Sea Level Rise and Subsidence Issues and the Coastal Northern Gulf

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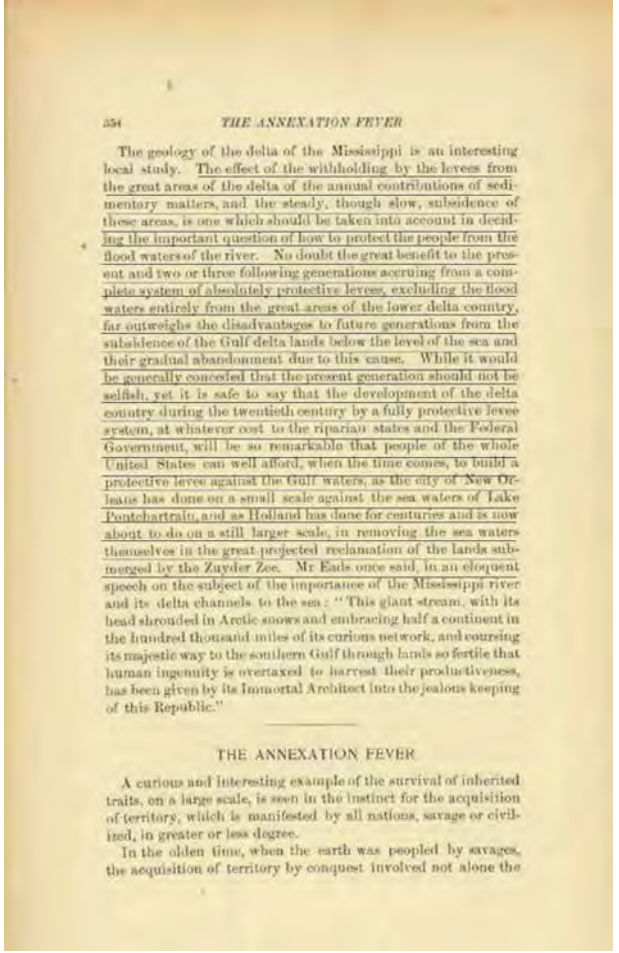


354 THE ANNEXATION FEVER

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 network, 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…"*

Early and Present Day Studies on Subsidence and Coastal Processes

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

LSU Coastal Studies Institute

LSU Center for GeoInformatics

Coastal and Physical Oceanography

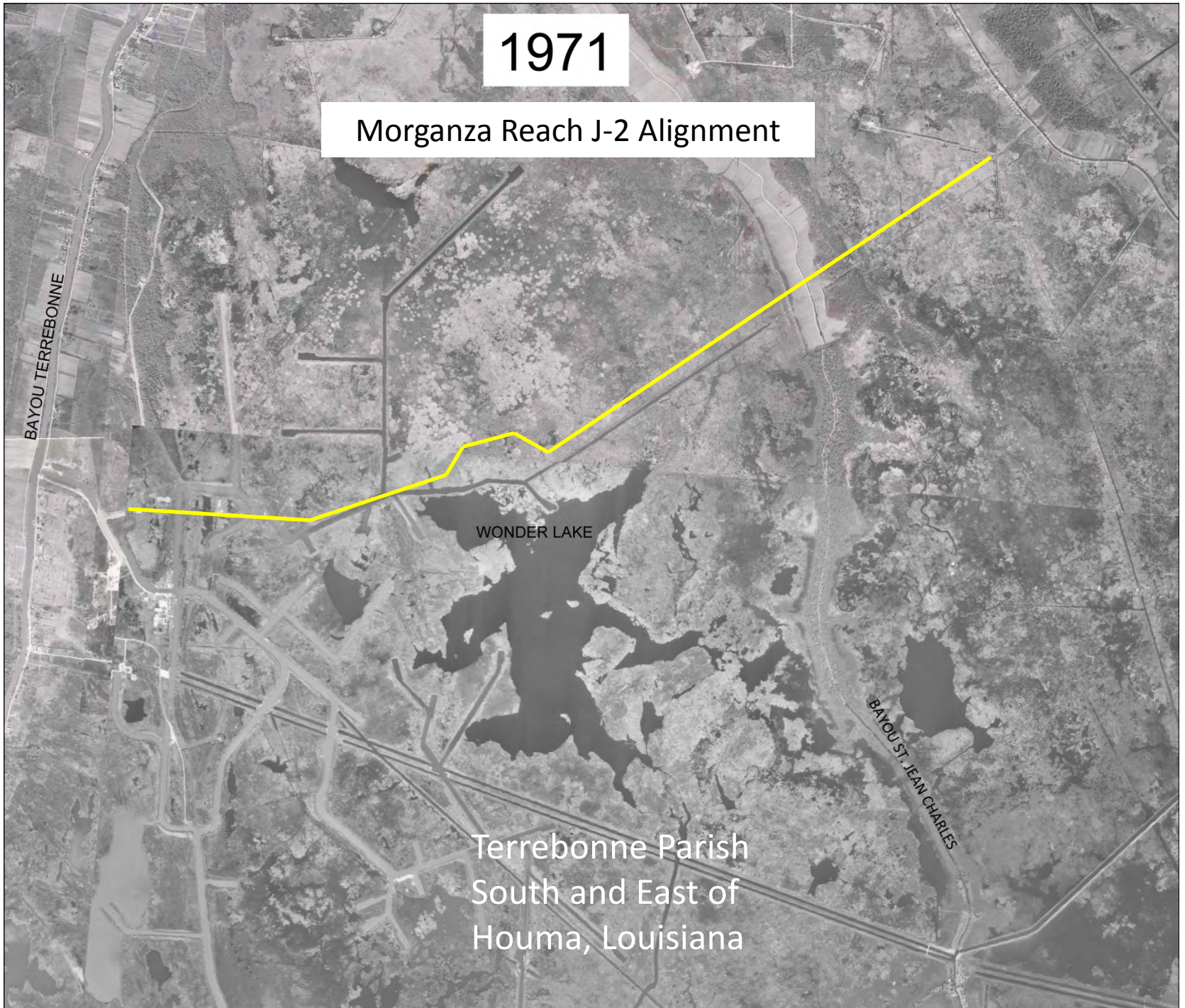
- Vagn Ekman, Advancing the Science of Ocean and Water Movements

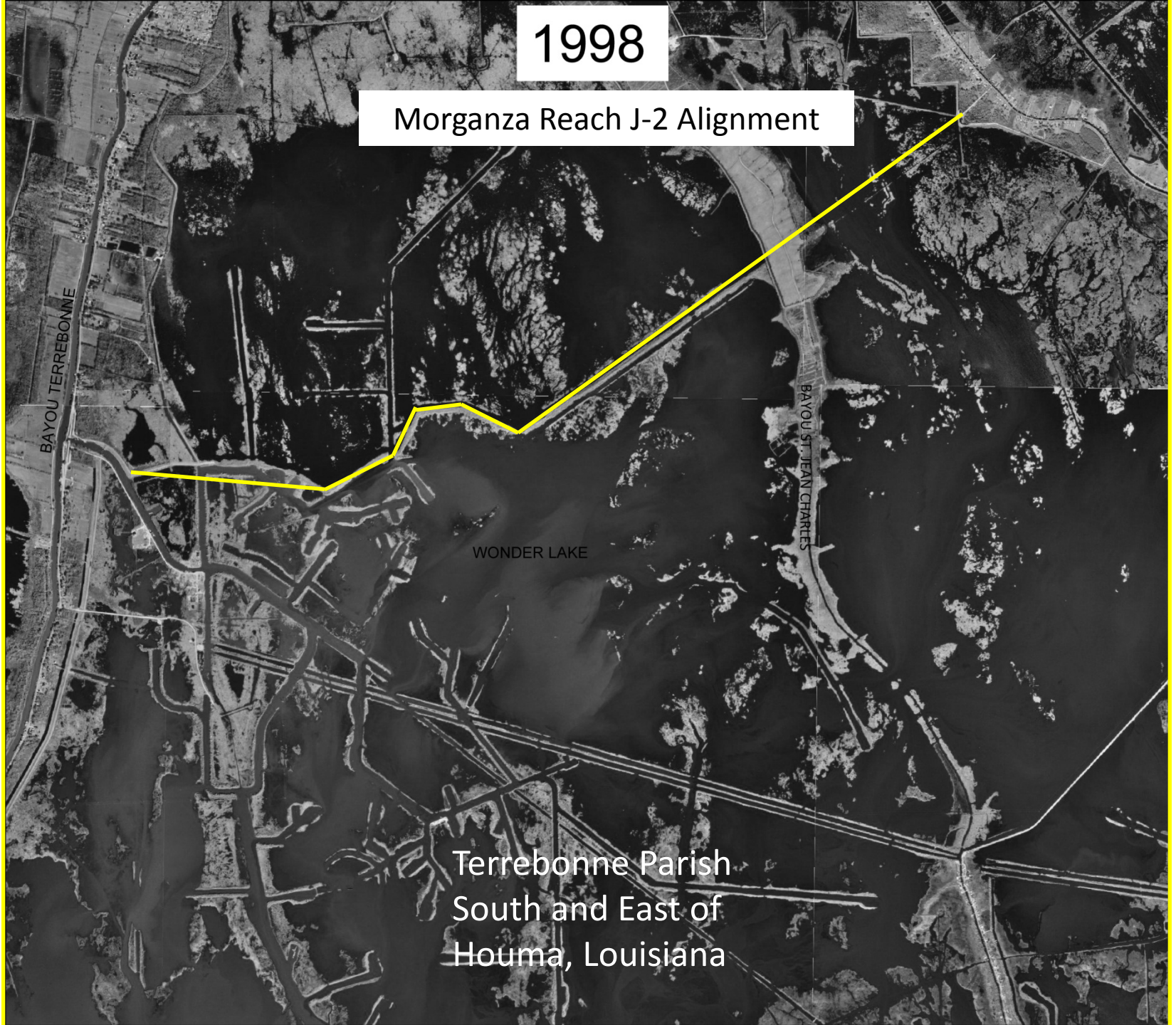
- Ekman Transport
- Combined with SLR
- Combined with Subsidence
- Create an Upward Rise of Water Along the Coast


