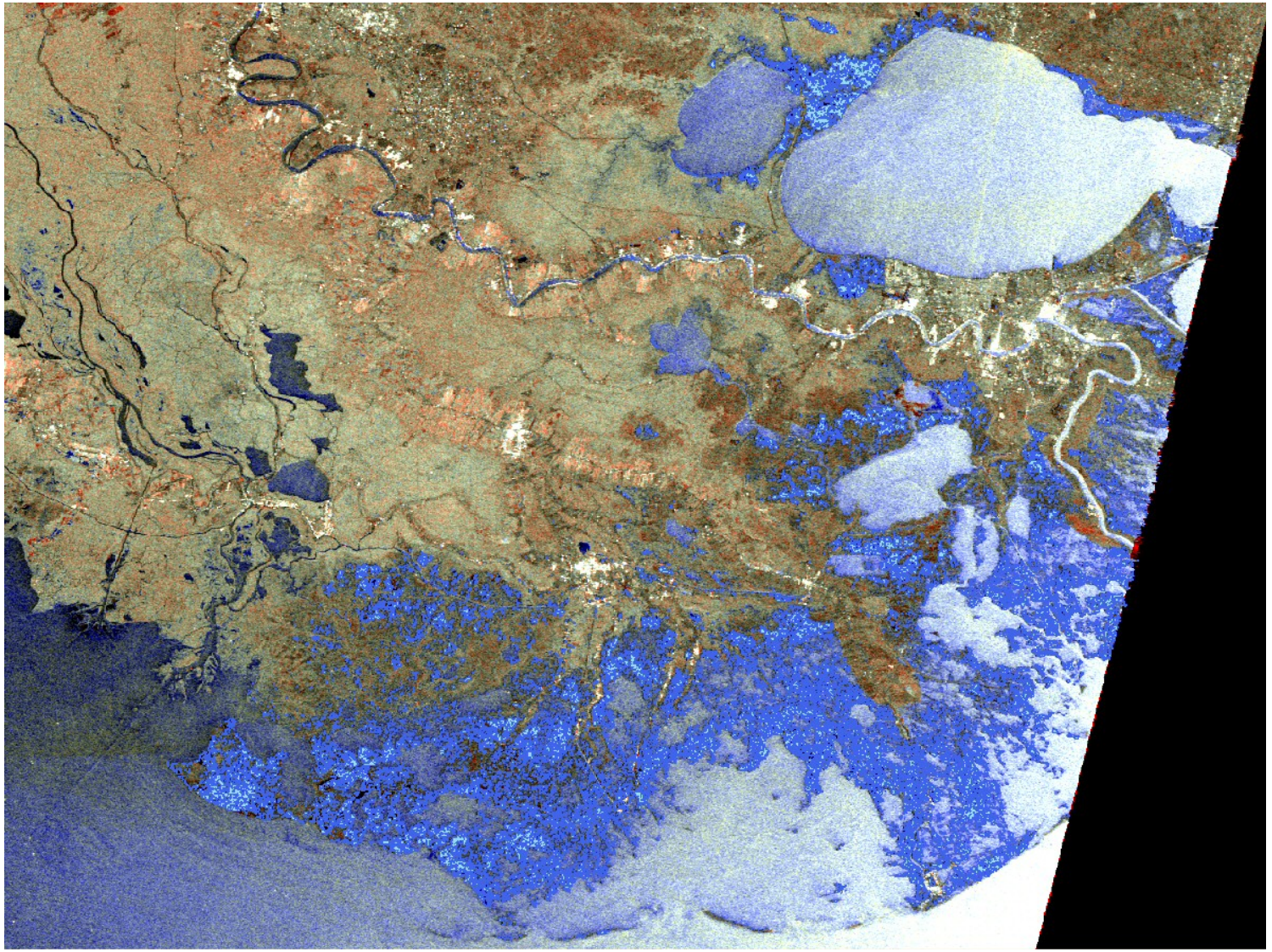

1998
Morganza Reach J-2 Alignment
BAYOU TERREBONNE
WONDER LAKE
BAYOU ST. JEAN CHARLES


2010
Morganza Reach J-2 Alignment
BAYOU TERREBONNE
BAYOU ST. JEAN CHARLES
WONDER LAKE


Interior of Caminada Headland and Open Water

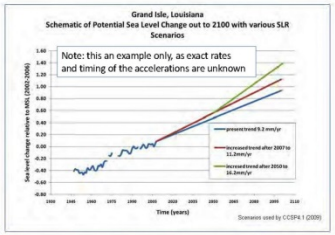
Caminada Headland Inundated by Tropical System, July 2010

