LINCOLN INSTITUTE OF LAND POLICY

Climate Change and the Resilience of New Orleans: the Adaptation of Deltaic Urban Form

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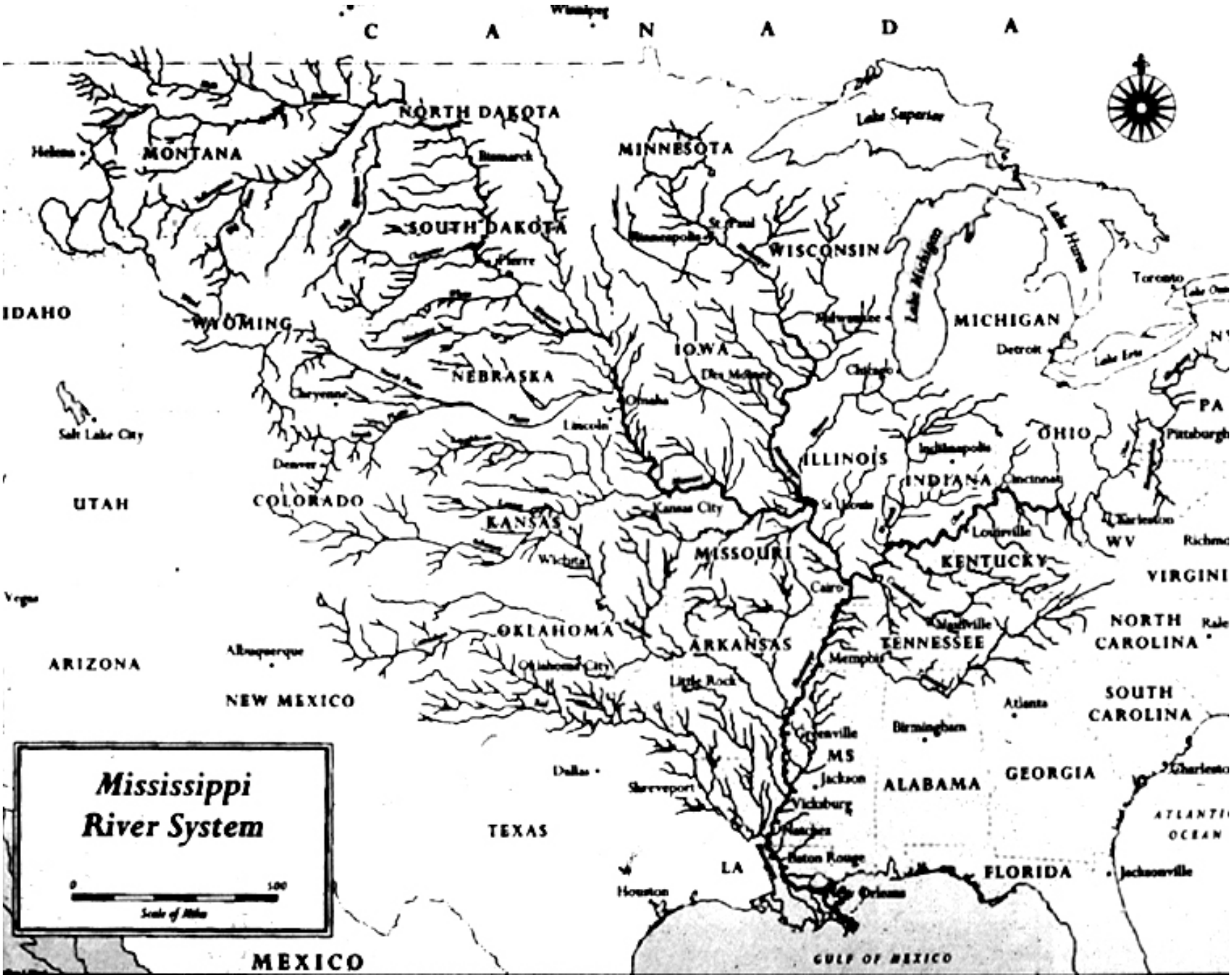
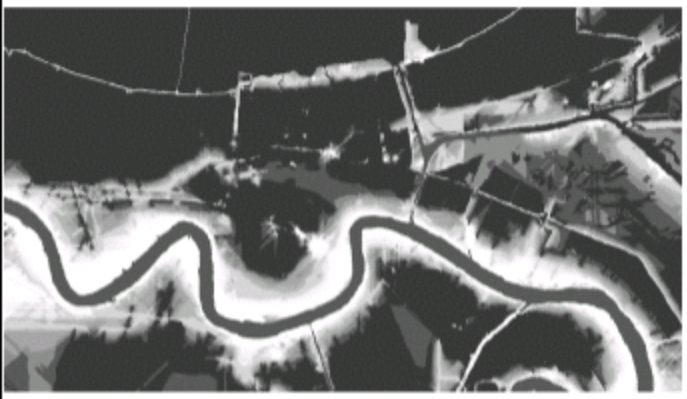
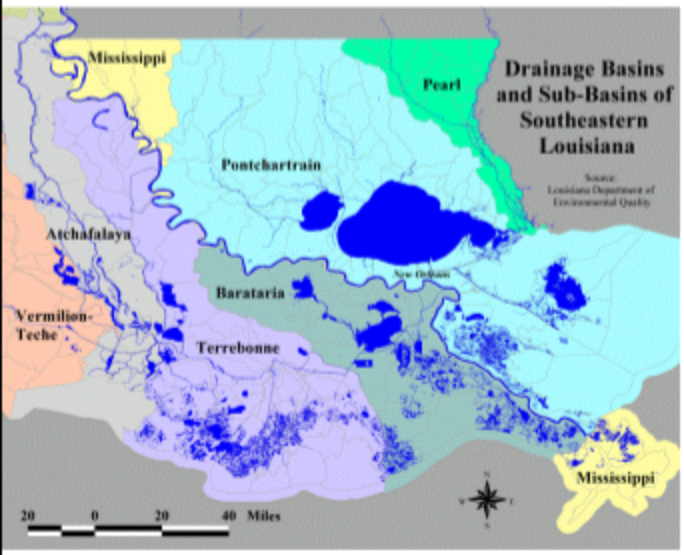
5th UN-HABITAT World Urban Forum
Rio de Janeiro, Brazil, 22-26 March, 2010


C A N A D A
Winnipeg
NORTH DAKOTA
MONTANA
Helena
Bismarck
MINNESOTA
Lake Superior
SOUTH DAKOTA
Pierre
WISCONSIN
Lake Michigan
Lake Huron
Toronto
IDAHO
WYOMING
MICHIGAN
Detroit
Lake Erie
IOWA
NEBRASKA
Omaha
Lincoln
Chicago
Salt Lake City
Denver
ILLINOIS
OHIO
Indianapolis
INDIANA
Cincinnati
UTAH
COLORADO
Kansas City
St. Louis
KANSAS
Louisville
WV
MISSOURI
KENTUCKY
Cairo
OKLAHOMA
ARKANSAS
TENNESSEE
Memphis
NORTH CAROLINA
Albuquerque
ARIZONA
NEW MEXICO
Little Rock
Atlanta
SOUTH CAROLINA
Birmingham
MS
Jackson
ALABAMA
GEORGIA
Dallas
Shreveport
Vicksburg
TEXAS
Baton Rouge
LA
FLORIDA
Jacksonville
Houston
New Orleans
ATLANTIC OCEAN
GULF OF MEXICO
MEXICO
Mississippi River System
0
500
Scale of Miles





Source:
Campanella, *Time and Place in New Orleans*

New Orleans Topography

5 Miles

Reclaimed Land
Lakeside Lowlands
Canal Excavation
Lakeside Lowlands
Bayou St. John
Lakeside Lowlands
Bayou Gentilly/Sauvage/Bienvenue Ridge
Gentilly Ridge
Metairie Ridge
Former Backswamp
Bayou Road/ Esplanade Ridge
Former Backswamp
Mid City Lowlands (Former Backswamp)
Mississippi River Natural Levee
Carrollton Spur
Batture
Mississippi River Natural Levee
Former Backswamp
Canal Excavation
Mississippi River Natural Levee

Elevation of Land Surface in Feet Above/Below Mean Gulf Level, 1994
17 - 40
13 - 16
11 - 12
9 - 10
7 - 8
5 - 6
3 - 4
1 - 2
0
-1 - -2
-2 - -3
-4 - -5
-5 - -6
-6 - -9
-12 - -9
-12 - -15
-15 - -17

Original data from New Orleans City Planning Commission

N
W E
S

New Orleans Topographical Features

Gradual Change

- Decreased sediment (in river/from river - 70% reduction primarily because of hydroelectric dams upstream)
- Relative sea level rise (incl. compaction and sea level rise) from 3 to 10mm/year
- Decreased contiguity (oil & gas, waterborne commerce, roads, levees, etc.)
- Increased hurricane frequency/intensity
- Decreased social connection to urban/natural environments.