ayou Lafourche
Bay Champagne
er Bay
Use of USAC
NOAA Image
Mapping Sh
Coastal Mov
and Loss Th
the Abandor
the Mississip
Delta Lobes
Headlands
Shoreline Loss and Interior Headland Areas Converting to Open Water (Port Fourchon and Caminada Headland

Interior of Caminada Headland and Open Water- Conversion to Open Water with Subsidence of the Delta Headland and Sea Level Rise

Caminada Headland Inundated by Tropical System, July 2010- Tropical Storms and Hurricanes are Significant Drivers in Changing and Loss of the Coastal Landscape


1971
Morganza Reach J-2 Alignment
BAYOU TERREBONNE
WONDER LAKE
BAYOU ST. JEAN CHARLES
Terrebonne Parish
South and East of
Houma, Louisiana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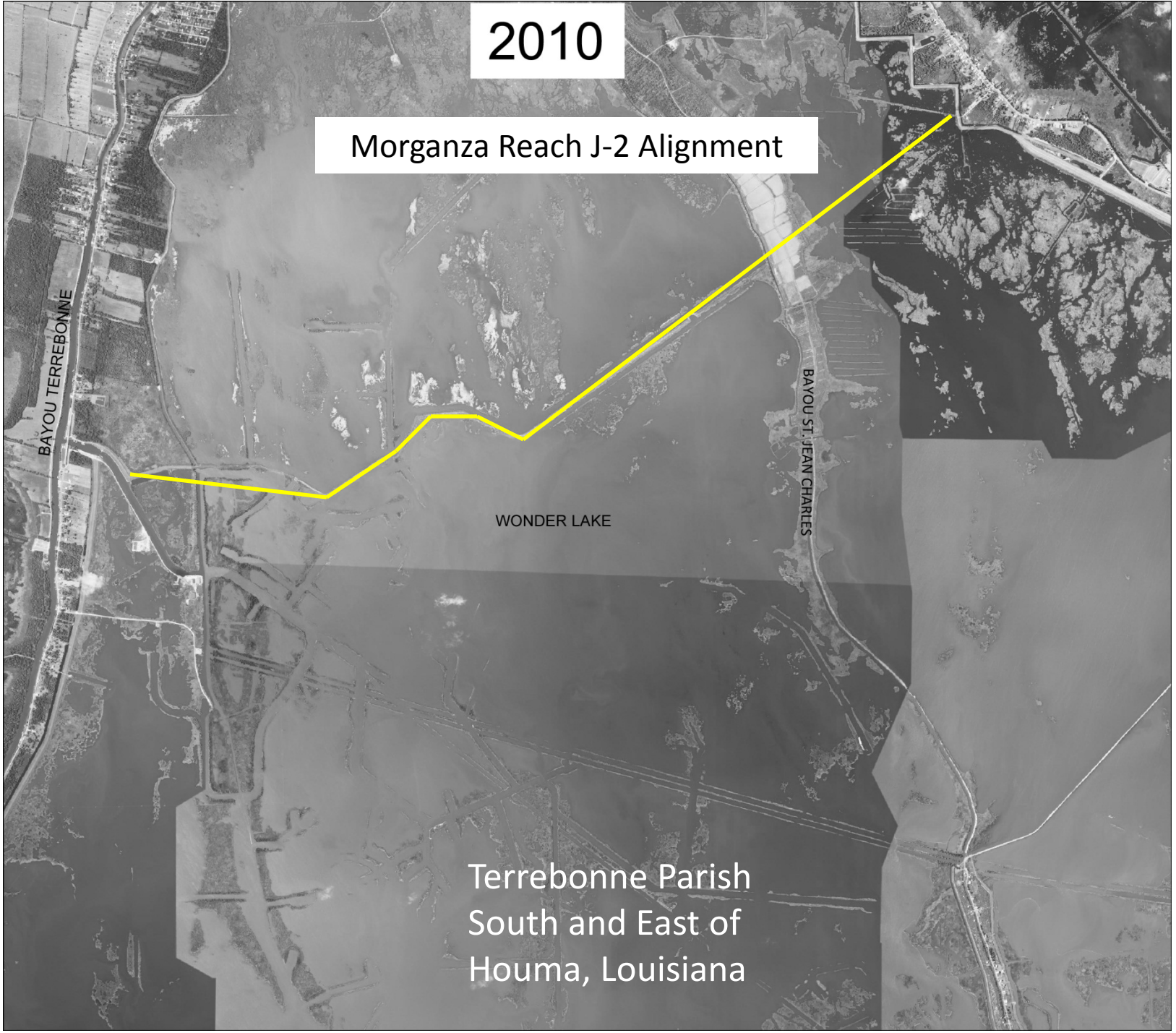
2010
Morganza Reach J-2 Alignment
BAYOU TERREBONNE
WONDER LAKE
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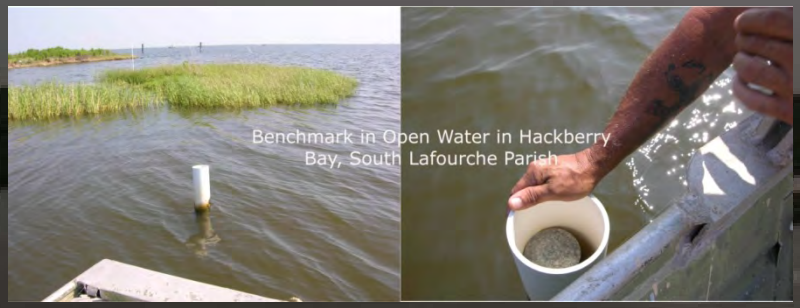
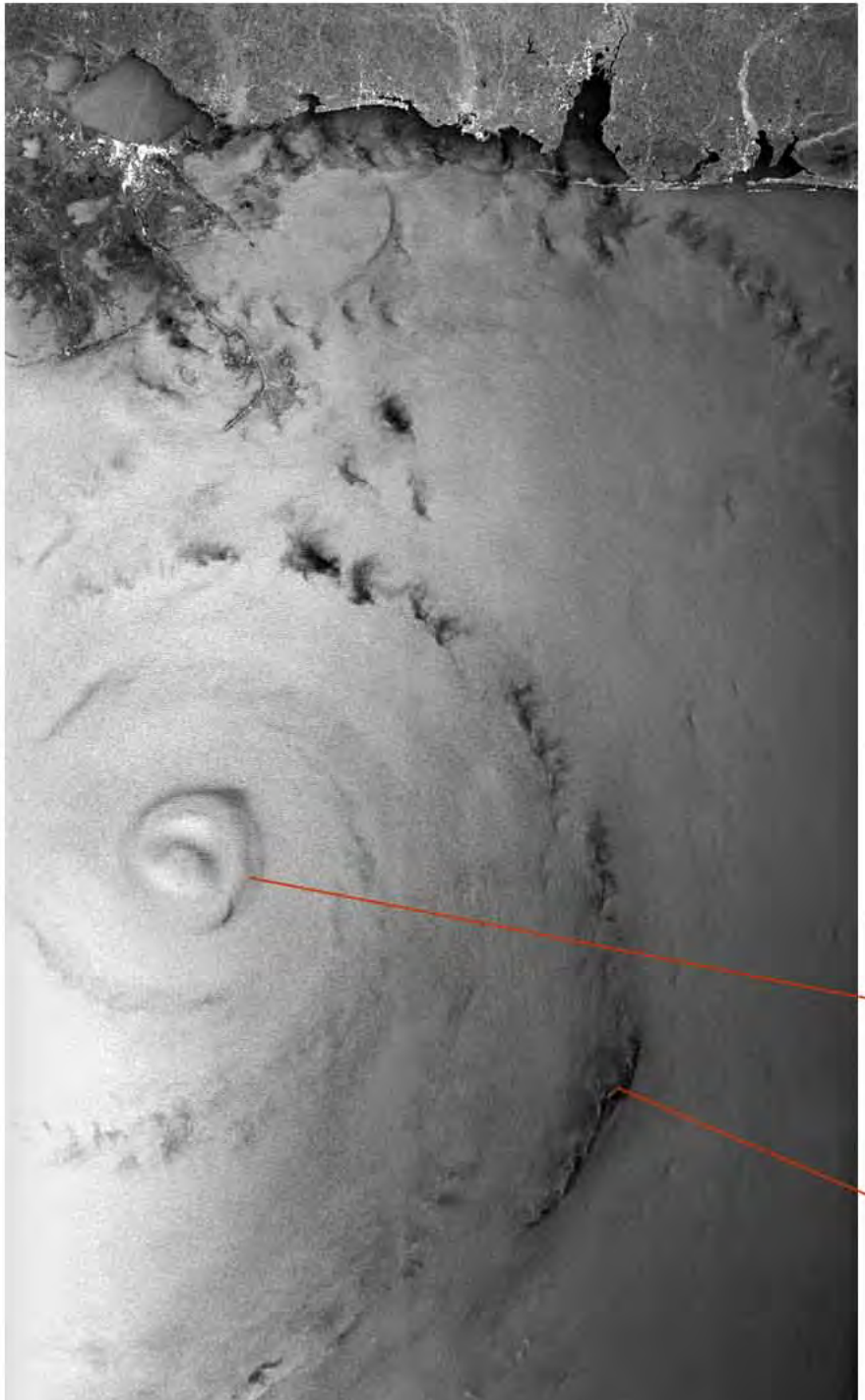
Terrebonne Parish
South and East of
Houma, Louisiana