Hurricane Ike Flooding Eastern Louisiana



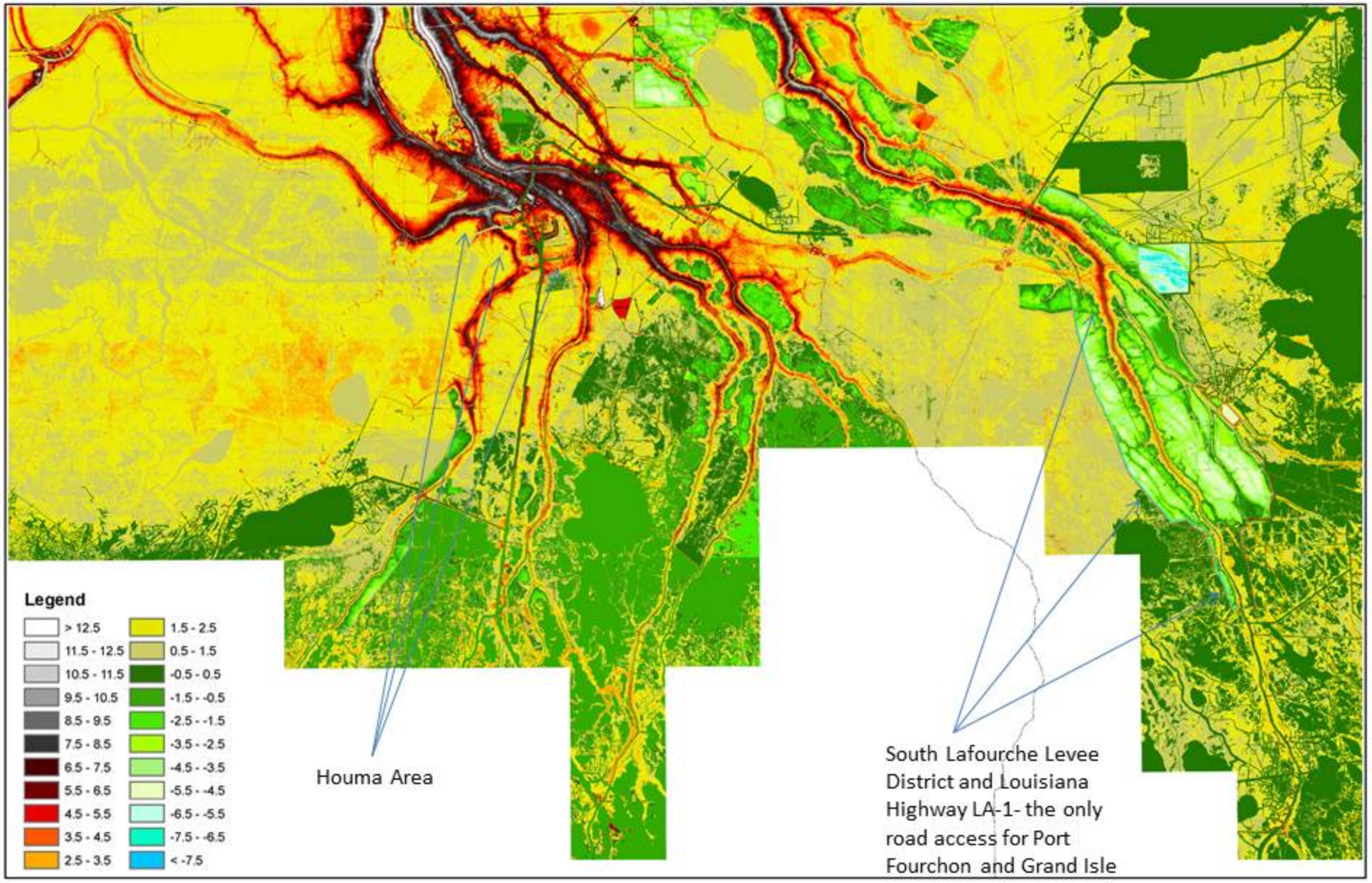
St Charles Parish— Bayou Gauche Area– Flooding of the Main Road and Home Areas by High Tides. With 9.24mm of Relative SLR Yearly– Submergence of this Area is Rapid

Climate models project acceleration in Sea Level Rise starting before 2100 due to climate change- Many Areas through SE Coastal Louisiana See High Rates Now In Excess of 10mm



Living in a Basin

LIDAR Elevation Imagery over Terrebonne and South Lafourche Parishes, Louisiana



An Effort was Implemented by NOAA CO-OPS to Update the Posted Water Levels of Various Coastal Areas on a Shorter- 5 Year Cycle

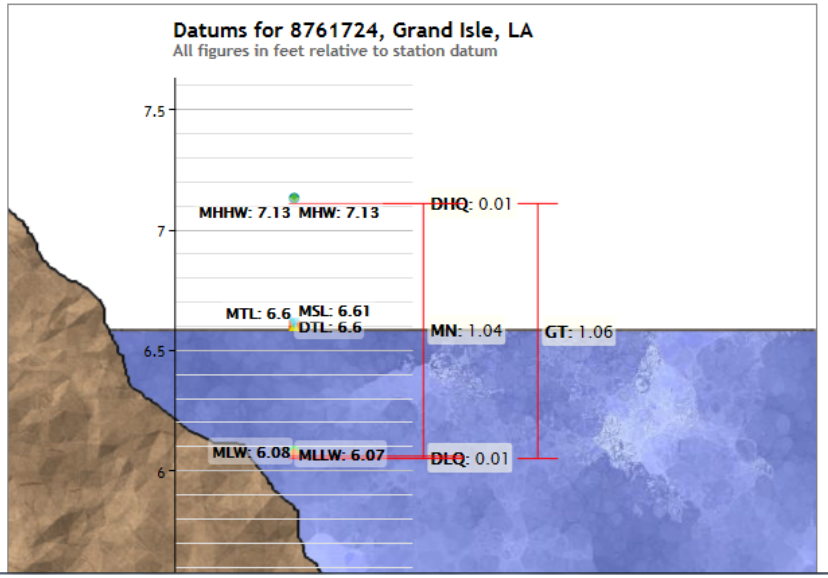
Datums for 8761724, Grand Isle LA

Certain geographic areas are experiencing rapid land movement due to uplift or subsidence, which results in anomalous relative sea level trends compared to most other coastal regions in the United States (see http://tidesandcurrents.noaa.gov/sltrends/). In these areas, NOAA has adopted a modified procedure for computing accepted tidal datums for the National Water Level Observation Network (NWLON). The long-term control stations in these areas have tidal datums updated approximately every 5 years using the modified procedure, with the most recent update being the 2007-2011 Modified Procedure. The adoption of this procedure was necessary to ensure that these tidal datums accurately represent the existing stand of sea level relative to the land. A detailed report explaining this modified procedure can be found in the publications section of the CO-OPS Tides & Currents website at http://tidesandcurrents.noaa.gov/pub.html.

