
USGS
science for a changing world
The DOT Center for Climate Change & Environmental Forecasting
CCSP Product 4.7
Impacts of Climate Change and Variability on Transportation Systems and Infrastructure:
Gulf Coast Study

Overview

- Project objectives, 3 phases
- Study area
- Research team and stakeholders
- Methods, scientific approach
- Status

Bonner Bridge, Oregon

Alaska Highway

- Transportation infrastructure is built for the long haul
- As climate changes, our infrastructure may have to evolve to handle new conditions
- Impacts on transportation is an underdeveloped area of research
- Each region has unique transportation assets and vulnerabilities

Potential Impacts of Climate Change on Transportation

Climate Changes and Variability

- Temperature change
- Precipitation change
- Accelerated sea-level rise
- Increased storm surge and intensity

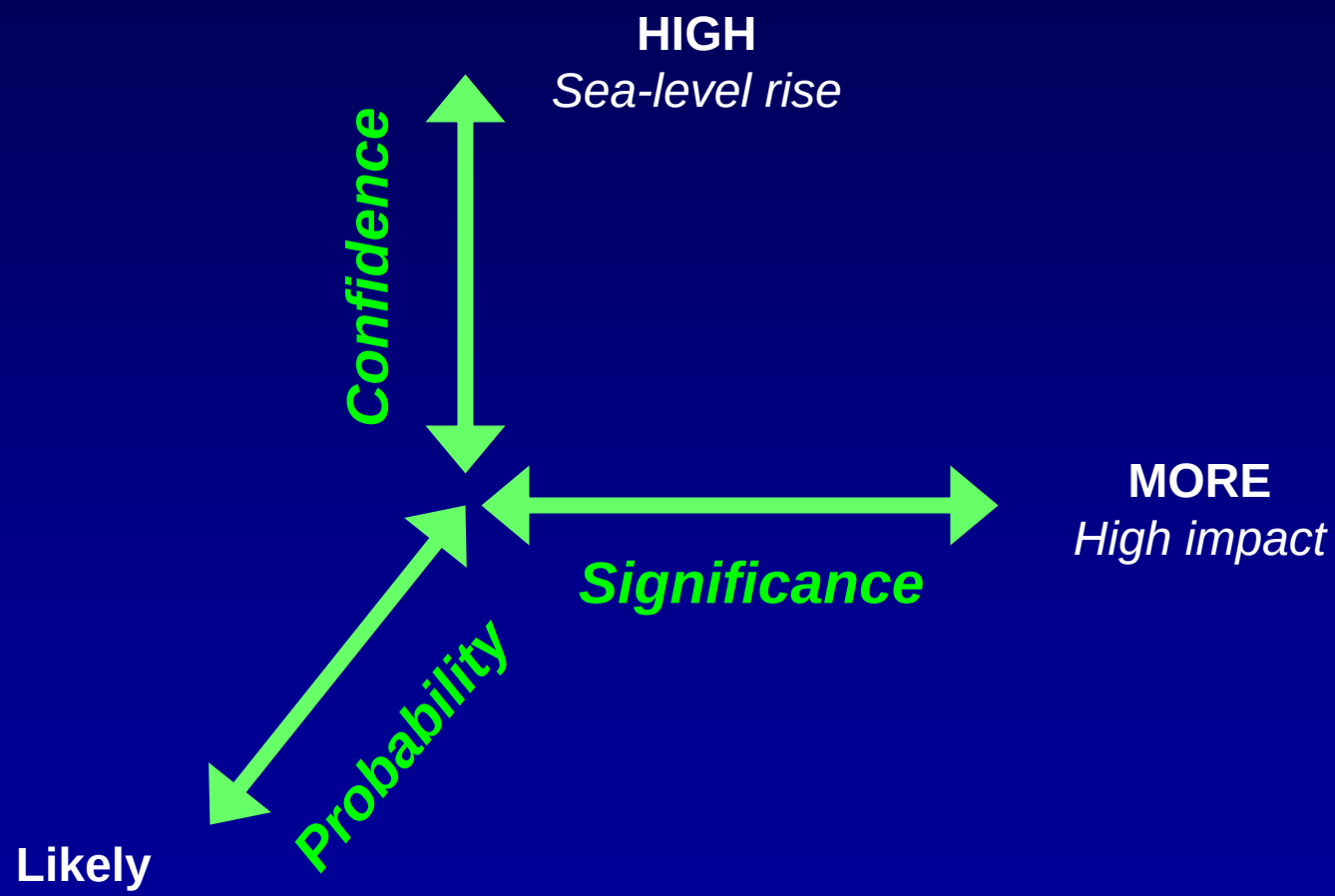
Transportation Decision-Making

- System Planning
- Project Development
- Operations
- Maintenance
- System Assessment

Transportation Impacts

- Location
- System design
- Design specifications
- Materials
- Safety
- Emergency management / evacuation
- Replacement / repair schedules
- Investment levels

Risk & Resilience
Need for New Tools



Adapted from Brian Mills (Meteorological Service of Canada) and Jean Andrey (University of Waterloo)