Conventional Measurement Reference Points are Quickly Made Points of Error without Updating to GPS and Real Time Networks



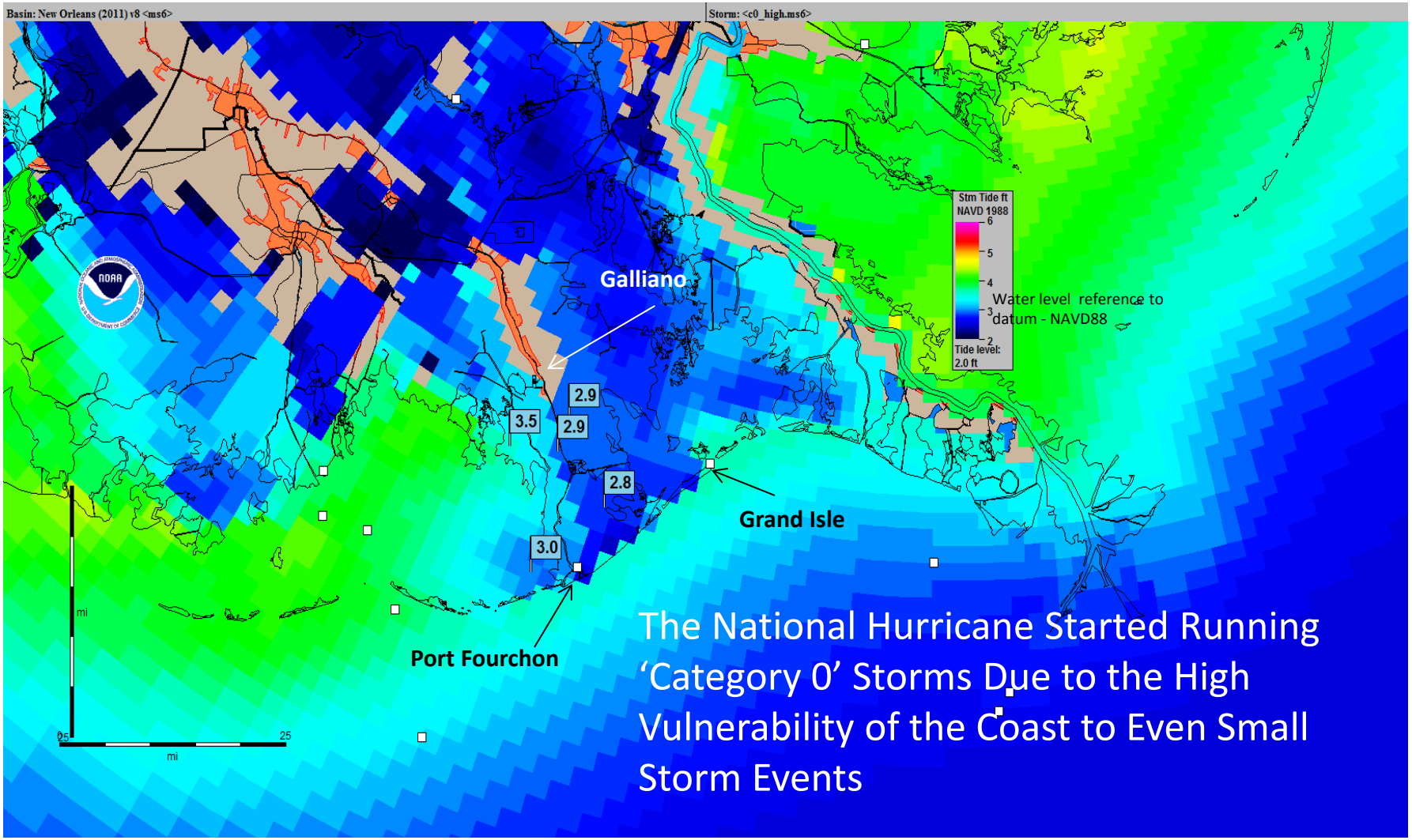


Hurricane K
by RADARS
August 28,

Eye of hurri

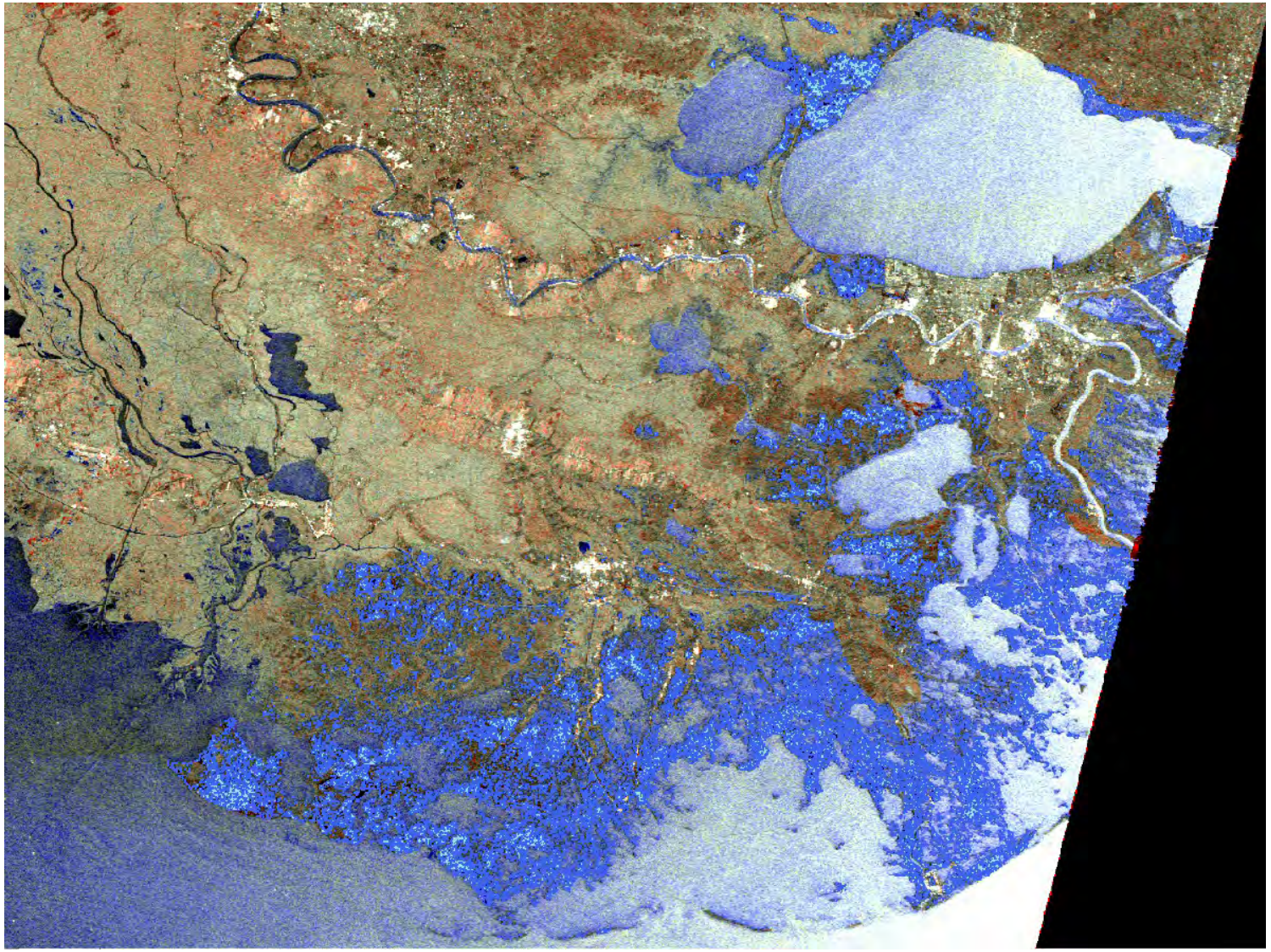
Rain bands

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

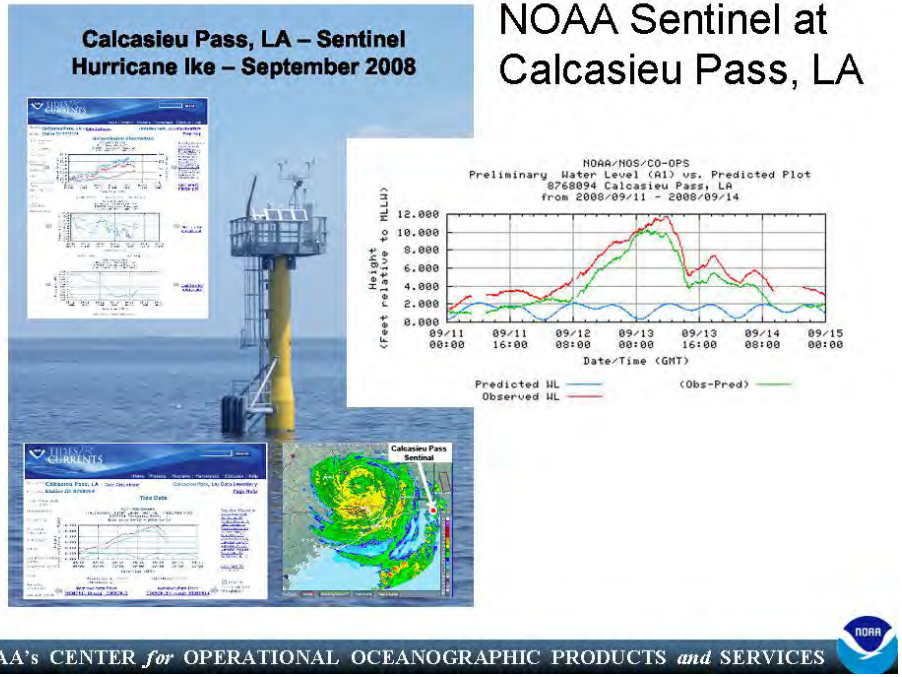


Storm Surge and Wave Impacts

Hurricane Ike Flooding Eastern Louisiana
The Coastal Areas are Hugely Vulnerable




Landfalling Hurricanes in Other States are Flood Threats to the Louisiana Coast