Elevations on Station Datum

Station: 8761724, Grand Isle, LA **T.M.:** 90 W
Status: Accepted (Apr 29 2014) **Epoch:** 2007-2011
Units: Feet **Datum:** STND

Datum	Value	Description
MHHW	7.13	Mean Higher-High Water
MHW	7.13	Mean High Water
MTL	6.60	Mean Tide Level
MSL	6.61	Mean Sea Level
DTL	6.60	Mean Diurnal Tide Level
MLW	6.08	Mean Low Water
MLLW	6.07	Mean Lower-Low Water
NAVD88		North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	1.06	Great Diurnal Range
MN	1.04	Mean Range of Tide



Notification Of Updated Tidal Datums
Using The 2007-2011 Modified Procedure For Computing Accepted Tidal Datums
For Areas With Anomalous Sea Level Trends

SUMMARY: NOAA's National Ocean Service (NOS), Center for Operational Oceanographic Products and Services (CO-OPS), last updated the Nation's tidal datums to a new National Tidal Datum Epoch (NTDE) in April 2003 to adjust for changes in mean sea level that have occurred along the Nation's coast over the past 25 years. The NTDE was updated from the 1960-1978 to the 1983- 2001 time period effective on May 28, 2003 (Federal Register, volume 68, Number 102). The NTDE is a specific 19-year period over which tide observations are taken to determine Mean Sea Level and other tidal datums such as Mean Lower Low Water and Mean High Water. This period includes an 18.6 year astronomical cycle that accounts for all significant variations in the distances to the moon and sun that cause slowly varying changes in the range of tide. It is the policy of NOS to consider a revised NTDE every 20-25 years in order to take into account relative sea level changes caused by global sea level rise and the effects of long term land movement on local sea level due to subsidence or glacial rebound. The NTDE of 1983-2001 has been adopted so that all tidal datums throughout the United States will be based on one specific common reference period.

In 1998, NOS recognized the need for a modified procedure for computing accepted tidal datums for regions with anomalously high rates of relative sea level change, and has adopted a 5 year computational period to better reflect the current mean sea level datum. Consequently, tidal datums at stations exhibiting anomalous trends are computed from MSL observations for the most recent 5 year time period, and tidal ranges based on the most recent 19 year NTDE observations at that station. Anomalous relative sea level trends are seen along the western Gulf Coast, southeast Alaska, and southern Cook Inlet, AK (Figure 1). The magnitudes of the sea level trends in these areas are so large, (+9.24 mm/yr in Grand Isle, LA; -12.92 mm/yr in Juneau, AK; and -9.45 mm/yr in Seldovia, AK), that computation of a 19-year epoch value for mean sea level has little practical meaning.

The modified procedure is necessary at selected stations to ensure that the tidal datums accurately represent the existing stand of sea level. Sea level analyses in these anomalous regions are conducted approximately every five years to determine if the sea level trend exceeds the established 9.0mm/yr threshold tolerance in order to qualify for a 5-yr modified procedure datum update. A detailed report explaining this modified procedure can be found in the publications section of the CO-OPS Tides & Currents website at http://tidesandcurrents.noaa.gov/pub.html.