1945

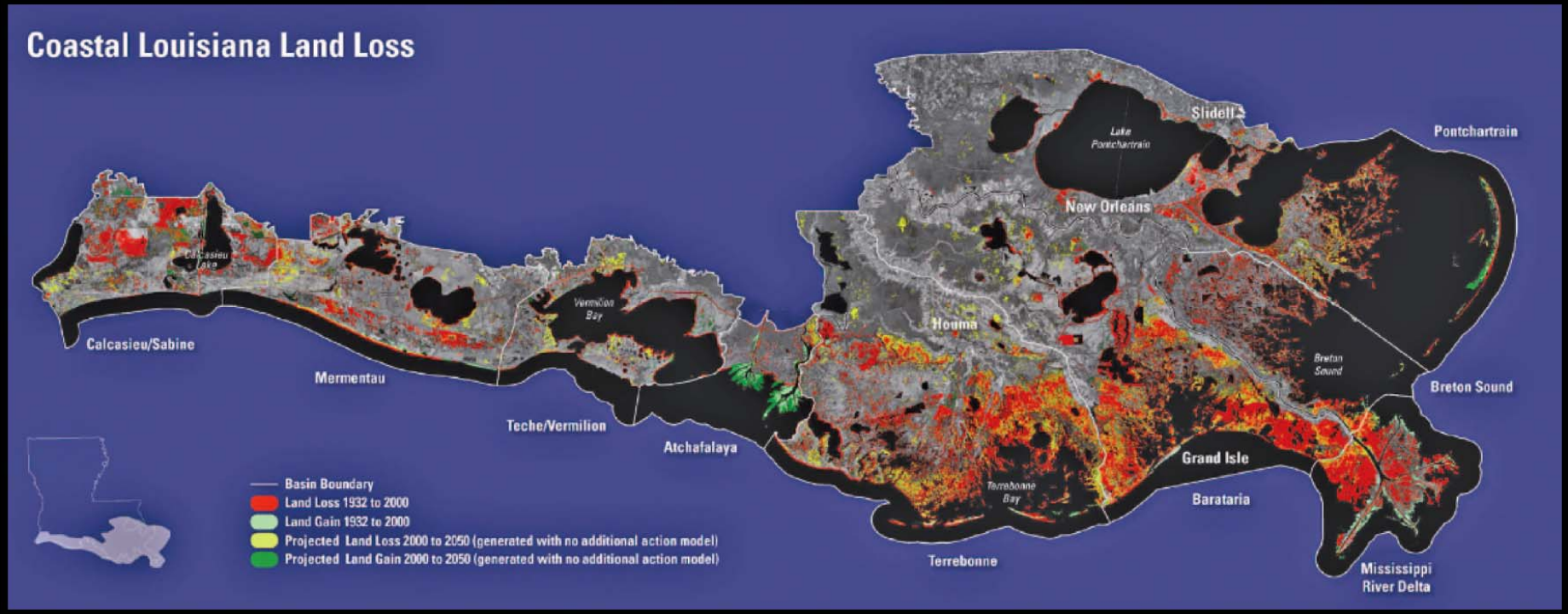
The impacts of oil and gas withdrawal are evident in these before and after shots of the Barataria Basin, where the first canals were cut in the 1940s.

1998

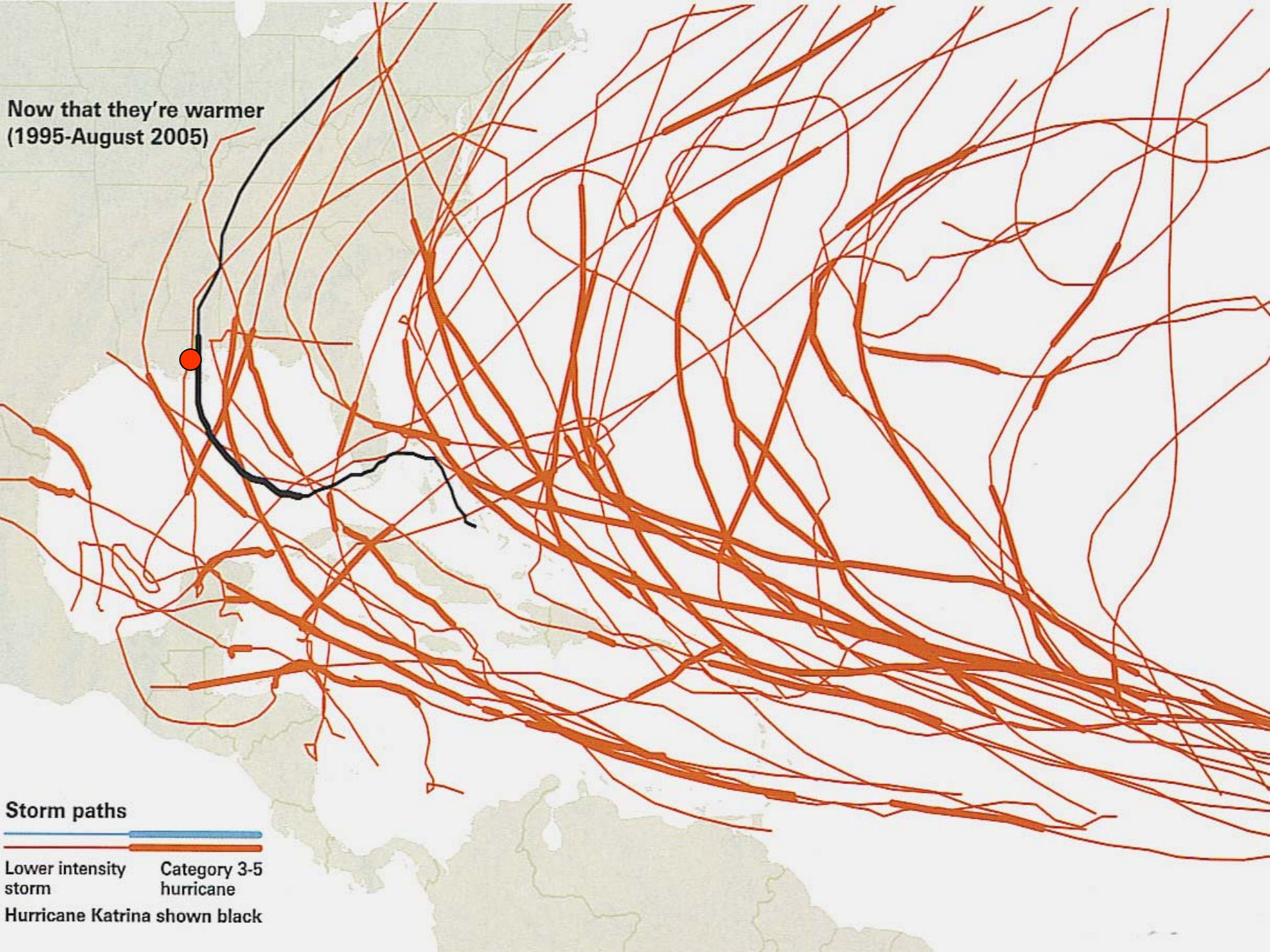
By the late 1990s most of the marsh was gone, due to erosion, saltwater intrusion, and subsidence accelerated by oil and gas withdrawals.