South Lafourche Levee District Levee Southern Extent During Hurricane Ike
Flooded Homes outside South Lafourche Levee District Levees and Flooded Highway LA-1 to Port Fourchon and Grand Isle
South Lafourche Flood Gate now converted to a Lock
Hurricane Ike Inundation South Lafourche Parish

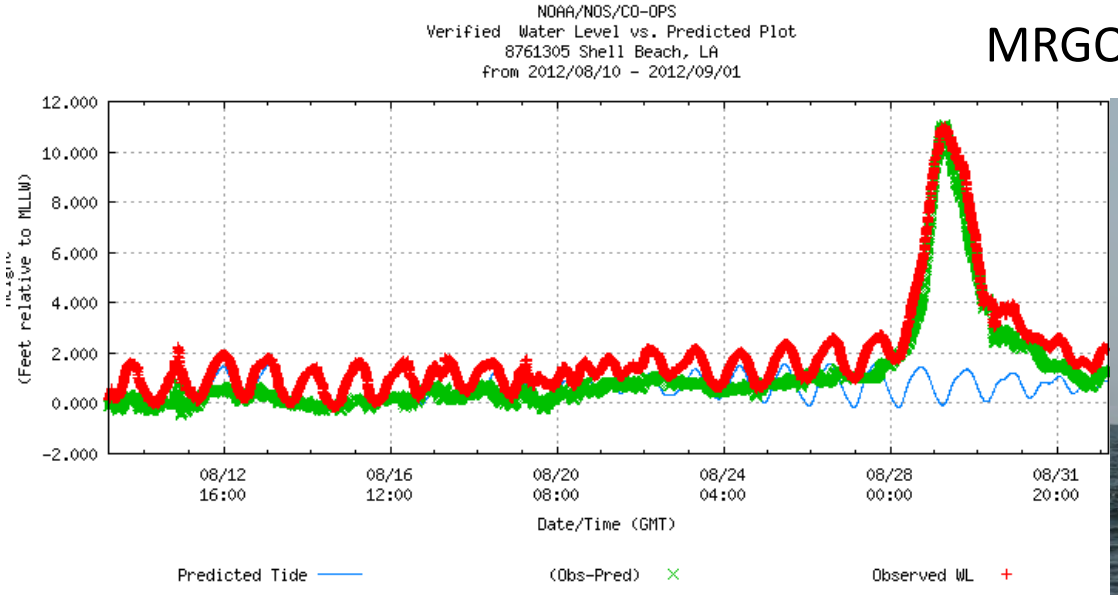


NOAA Sentinel at Calcasieu Pass, LA

NOAA's CENTER *for* OPERATIONAL OCEANOGRAPHIC PRODUCTS *and* SERVICES

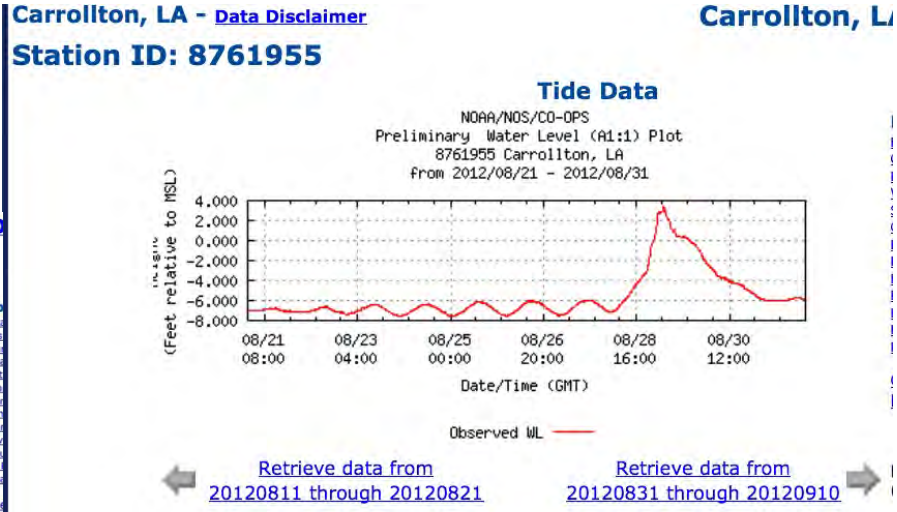
Hurricane Ike Surge Event at Cameron Parish, Calcasieu Pass and