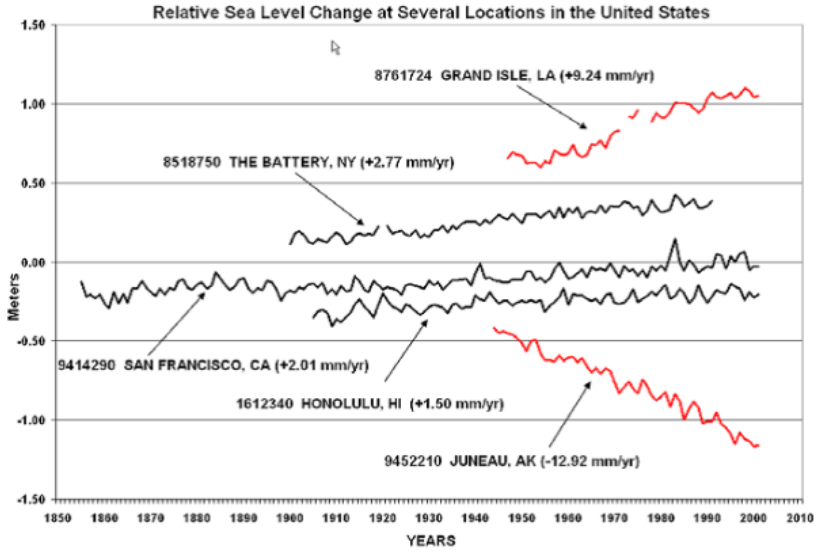
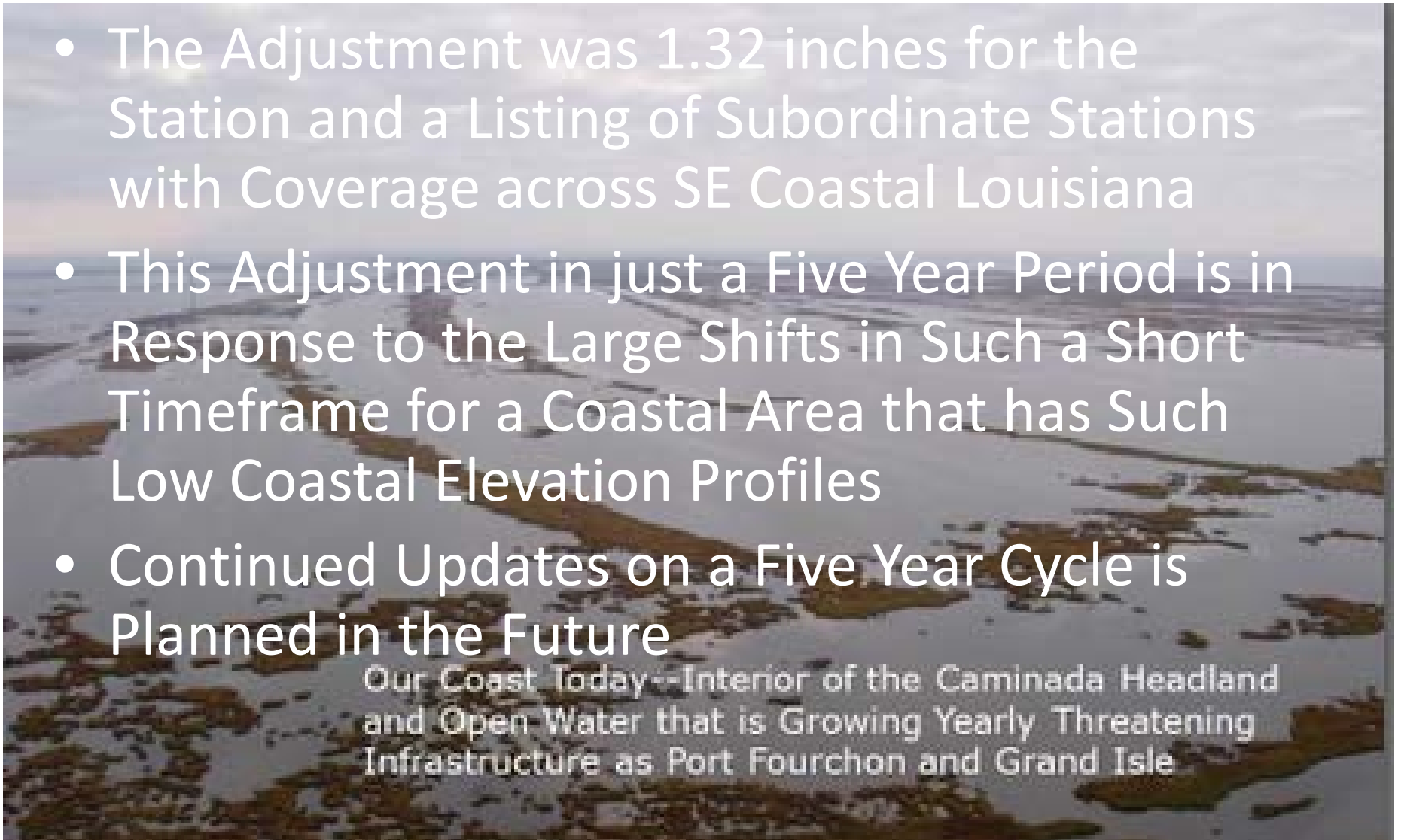


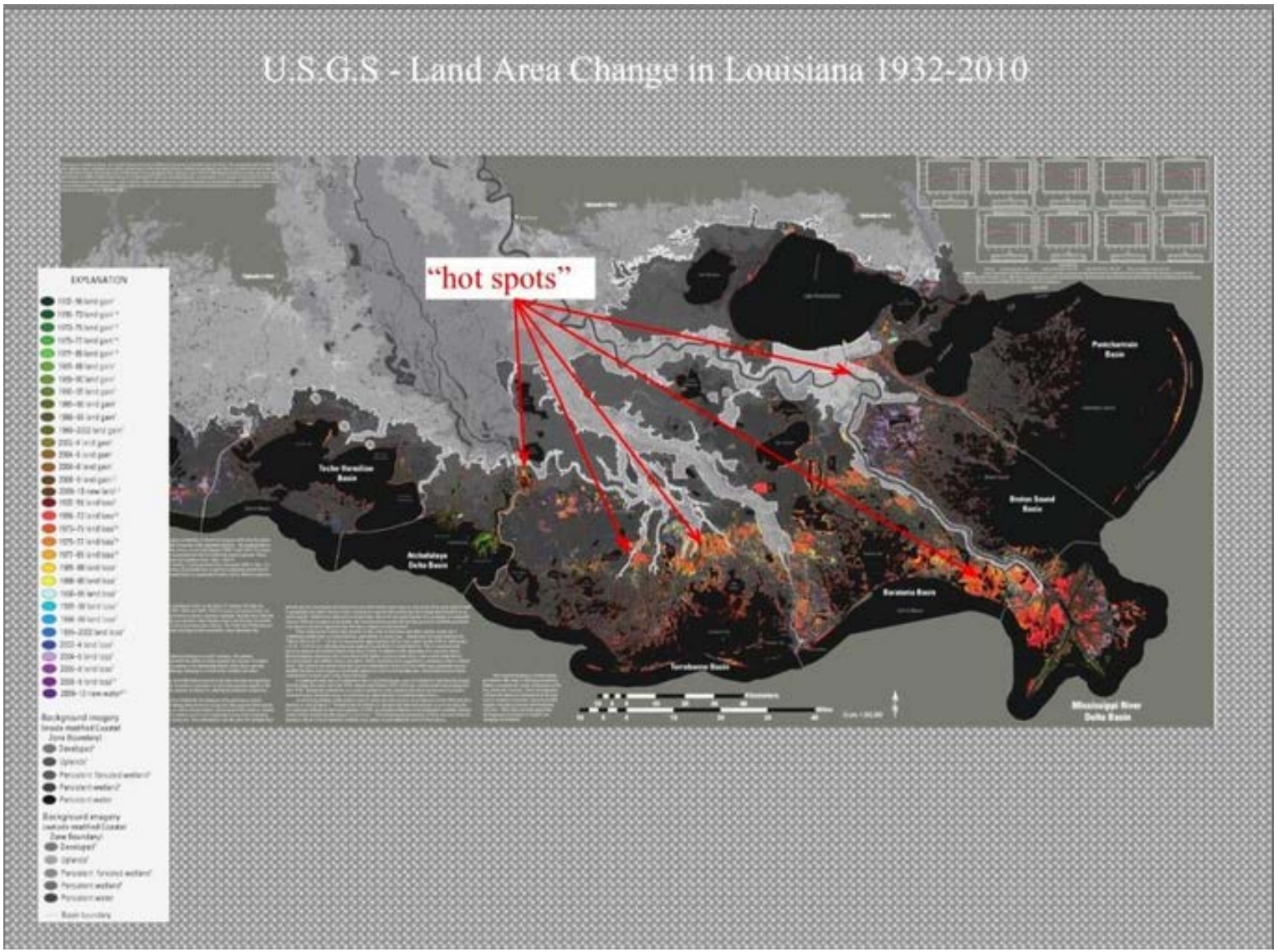
Figure 1: Plots of relative sea level change for several locations around the U.S. highlights the anomalous trends in Louisiana and Alaska.