source: USGS

Coastal Wetland Loss in Louisiana



Wetland/water conversions 1932-2000

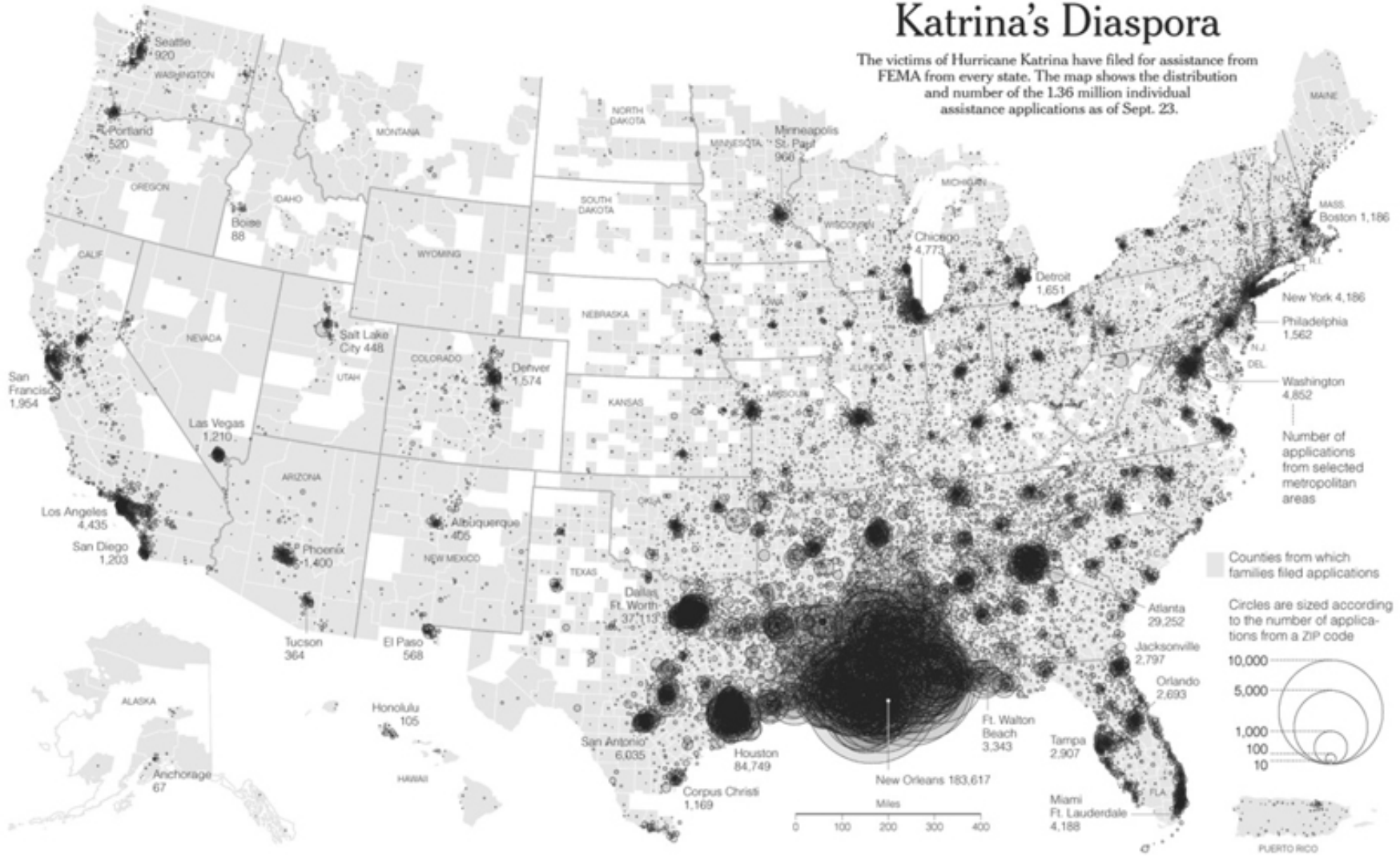

Now that they're warmer
(1995-August 2005)
Storm paths
Lower intensity storm
Category 3-5 hurricane
Hurricane Katrina shown black

The New York Times

October 2, 2005

Katrina's Diaspora

The victims of Hurricane Katrina have filed for assistance from FEMA from every state. The map shows the distribution and number of the 1.36 million individual assistance applications as of Sept. 23.



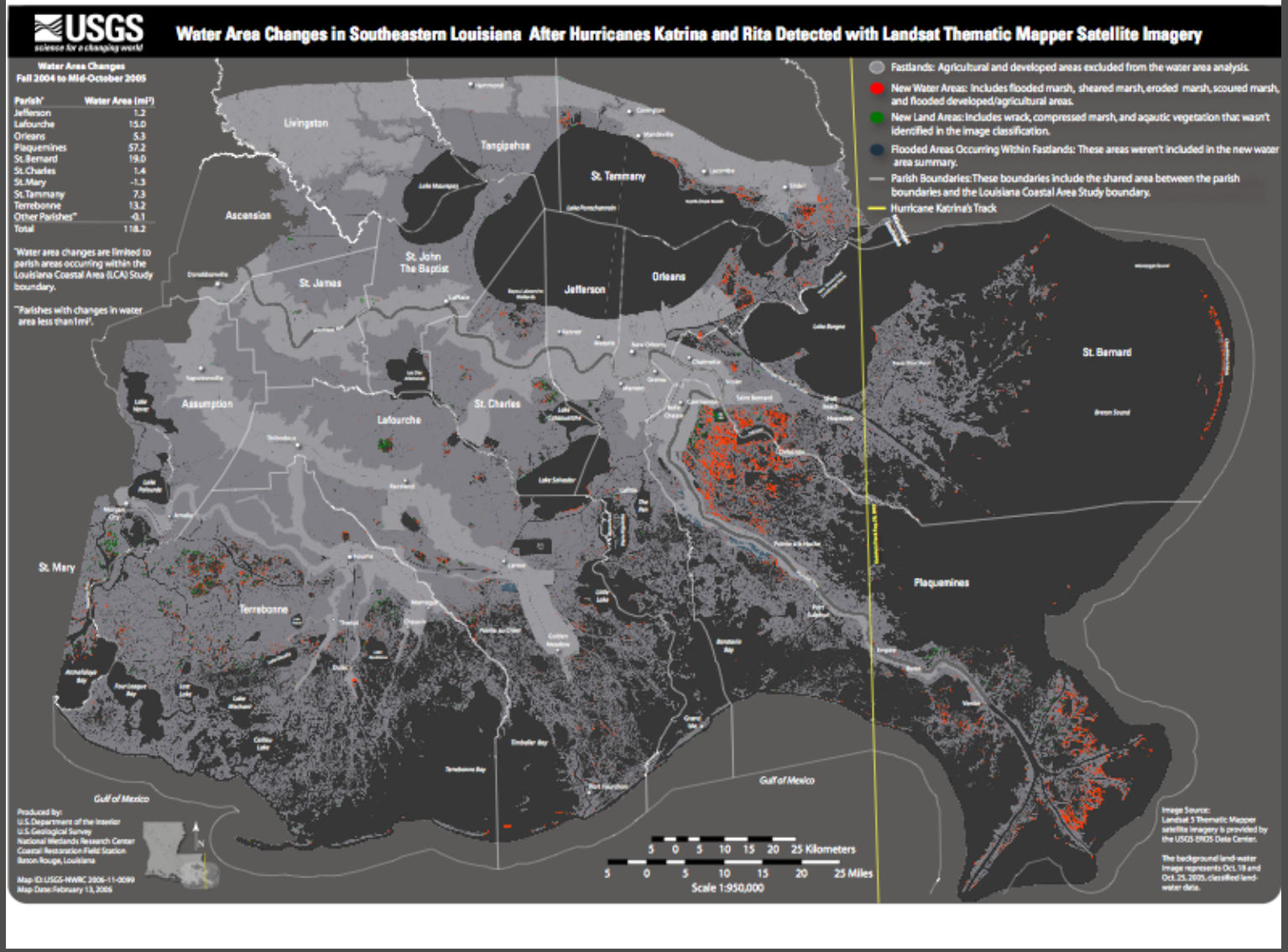
Applications by state

Louisiana	523,149	38.6%
Mississippi	383,840	28.3%
Texas	156,895	11.6%
Alabama	109,469	8.1%
Georgia	35,342	2.6%
Florida	31,005	2.3%
Tennessee	15,529	1.1%
Arkansas	11,027	0.8%
California	10,953	0.8%

Applications by distance from New Orleans

MILES	APPLICANTS	PCT.
0-100	626,232	46.2%
100-200	338,080	24.9%
200-400	184,169	13.6%
400-800	143,497	10.6%
800-1,600	45,371	3.3%
1,600-3,200	13,403	1.0%
3,200+	232	0.0%

Distances could not be calculated for 0.4 percent of applications.