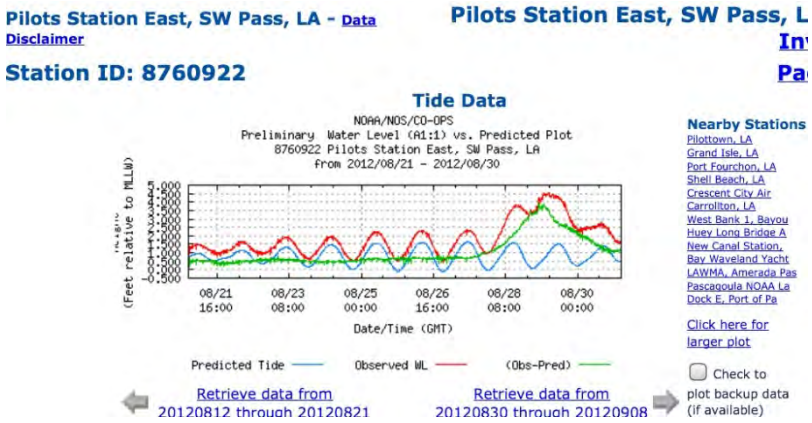
Hurricane Category Has No Relation to Height of Storm Surge! An Example- Ike Vs. Isaac



Hurricane Isaac Surge Event at St Bernard Parish at Shell Beach and the MRGO

Hurricane Isaac Storm Surge Mississippi River



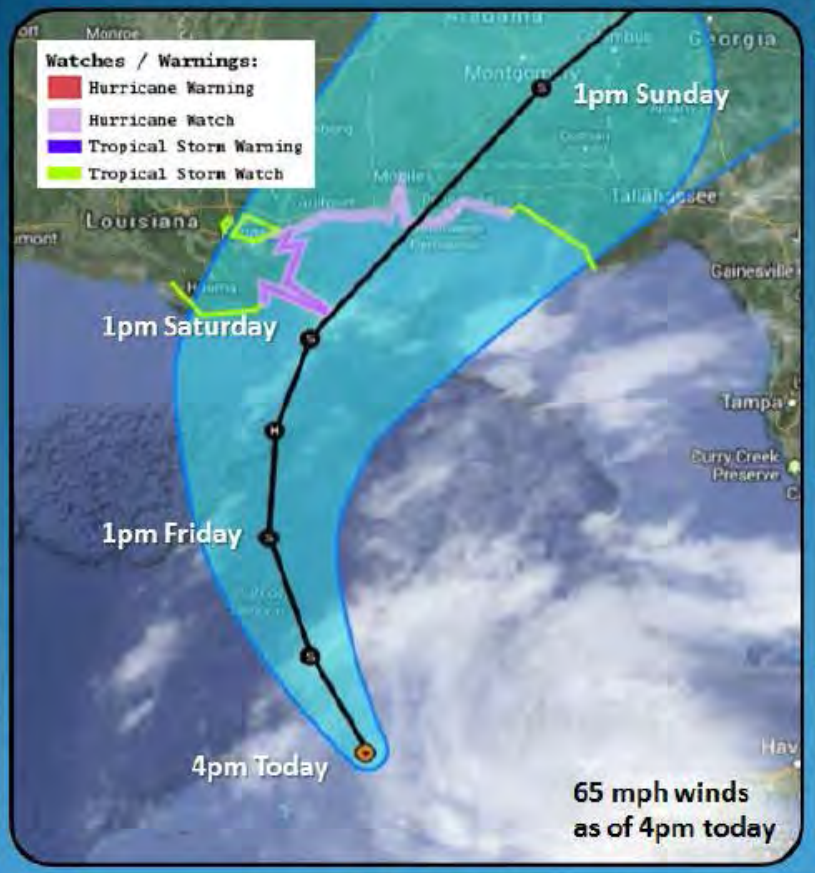


Surge Moving Up the Mississippi River is a Very Important and Not Well Realized Event- Isaac saw a 10 Foot Storm Surge

Even Minimal Storms Are a Real Threat to the Coast

Current Outlook

Tropical Storm Karen



Expected impacts to SE LA/ S MS:

- **Winds:**
  25-35 mph over land and Lake Pontchartrain….40-60 mph near immediate coast and offshore. Hurricane force gusts possible in hurricane watch area.
- **Seas:**
  Up to 15 ft – mainly east of MS River
- **Rain:**
  2-5" with locally higher (mainly across extreme SE LA and coastal MS)
- **Storm Surge:**
  2-4 ft in TS Watch area
  3-6 ft in Hurr Watch area
  Highest on East and Southeast facing shores

@NWSNewOrleans | US National Weather Service New Orleans | NWSNewOrleans | www.weather.gov/neworleans

Collaborative Efforts by USACE, NOAA , USGS, EPA and Others is Critical in the Production of Reports as the NCA and Sea Level Rise Scenarios Reports

The National Climate Assessment

The National Climate Assessment (NCA) is being conducted under the authority of the Global Change Research Act (GCRA) of 1990. The GCRA requires a report to the President and the Congress every four years that integrates, evaluates, and interprets the findings of the U.S. Global Change Research Program (USGCRP). The Act requires assessment of the effects of global change (both human-induced and natural) on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity. The time periods for analysis include current conditions as well as projections of major trends for the subsequent 25 to 100 years.

National climate assessments provide status reports about climate change science and impacts. They are based on observations collected across the country as well as research that uses projections from climate system and other models. The NCA incorporates advances in the understanding of climate science into larger social, ecological, and policy systems, and provides integrated analyses of impacts and vulnerability.

The NCA integrates scientific information from multiple sources and highlights key findings and significant gaps in our knowledge. It also helps the federal government prioritize climate research investments that will provide science for use by communities around the country to plan more sustainably for our future.

Global Sea Level Rise Scenarios for the United States National Climate Assessment

December 6, 2012

NOAA

USGS science for a changing world

SERDP DOD • EPA • DOE

US Army Corps of Engineers.

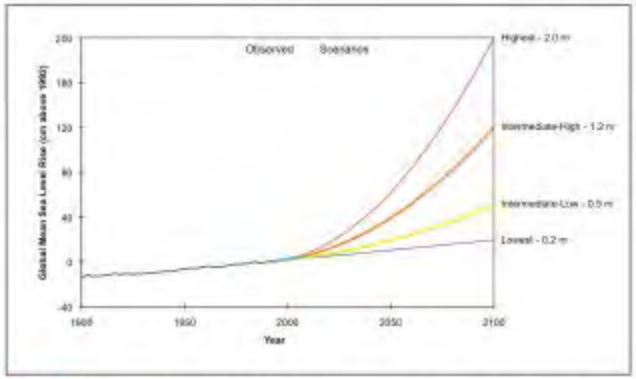
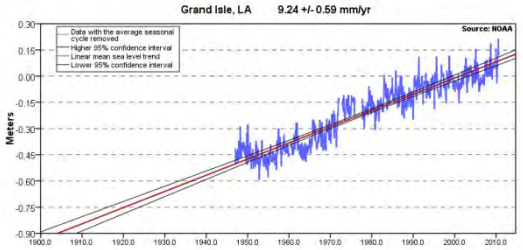
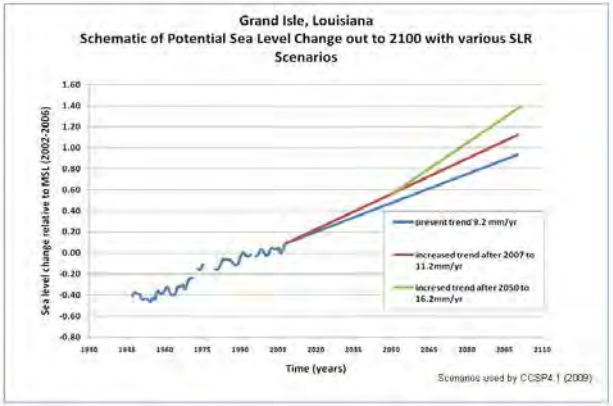


Figure ES 1. Global mean sea level rise scenarios. Present Mean Sea Level (MSL) for the US coasts is determined from the National Tidal Datum Epoch (NTDE) provided by NOAA. The NTDE is calculated using tide gauge observations from 1983 – 2001. Therefore, we use 1992, the mid-point of the NTDE, as a starting point for the projected curves. The Intermediate-High Scenario is an average of the high end of ranges of global mean SLR reported by several studies using semi-empirical approaches. The Intermediate Low Scenario is the global mean SLR projection from the IPCC AR4 at the 95% confidence interval.

Mean Sea Level Trend
8761724 Grand Isle, Louisiana



The mean sea level trend is 9.24 millimeters/year with a 95% confidence interval of +/- 0.59 mm/yr based on monthly mean sea level data from 1947 to 2006 which is equivalent to a change of 3.03 feet in 100 years.