Posting of Adjusted Values to Mean Sea Level Occurred Last Week by NOAA CO-OPS for the Time Period 2007-2011

- The Adjustment was 1.32 inches for the Station and a Listing of Subordinate Stations with Coverage across SE Coastal Louisiana
- This Adjustment in just a Five Year Period is in Response to the Large Shifts in Such a Short Timeframe for a Coastal Area that has Such Low Coastal Elevation Profiles
- Continued Updates on a Five Year Cycle is Planned in the Future



Indeed, A Lot of Discussion Around this High Rate of Relative Change is Very Common



Use of these Trends and the Analysis of Coastal Elevations has assisted the State and Lafourche Parish and Port Fourchon Assess the Flooding Outlook of Louisiana LA-1 for the Unelevated Section below Golden Meadow

HIGHWAY AT RISK

Flooded LA Highway 1

Two recent tidal inundation studies completed in cooperation with the LA 1 Coalition estimate that the existing LA Highway 1 between Golden Meadow and Leeville has less than 40 years of life left before being covered in water and impassible for more than 300 days per year, threatening America's energy and economic security. Additionally, the highway could experience a total wash-out before that time as a result of a tropical storm or hurricane in the area, cutting off access to Port Fourchon indefinitely.

The effects of sea level rise and subsidence on LA 1 traffic and national commerce, however, will begin to be experienced even sooner, according to modelings conducted by the National Oceanic and Atmospheric Administration (NOAA) and environmental researchers at Stratus Consulting.

By 2027, NOAA predicts inundation levels that will obligate local officials to close a seven-mile section of the existing highway between Golden Meadow and Leeville for more than 30 days per year, restricting access to Port Fourchon and impacting hurricane evacuation.

Impact of Rising Water Level Values Being Updated by NOAA on Critical Infrastructure- Louisiana Highway LA-1 – The Only Road Access to Port Fourchon and Grand Isle

Increasing Rate of Flooding and Closures of Louisiana LA-1 South of Golden Meadow as Water Levels Rise