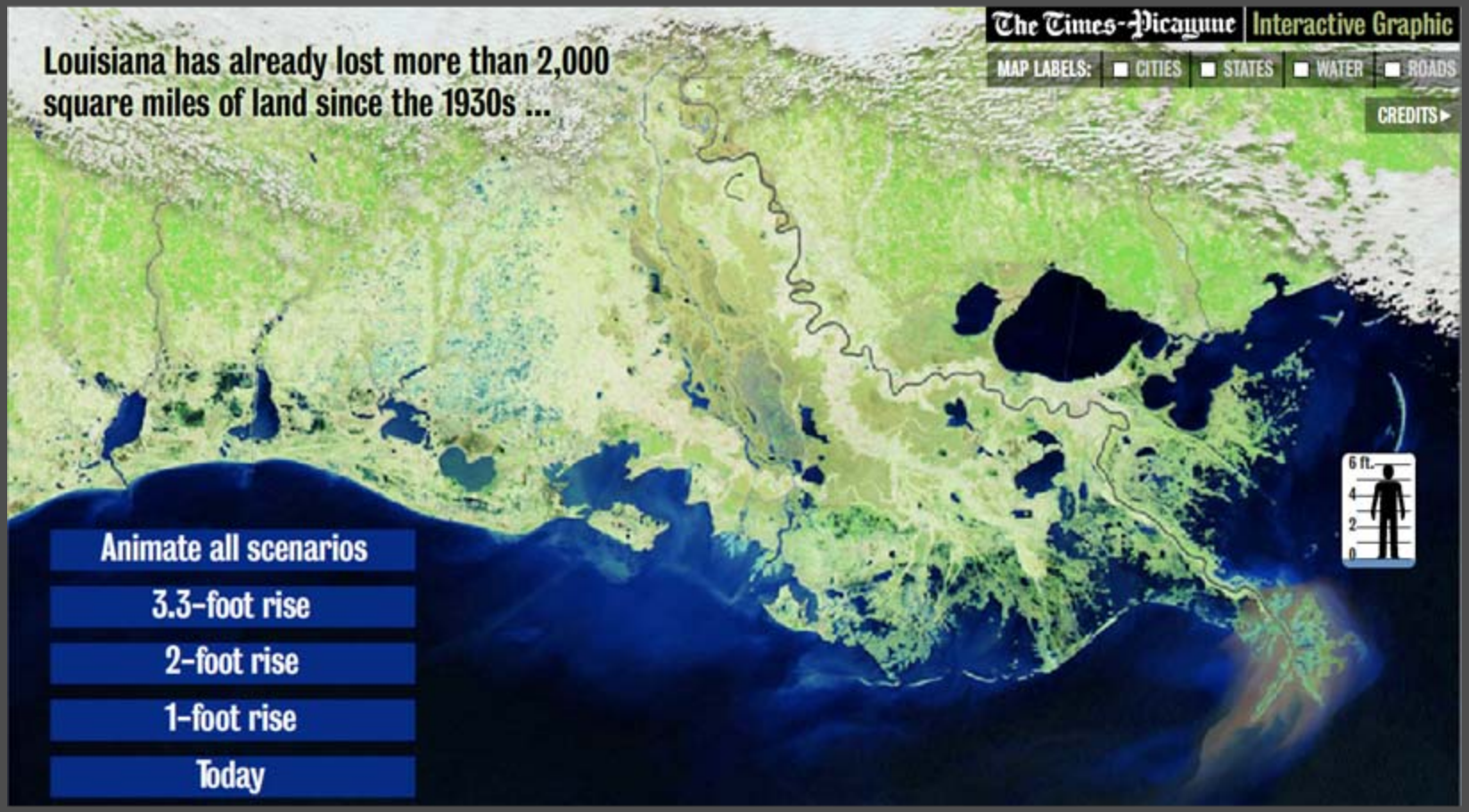


217 square miles (562 km^2) of wetland to water conversion

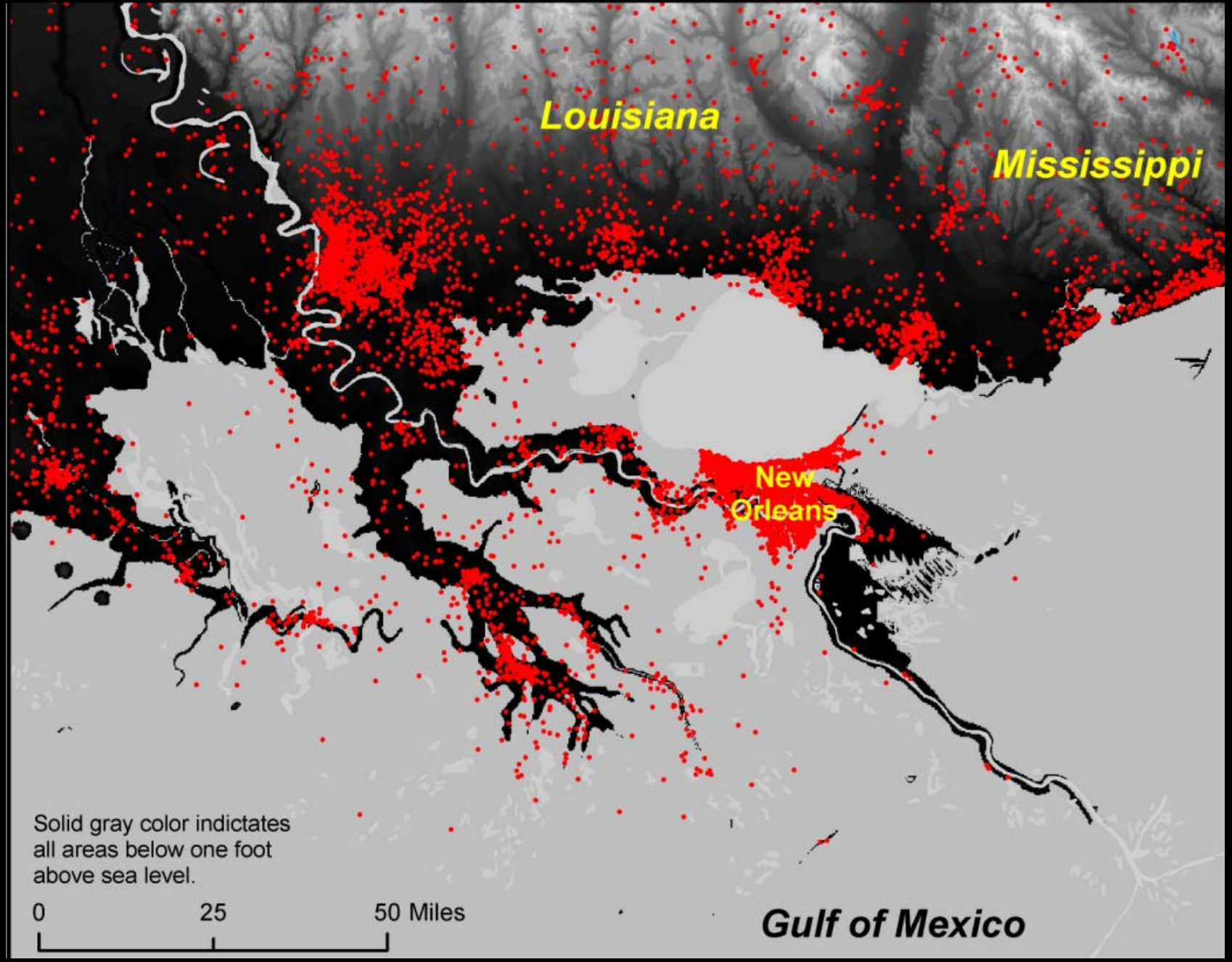
$1.1 billion acute loss to commercial fisheries