Collaborative Work in the Field Has Produced Reports on Vertical Motion Downward of Coastal Louisiana Landscapes that Are Important Companion Reports to the NCA and SLR Reports

Questions? • Comments?

Preface

Further review of **NOAA Technical Report 50: Rates of Vertical Displacement at Benchmarks in the Lower Mississippi Valley and the Northern Gulf Coast** supported clarification of the following:

1. The rates and computed elevations in the study area covered by this report were derived through the analysis of leveling projects in the National Geodetic Survey (NGS) database observed between 1920 and 1995. As such, it is important to note that the vertical displacement rates in **NOAA Technical Report 50** may not reflect the ***current*** rate of subsidence. Present-day surveys and accurate GPS measurements, including ties to Continuously Operating Reference Stations (CORS), must be used to validate the rates before attempting to determine elevations.
2. The original leveling observations used to compute subsidence rates in **NOAA Technical Report 50** were observed according to NGS procedures and specifications for the specified order of accuracy and class of survey. It is important to remember that the leveling network is comprised of a multitude of level lines adjusted to minimize errors while tying junctions together.
3. The National Ocean Service tide gauge data used in the analysis measures relative sea level rise at a specific location and also depicts relative subsidence within an area compared to a fixed water level datum. It should be pointed out that factors such as number of years of tide gauge records, short-term secular variation in water levels, and differences in decadal water level trends which are not related to the subsidence rates might be areas of additional study that would prove useful to this study.

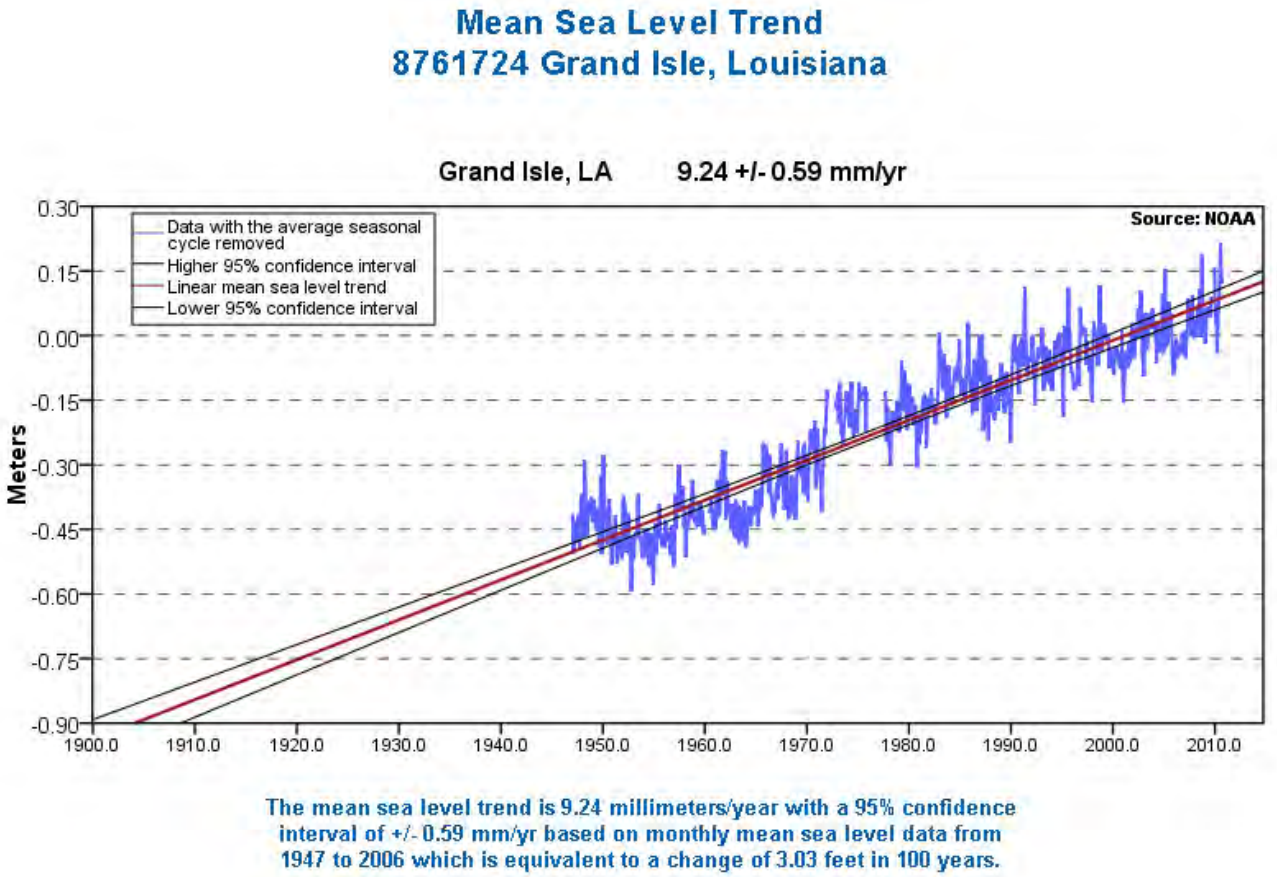
If you have questions or comments regarding this report or webpage, please contact us (email).

NOAA Technical Report 50: Rates of Vertical Displacement at Benchmarks in the Lower Mississippi Valley and the Northern Gulf Coast PDF

NOTE: APPENDIX 3 – TABLE OF RATES, ELEVATIONS, AND POSITIONS

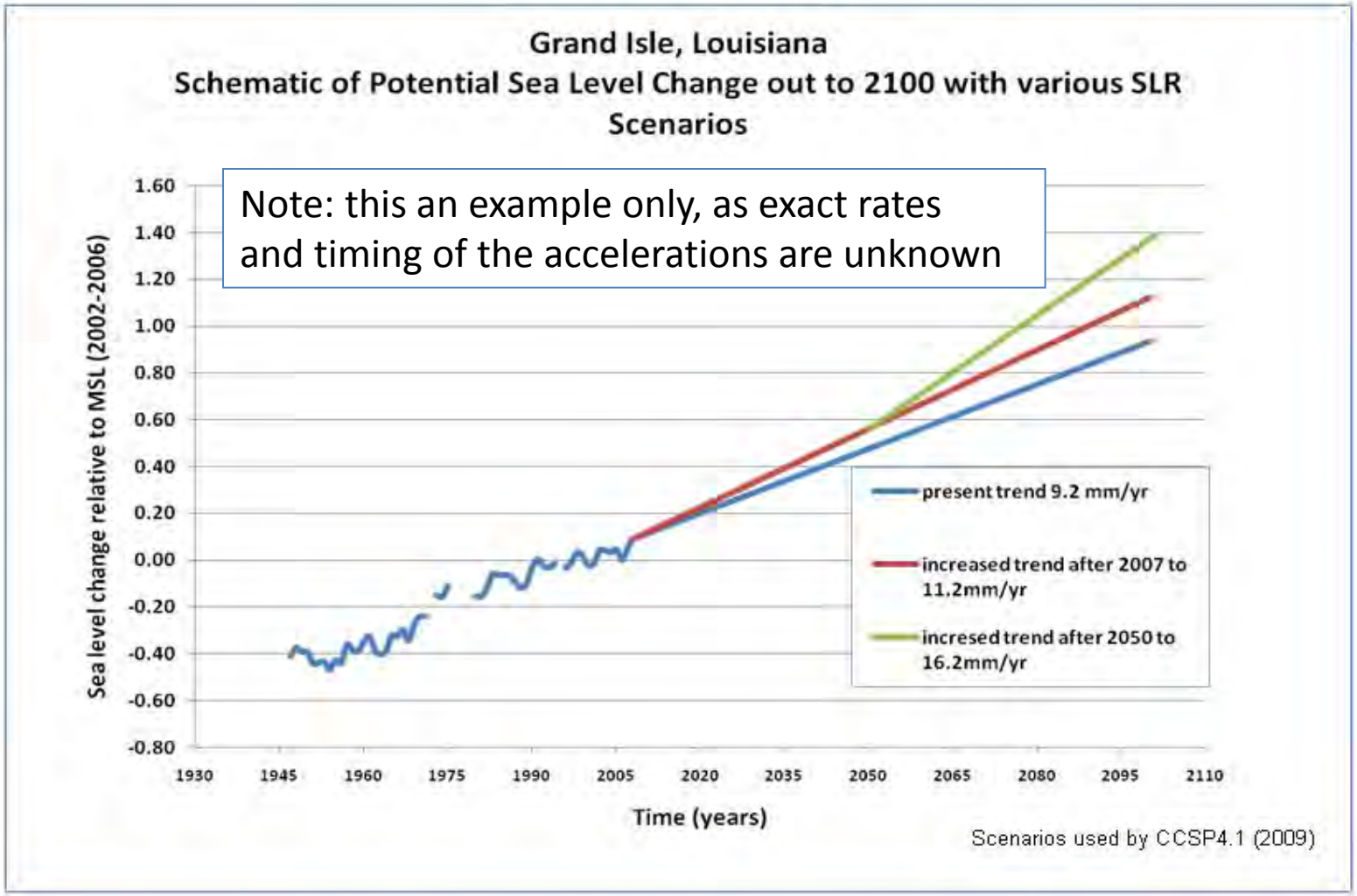
Rates and computed elevations for benchmarks in the subsidence network listed in APPENDIX 3 – Table of Rates, Elevations, and Positions are neither final nor publishable for vertical control. The subsidence rates have been analyzed and validated for the base years spanned by the historic leveling projects. While elevations derived using these rates are likely better than the heights currently in the National Spatial Reference System, there is no guarantee that the subsidence rates are constant over time. Therefore, vertical velocities must be validated independently when used to extrapolate elevations into the future.