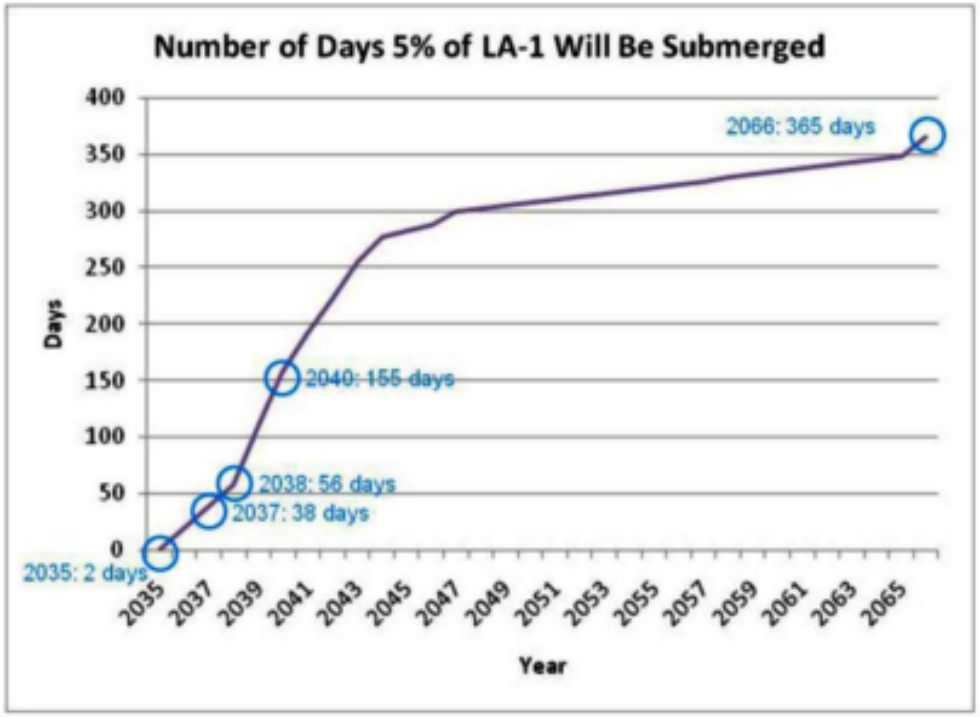


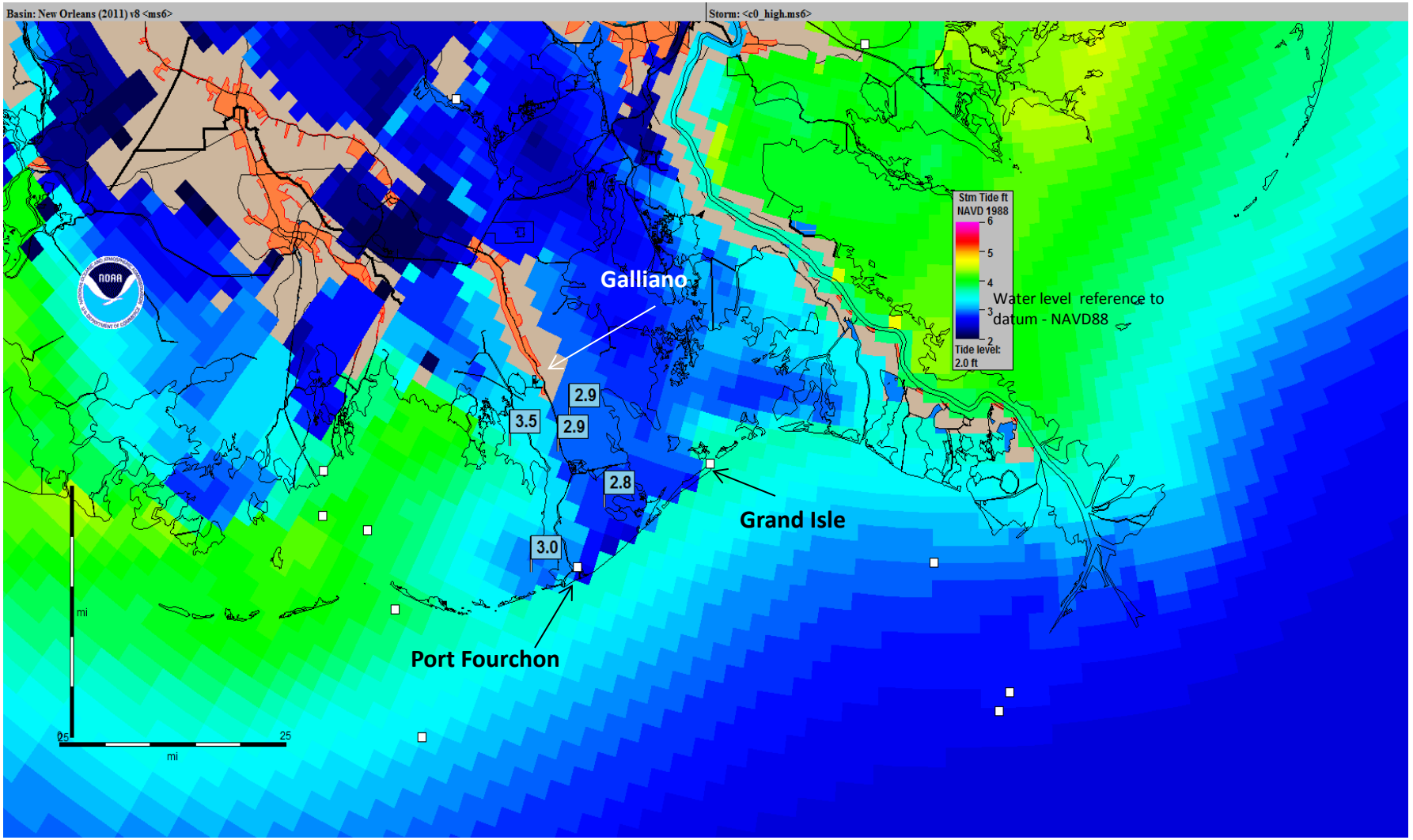
Figure 2–12: Consecutive Days of LA-1 Submergence, using 9.24mm/yr