$150 million near-term loss to oyster harvests

Coastal Louisiana Land Water Interface - Today



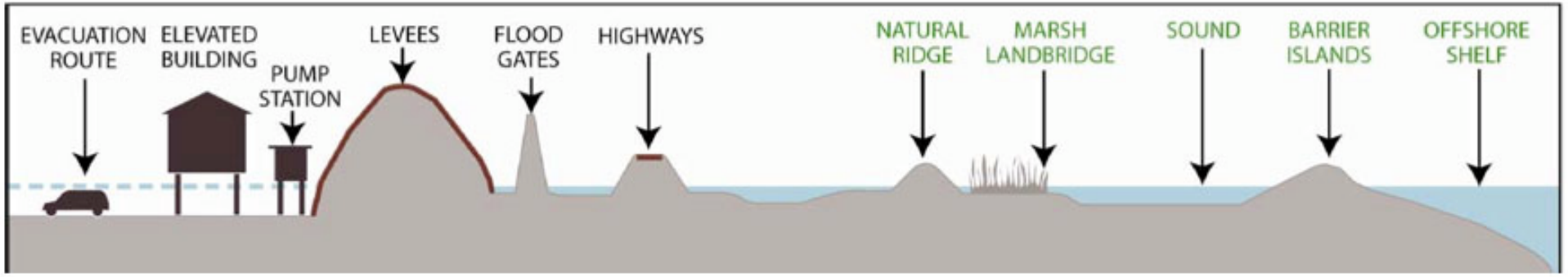
Coastal Louisiana Land Water Interface – 3 Foot Sea Level Rise



From **Campanella, R**. *Geographies of New Orleans: Urban Fabrics Before the Storm*. Center for Louisiana Studies, University of Louisiana at Lafayette, August 2006.

Multiple Lines of Defense: New Concept for Integrated Levee Protection and Coastal Louisiana

Cross-Section of Urban, Rural, and Natural Land Forms



Multiple Lines of Defense Concept (Courtesy of the Lake Pontchartrain Basin Foundation)

Louisiana Levee Repair Costs

	New Orleans Metro Area	Southeast Louisiana
Repair Cost	$3.5-9.5 billion ($7.2billion?)	$4-5 billion
Area Protected	115,616 acres	550,990 acres
Population Protected	1-1.3 million	120,000
Cost/resident (not incl. maintenance)	$2,692-$9,500	$33,333-$41,667

Six Planning Phases Since September 2005

1. The Bring New Orleans Back Commission (BNOBC),
2. New Orleans Neighborhood Rebuilding Plan (NONRP),
3. The Unified New Orleans Plan (UNOP),
4. The Office of Recovery Development and Administration (ORDA),
5. **The Comprehensive Master Plan and Zoning Ordinance (CMP/ZO), and**
6. **Numerous grassroots and neighborhood-based planning.**

Sustainable Systems:

Environmentally sound development

- Improve stormwater management with water collecting site design requirements.
- Reduce the urban heat island by requiring vegetated surfaces.
- Impact climate change by allowing solar panels, residential wind turbines within the accessory structure and use regulations.

(from Camiros: New Orleans CMP/ZO)

Zoning for Sustainability

Promote the use of water conservation & innovative stormwater management techniques in site planning & new construction

Reduce the urban heat island impact through design Of new development which minimizes reflective Flat surfaces

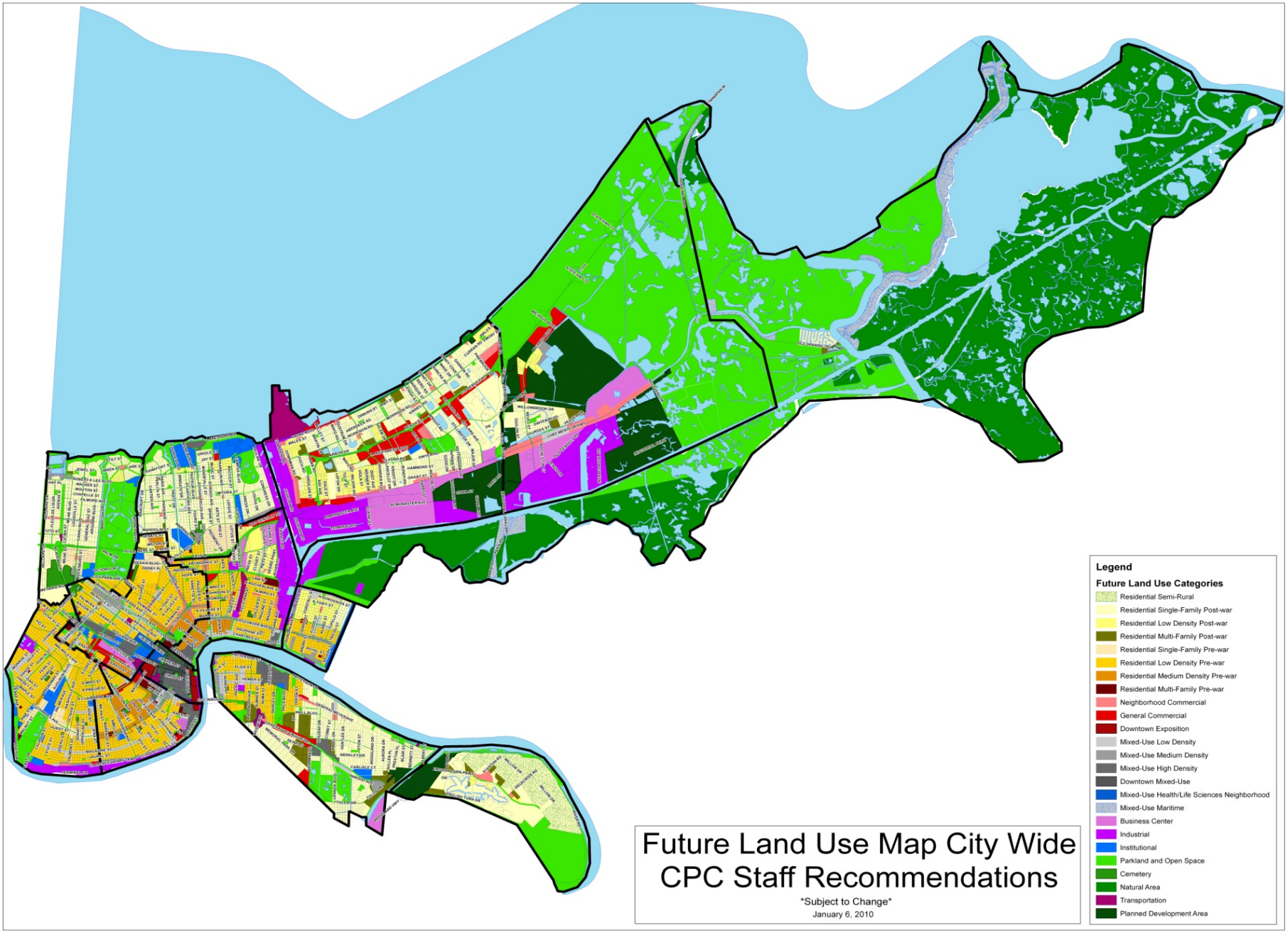
Reduce greenhouse gas emission through alternative Energy systems

Build the needs of bicycle transportation into development standards

(from Camiros: New Orleans CMP/ZO)

High Frequency or Consequence Flood Risk Areas Master Plan "Supports" Adaptation Including:

1. Property buyouts in low-lying/high risk areas allowing for relocation elsewhere in the city, state, or USA;
2. Relocation to new elevated structures in the same or adjacent neighborhoods;
3. Elevation of damaged structures in place (minimum of 3 feet; maximum of 12-15 feet) ***(will it happen?)***;
4. Secondary levees and floodwalls (up to 6 feet) around critical public facilities or commercial buildings;
5. Dry flood proofing of commercial buildings (installation of external waterproof walls up to 4 feet in areas with a history of not more than 3 feet of flooding); and
6. Hardening of critical facilities through elevating pumps, generators, electrical wiring, etc., and moving operations above the first floor.