Sea Level in Lousiana is Rising Relative to the Land at a Rapid Rate- More So Than Almost Any Other Area on the Planet



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

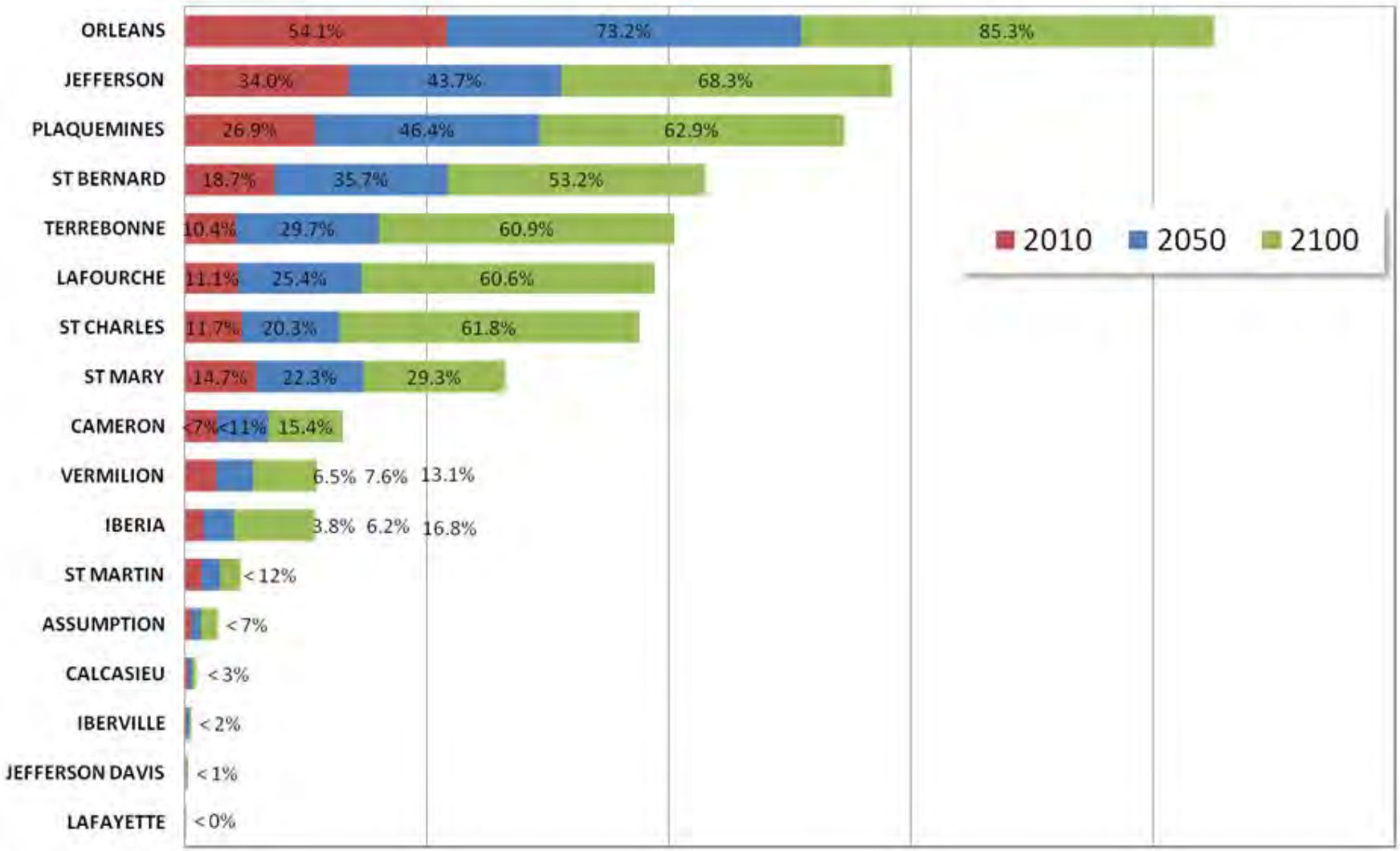
Climate models project acceleration in Sea Level Rise starting before 2100 due to climate change- Many Areas through SE Coastal Louisiana See High Rates Now In Excess of 10mm



Use of GPS Based Real Time Network Positioning Shows Today A Loss of over 1 Feet of Elevation in 20 years in Some Coastal Areas

Surveying using the LSU C4G Real Time Network along Louisiana Highway LA-1 Above Port Fourchon

Percent Land Below Sea Level by Parish Through 2100



Source- LSU Center for GeoInformatics

USACE Reports and Planning Guidance are Important Resources

Planning for Changing Sea Levels

More than 8 million people live in areas at risk of coastal flooding. Along the U.S. Atlantic Coast alone, almost 60 percent of the land that is within a meter of sea level is planned for further development, with inadequate information on the potential rates and amount of sea level rise.

Global sea level rise has been a persistent trend for decades. It is expected to continue beyond the end of this century, which will cause significant impacts in the United States. Scientists have very high confidence (greater than 90% chance) that global mean sea level will rise at least 8 inches (0.2 meter) and no more than 6.6 feet (2.0 meters) by 2100. Many of the nation's assets related to military readiness, energy, commerce, and ecosystems that support resource-dependent economies are already located at or near the ocean, thus exposing them to risks associated with sea level rise. There is a **simple tool** to help understand the effects of changing sea levels over time, and a more **detailed tool** to help understand the effects of changing sea levels over time. The frequently asked questions (FAQS) about the tool will answer other questions you may have concerning these items. A complete discussion of these coastal resilience tools for Sandy recovery can be found on the U.S. Global Change Research Program website.

Federal Emergency Management Agency (FEMA). FEMA has provided best available flood hazard information, preliminary work maps, and other products to provide best available flood hazard information in the New York–New Jersey area. The BFEs/best available elevation information can help communities better understand current flood risks and ensure structures are rebuilt stronger and safer to reduce the impact of similar events in the future.

U.S. Army Corps of Engineers (USACE). The U.S. Army Corps of Engineers has developed a Sea-Level Change Calculator to assist in developing information to support its sea-level change policy *(pdf)*, which supports the USACE overarching climate change adaptation policy. This tool has been modified to NOAA scenarios to help people rapidly assess what the coming changes could look like.