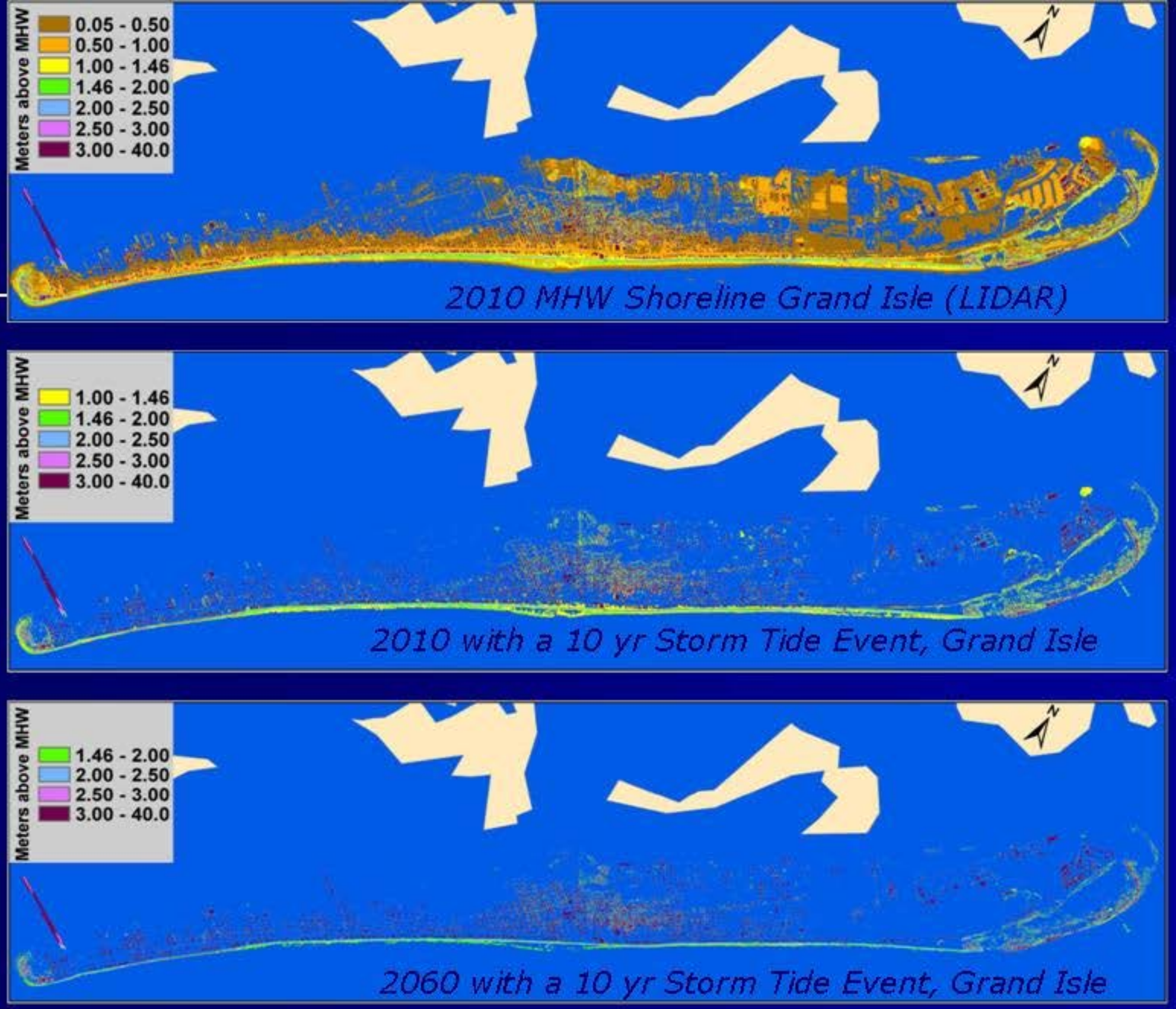
In fact, the slower increase in the curve of this graph after about the year 2044 will likely be an artifact of the estimation model. Further investigation will probably show this model reaching 365 days of submergence significantly earlier than 2065, perhaps as early as 2050.

2.1.1.4 A Worse Case

As mentioned during the discussion of Figure 2–2, NOAA estimated that the rate of Mean Sea Level rise in this geographic area is increasing. Using their predicted rate of 11.2mm/yr from 2007 through 2050, a 90 consecutive day outage could be reached by 2030 or 2031, 8 or 9 years earlier than when using 9.24mm/yr. See Figure 2–13.

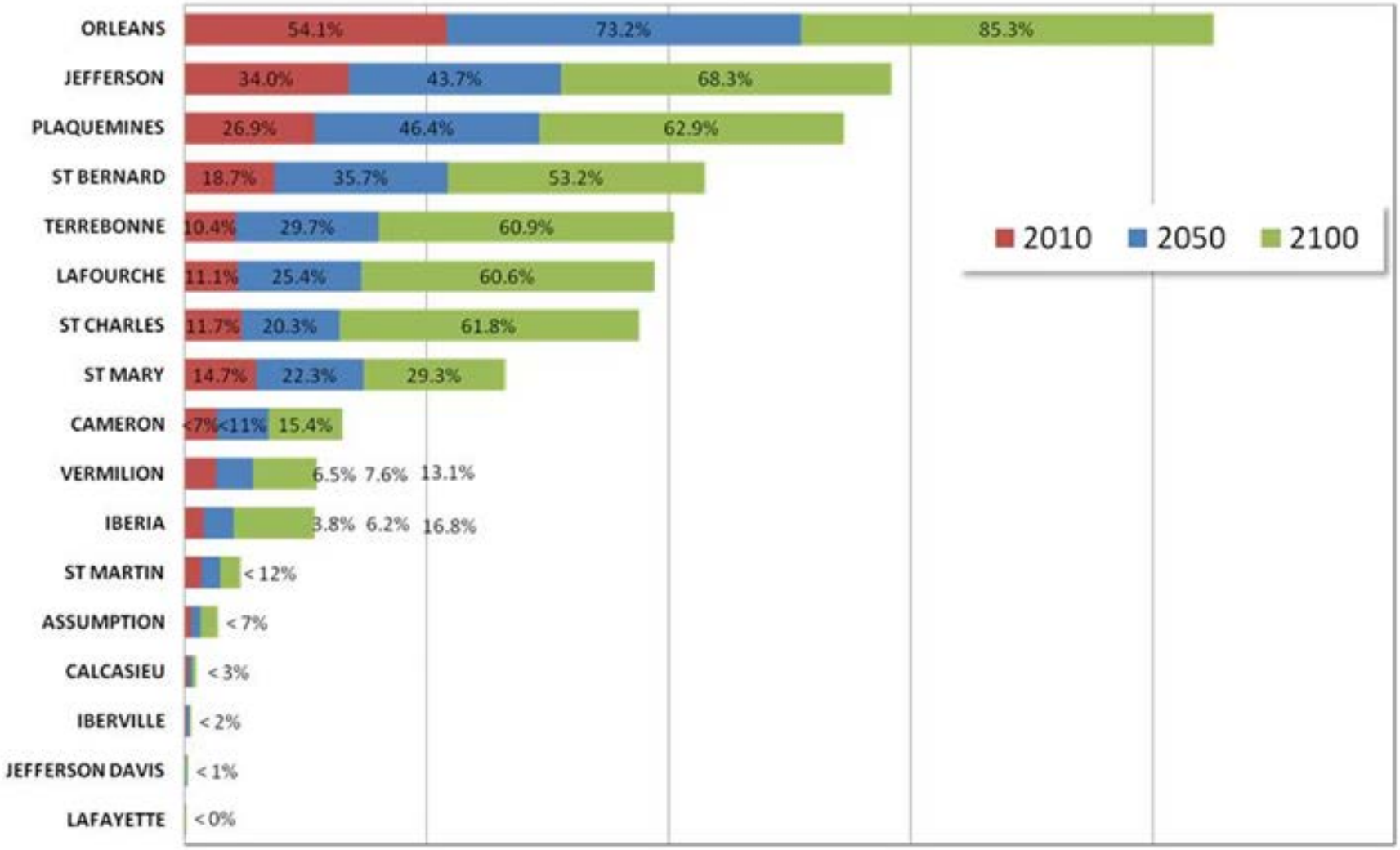
Weak Tropical Storms at Port Fourchon Will Inundate LA 1 to the Point of Closure- Source NWS New Orleans Baton Rouge – Category 0 Storm Surge Slosh Ouput