Future Land Use Map City Wide
CPC Staff Recommendations

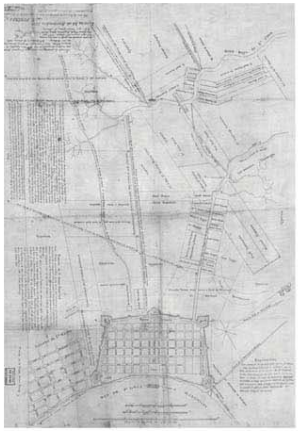
Subject to Change

January 6, 2010

Holy Cross/Lower 9th
An Model Urban Ecosystem for Sustainability

- Climate Neutrality / Energy Efficiency
- Sustainable Architecture
- Bayou Bienvenue Restoration
- Neighborhood Landscaping
- New land uses

Tulane University CBR/Law, Bob Berkabile, John Williams Architects, University of Wisconsin, Mossop + Michaels



MAP, 1819. THE LOWER NINTH AND CYPRESS SWAMP WERE ONCE SEAMLESSLY INTEGRATED.

BAYOU BIENVENUE, 1910

BAYOU BIENVENUE TRAINGLE WAS ONCE A FLOURISHING CYPRESS SWAMP WHERE RESIDENTS OF THE LOWER NINTH COULD HUNT, FISH, AND ENGAGE WITH NATURE. IN THE LAST FIFTY YEARS, THE SWAMP HAS BEEN TRANSFORMED INTO AN OPEN WATER LAKE. ALL THAT REMAINS ARE GHOSTS OF THE LOST CYPRESS.

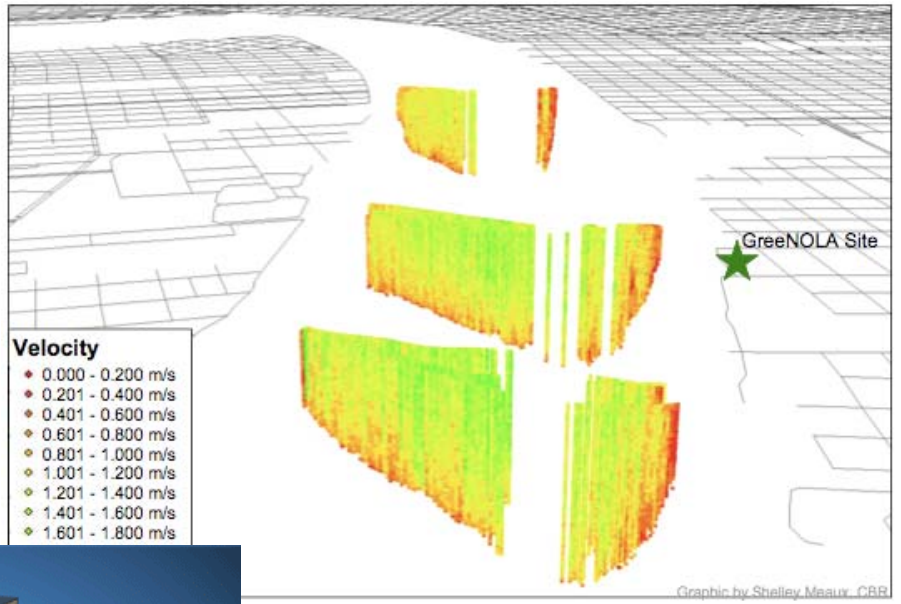
Louisiana Lift House

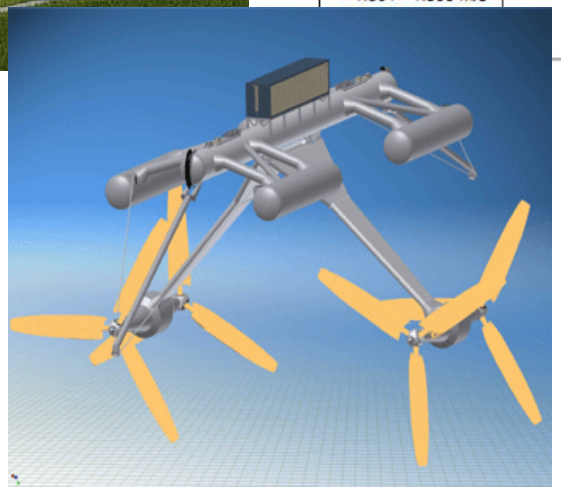
Make it Right — KieranTimberlake Associates