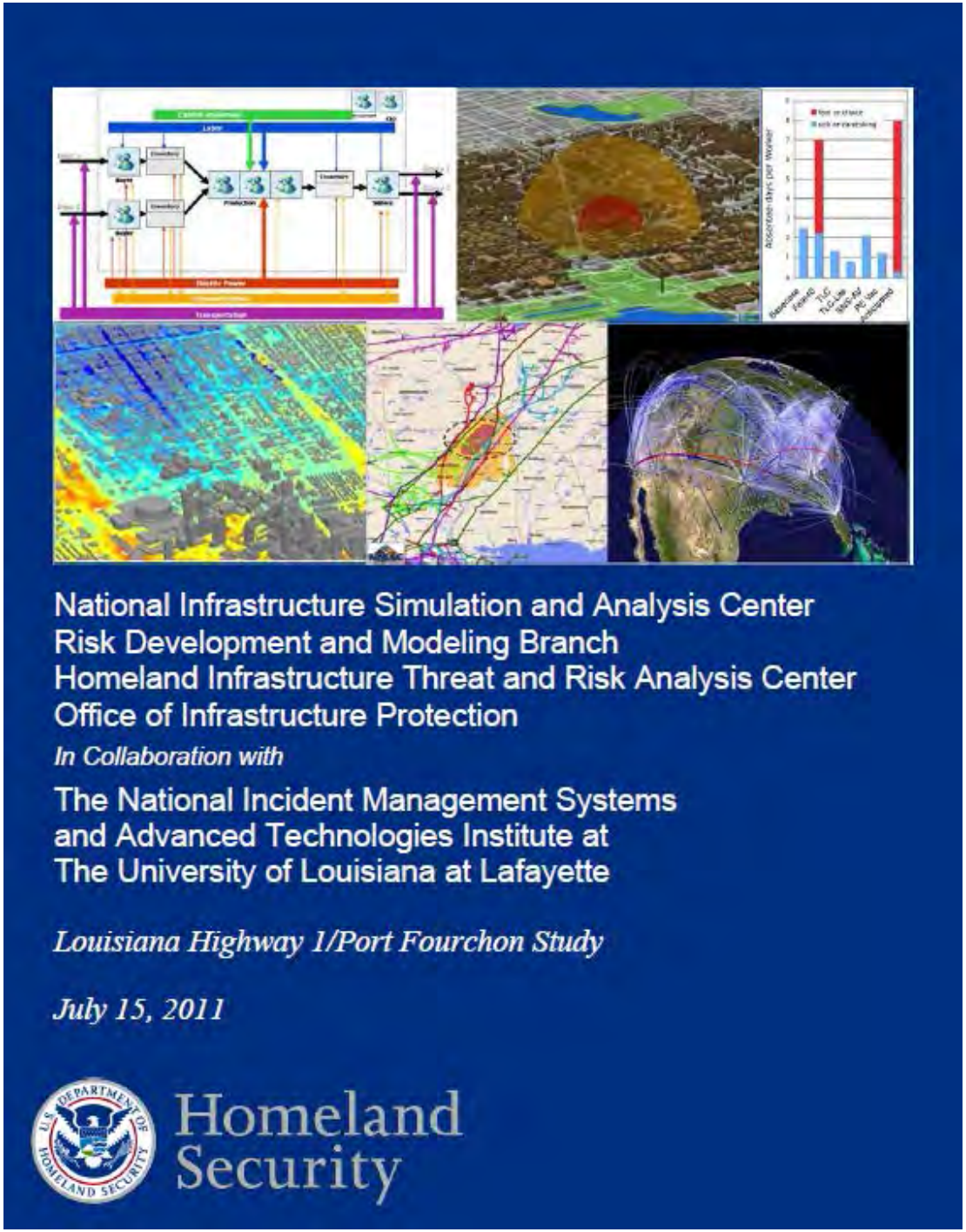
National Oceanic and Atmospheric Administration (NOAA). NOAA's Climate Program Office has recently published a report about global sea level rise, which has been a persistent trend for decades that is expected to continue beyond the end of this century. The report provides a synthesis of the scientific literature on global sea level rise, and a set of four scenarios of future global sea level rise. The report was produced in collaboration with twelve contributing authors from ten different federal and academic science institutions including NOAA, NASA, the U.S. Geological Survey, the Scripps Institution of Oceanography, the U.S. Department of Defense, the U.S. Army Corps of Engineers, Columbia University, the University of Maryland, the University of Florida, and the South Florida Water Management District.

U.S. Global Change Research Program (USGCRP). The USGCRP is a Federal program that coordinates and integrates global change research across 13 government agencies to ensure that it most effectively and efficiently serves the Nation and the world. USGCRP was mandated by Congress in the Global Change Research Act of 1990, and has since made the world's largest scientific investment in the areas of climate science and global change research.

Long Beach Island

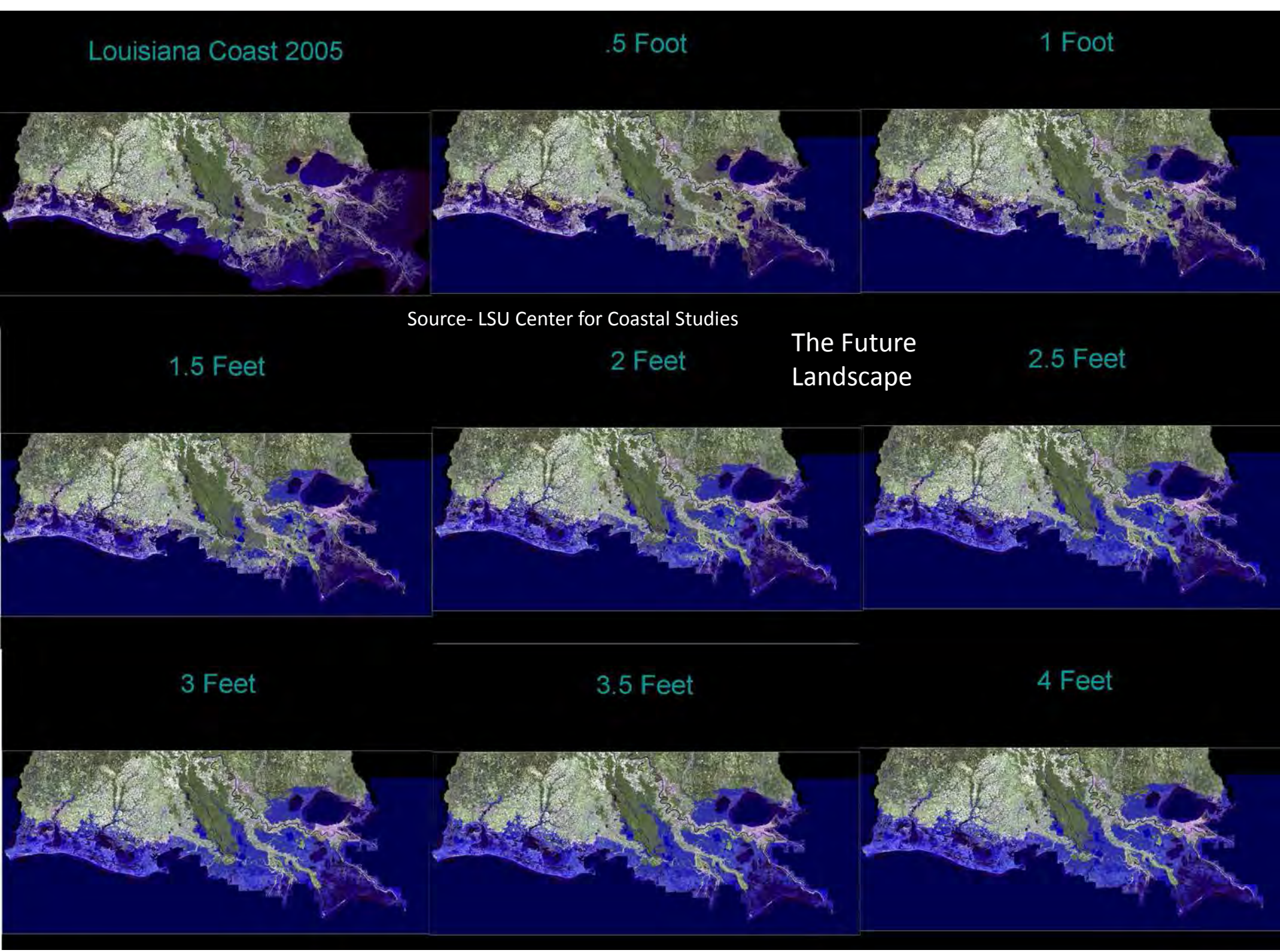
Breach at Mantoloking, NJ

Louisiana Has Critical Infrastructure and Facilities that are now the Focus of Studies Looking at Future Vulnerability (South Lafourche Parish and Highway LA-1



SLR and Subsidence Effects Lead to Greater Storm Damage in the Future with the same Storm Event

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



Source- LSU Center for Coastal Studies

The Future Landscape

In Summary

Important Resources Can Now Be Applied to Coastal Resources in Louisiana to Monitor and Forecast the Movement of Elevations Downward and the Rise of Sea Levels. This is Critical for Such a High Loss Landscape of South Louisiana that is Seeing an Acceleration of Loss Rates

Project Specific Efforts Have Been Implemented

With Various Scenarios Described in the National Climate Assessment and Other Documentation, Forecasted Sea Level Rise Can be Assessed and Monitored Along the Northern Gulf

With Very Low Elevations Today and High Rates of Relative Sea Level Rise, Active Collaboration and Application of the High Rates of Change Need to Protection Coastal Populations and Management of our Natural Resources Will be Very Important