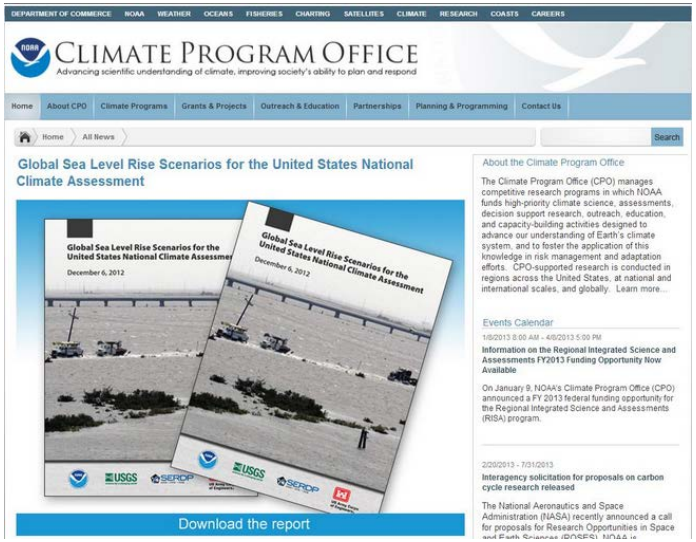




Grand Isle Louisiana, Sea Level Rise 2010-2060 and Growing Inundation by the same 10 year storm tide event

Percent Land Below Sea Level by Parish Through 2100



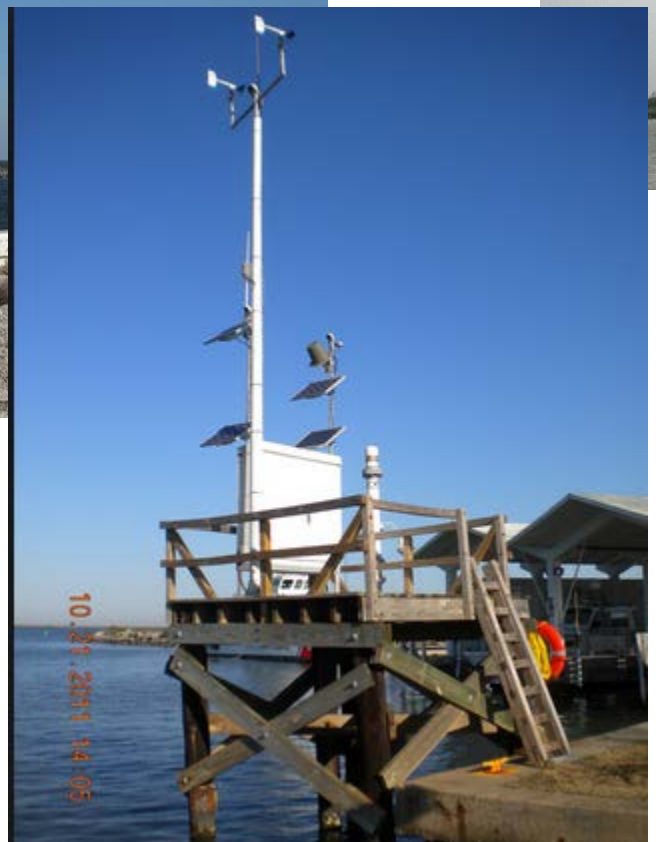


- Reports as ‘Global Sea Level Rise Scenarios for the United States National Climate Assessment Provide Reasonable Support that Increases in the Rate of Relative Sea Level Rise May be Seen in Coastal Louisiana

Recommendations

Continuous GPS RTN Surveying of SLFPAE Levees, Barriers, Gates, and other Structures

Trends of Relative Sea Levels



Installation and Operation and Observation by Storm Hardened Water Level and Surge Stations– ***With Tidal Datums Established at Each Station!***