Raised housing options

Sustainable Built and Natural Systems

Models for Efficient/Renewable Energy



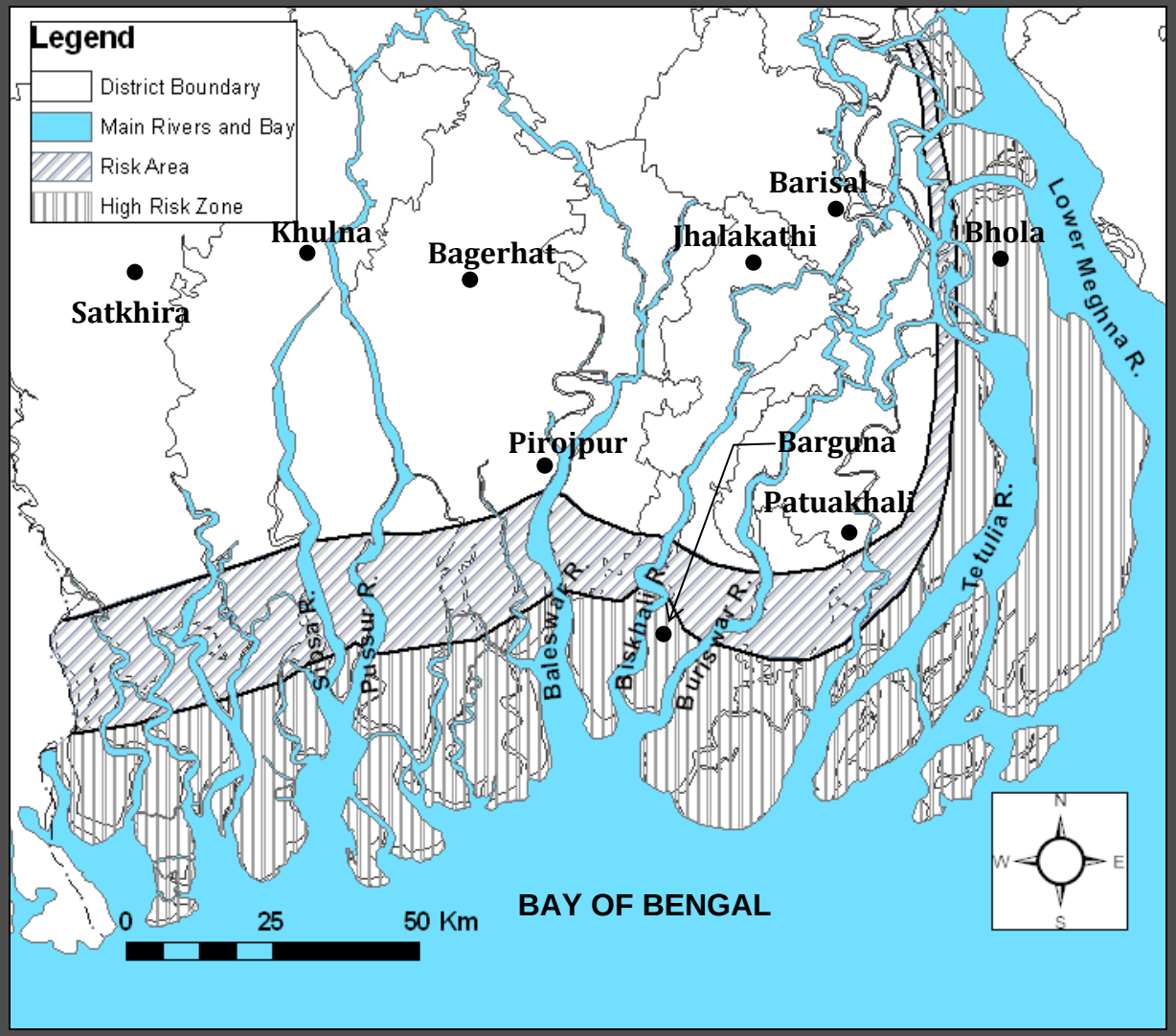


CENTER FOR BIOENVIRONMENTAL RESEARCH
at Tulane and Xavier Universities

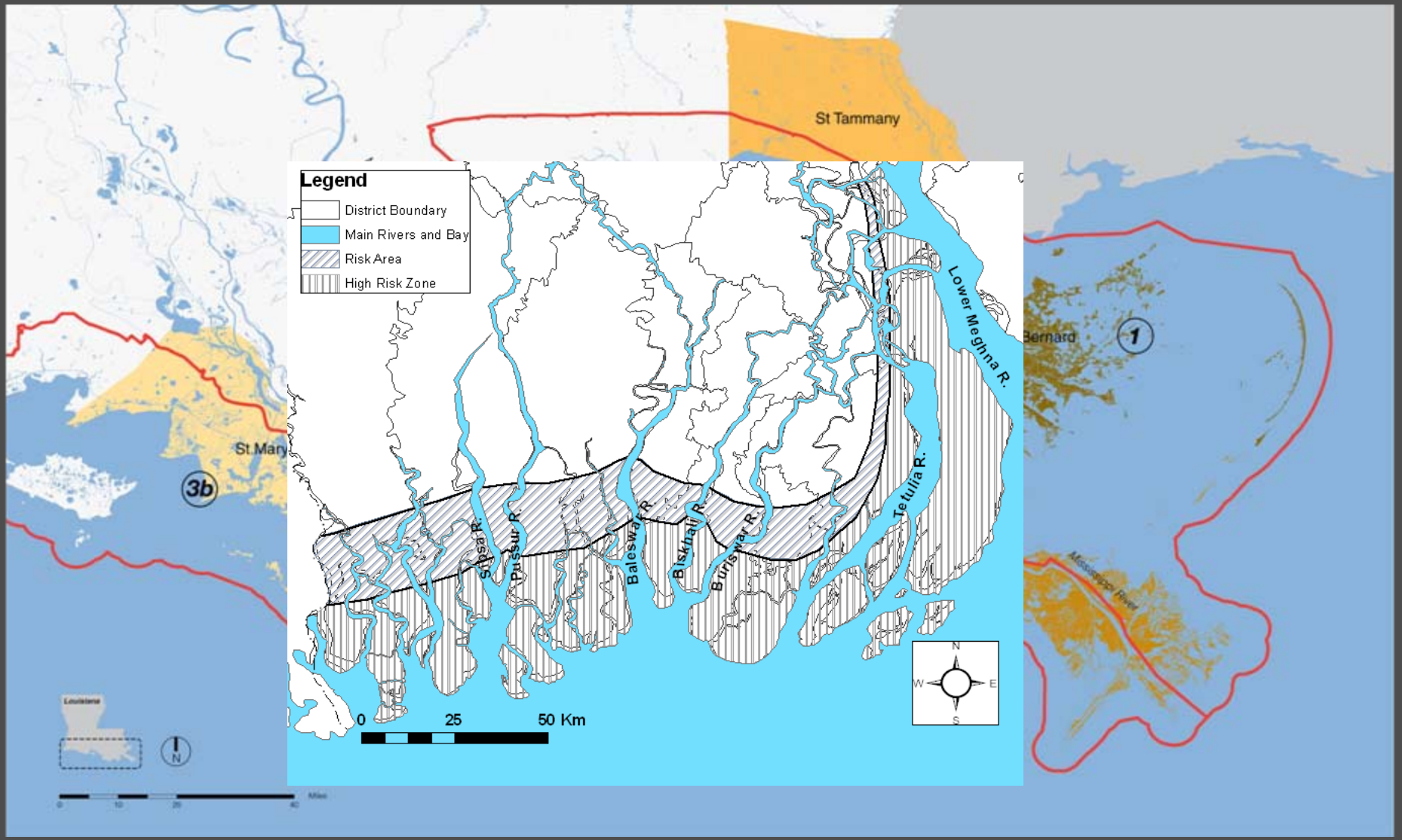
Relevance of New Orleans as a case study for application developing countries

- New Orleans offers is an urban/major delta subject to both climate change and disaster.
- New Orleans is data rich case study as both a historical and predictive model.
- New Orleans is a potential example of “ecostructure” as an urban strategy for adaptation and mitigation.

Bangladesh Flood Risk



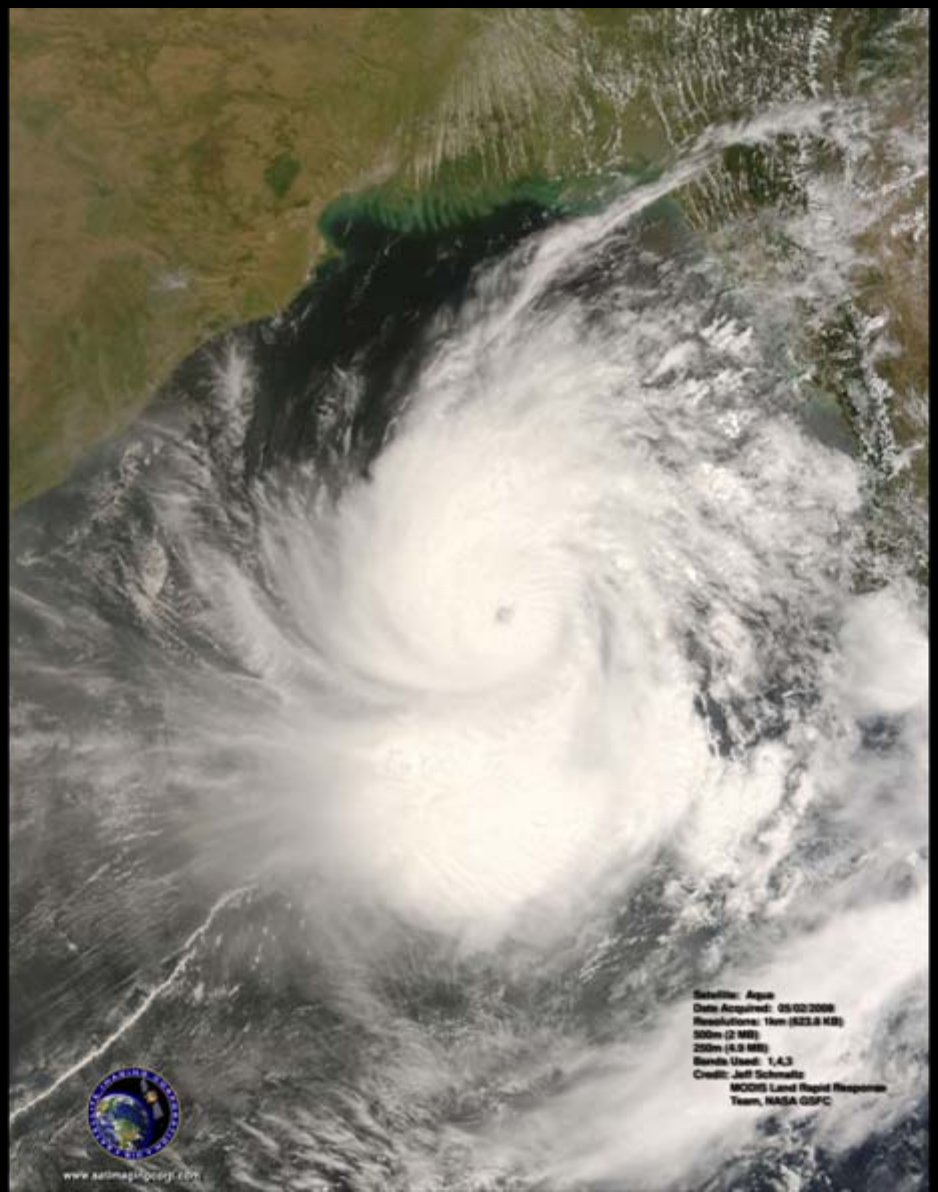
Bangladesh and Louisiana Relative Sizes



Louisiana/Bangladesh Comparison

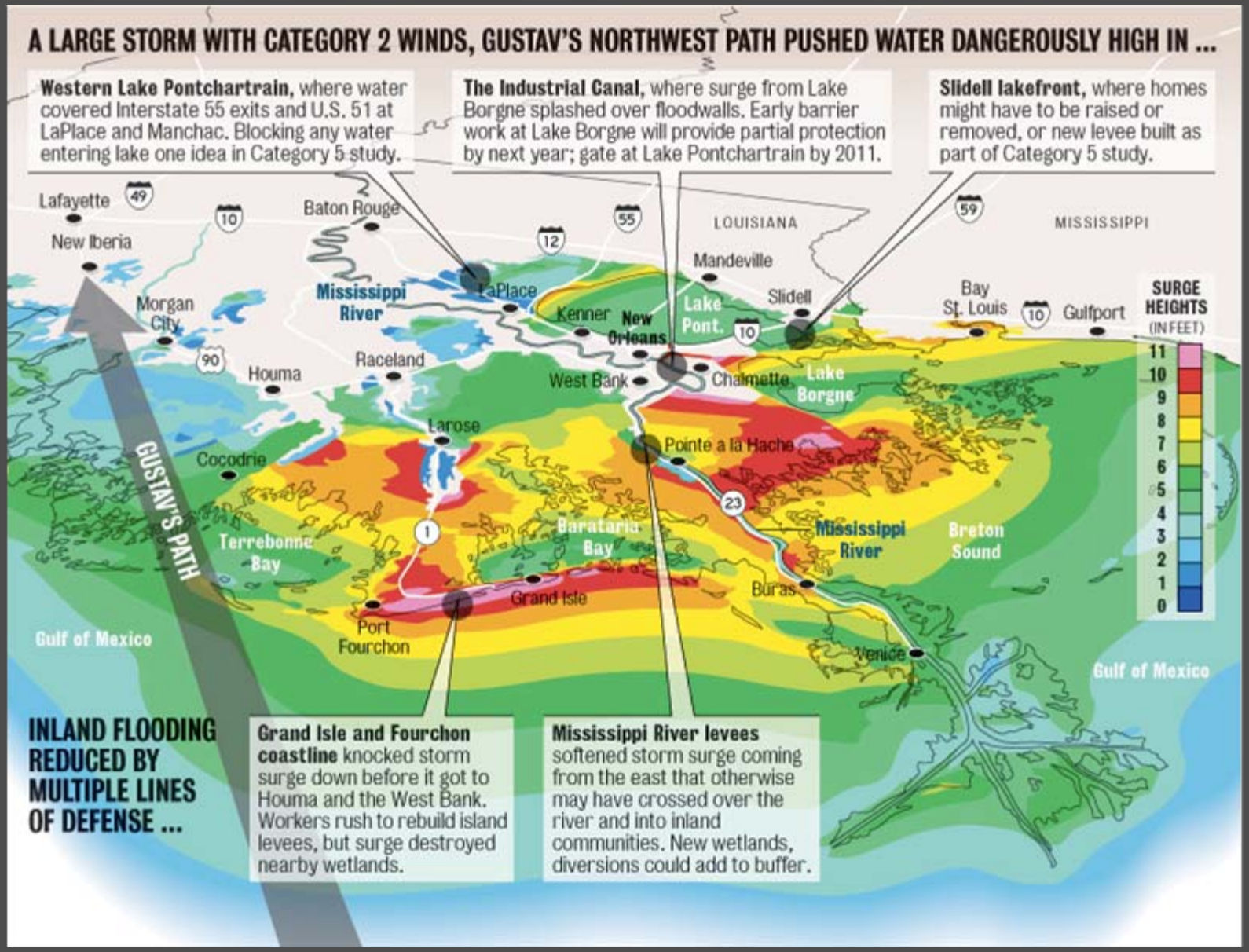
Indicator	Louisiana Coast	Bangladesh Coast
Average River Flow	900,000 cfs (Miss/Atchaf)	1,511,750 cfs (GBM)
Coastline Length	639 km	710 km
Coastal Zone Area	21,448 km^2 (19 parishes)	47,201 km^2 (19 districts)
RSLR	9 mm per year	4-7 mm per year
Coastal Residents	2 million	14 million
Population Density	93.3 residents per km^2	541 residents per km^2

Cyclone Nargis, 5/1/08



The Louisiana/Bangladesh Case Study

1. Storm surge modeling developed for New Orleans after Hurricane Katrina was applied to Hurricane Gustav and Cyclone Nargis
2. Modeling results informed emergency evacuation of millions of vulnerable residents through Bangladesh Disaster Management
3. Results were devastating but likely with fewer casualties than without enhanced warning system


A LARGE STORM WITH CATEGORY 2 WINDS, GUSTAV'S NORTHWEST PATH PUSHED WATER DANGEROUSLY HIGH IN ...
Western Lake Pontchartrain, where water covered Interstate 55 exits and U.S. 51 at LaPlace and Manchac. Blocking any water entering lake one idea in Category 5 study.
The Industrial Canal, where surge from Lake Borgne splashed over floodwalls. Early barrier work at Lake Borgne will provide partial protection by next year; gate at Lake Pontchartrain by 2011.
Slidell lakefront, where homes might have to be raised or removed, or new levee built as part of Category 5 study.
LOUISIANA
MISSISSIPPI
Lafayette
New Iberia
Baton Rouge
Mississippi River
LaPlace
Kenner
New Orleans
Lake Pont.
Mandeville
Slidell
Bay St. Louis
Gulfport
Morgan City
Houma
Raceland
West Bank
Chalmette
Lake Borgne
Larose
Cocodrie
Pointe a la Hache
GUSTAV'S PATH
Terrebonne Bay
Barataria Bay
Mississippi River
Breton Sound
Grand Isle
Buras
Port Fourchon
Venice
Gulf of Mexico
Gulf of Mexico
SURGE HEIGHTS (IN FEET)
11
10
9
8
7
6
5
4
3
2
1
0
INLAND FLOODING REDUCED BY MULTIPLE LINES OF DEFENSE ...
Grand Isle and Fourchon coastline knocked storm surge down before it got to Houma and the West Bank. Workers rush to rebuild island levees, but surge destroyed nearby wetlands.
Mississippi River levees softened storm surge coming from the east that otherwise may have crossed over the river and into inland communities. New wetlands, diversions could add to buffer.

Impacts of Nargis
Irrawaddy Delta region of Burma

A mother and son contemplate the impact of the cyclone.

The remains of a dormitory at the orphanage, where three 12-year old boys were killed.

School teacher Saya Gyi Moe assesses the devastation of a classroom.

Another building at the orphanage is totally destroyed

Concluding Remarks

- Acceptance of the dependency of urban inhabitants on ecosystems within and outside the urban region
- Use of both natural systems and hard structures for adaptation and mitigation
- Focuses primarily on low-probability/high-impact and high-probability/moderate-impact
- Locally, grass-roots demonstrations can inform city support, recommendations, and enforcement
- Internationally, “developed” and “developing” countries can inform each other through common endemic conditions

The “Dutch Dialogues”

Coastal Louisiana
(looking North)

Netherlands
(looking South)

Dutch Embassy, American Planning Association, et al.

GENTILLY CANAL SYSTEM