Gulf Coast Study

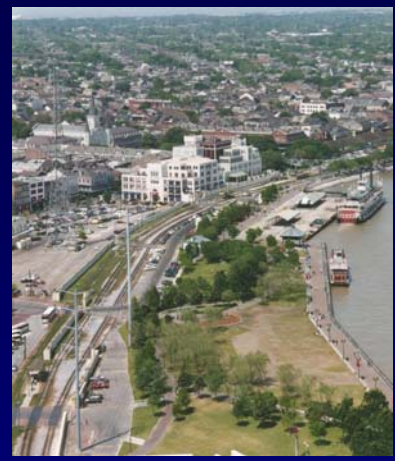
Objectives

- Collect data needed for assessing transportation vulnerability
- Develop knowledge about potential impacts
- Assess the significance of these risks
- Develop a methodological approach for assessment
- Identify strategies for adaptation
- Develop decision-support tools

USGS science for a changing world

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

Gulf Coast Counties



- 11% of US coastal population

  population ≅ doubled since 1950

  projected 25-40% growth by 2025
- 42,000 km ^{2} of land of land below 1.5 m
- 69% of US waterborne commerce
- 85% of US OCS oil and gas production
- 2/3 of US oil imports

Gulf Coast Case Study Design

- **Phase I – current effort**
  - Synthesis of existing data and information
  - Preliminary vulnerability assessment of region
  - Conceptual framework for risk and vulnerability assessment
- **Phase II**
  - In-depth assessment of impacts and risks to selected locations
  - Development of risk assessment tools and techniques
- **Phase III**
  - Identification and assessment of adaptation strategies
  - Development of techniques to evaluate adaptation strategies

Phase 1 Research Team

- **U.S. Department of Transportation (Lead Agency)**
- **U.S. Geological Survey (Supporting Agency)**

- **Cambridge Systematics**
- **Texas A&M University**
- **University of New Orleans**
- **Louisiana State University**
- **Wilbur Smith & Associates**
- **Texas Transportation Institute**

Expert Panel

Vicki Arroyo Director of Policy Analysis Pew Center on Global Climate Change	Philip B. Bedient Professor of Engineering Rice University	Leigh B. Boske Associate Dean Lyndon B. Johnson School of Public Affairs University of Texas	Tom Podany Assistant Chief, Planning U.S. Army Corps of Engineers, New Orleans District
Alan Clark Director of Transportation Planning Houston-Galveston Area Council	Fred Dennin Regional Administrator, Region 3 Federal Railroad Administration	Paul S. Fischbeck Professor of Social and Decision Sciences Carnegie Mellon University	Anthony Janetos Vice President Heinz Center for Science, Economics and the Environment
Thomas R. Karl Director, National Climatic Data Center National Oceanic and Atmospheric Administration	Gilbert Mitchell Chief, Geodetic Services Division National Geodetic Survey National Oceanic and Atmospheric Administration	Kenneth Perret Assistant Secretary Louisiana Department of Transportation and Development	Burr Stewart Strategic Planning Manager Port of Seattle
Chris C. Oynes Gulf of Mexico Regional Director Minerals Management Service	Elaine Wilkinson Executive Director Gulf Regional Planning Commission		

Potential stresses associated with climate/global change and variability:

Key drivers

- Changes in precipitation and temperature
- Accelerated sea-level rise
- Increased storm surge and intensity

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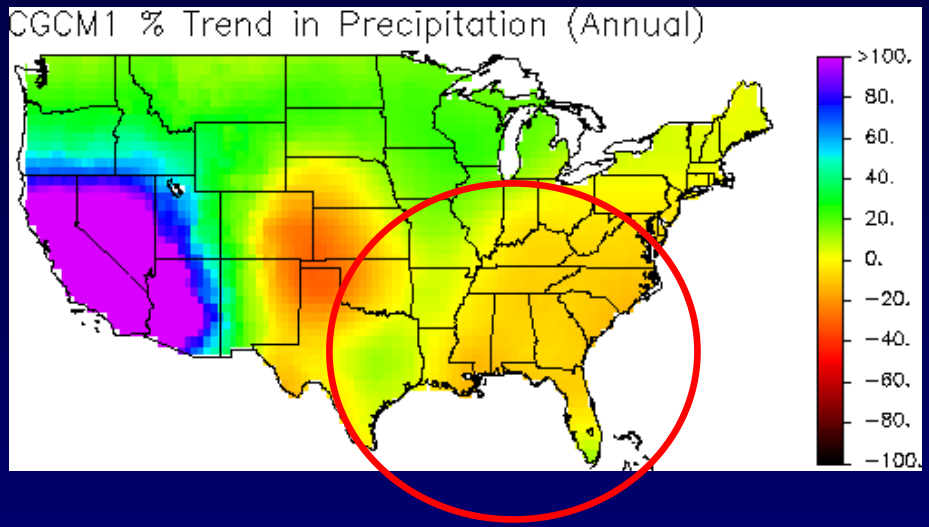
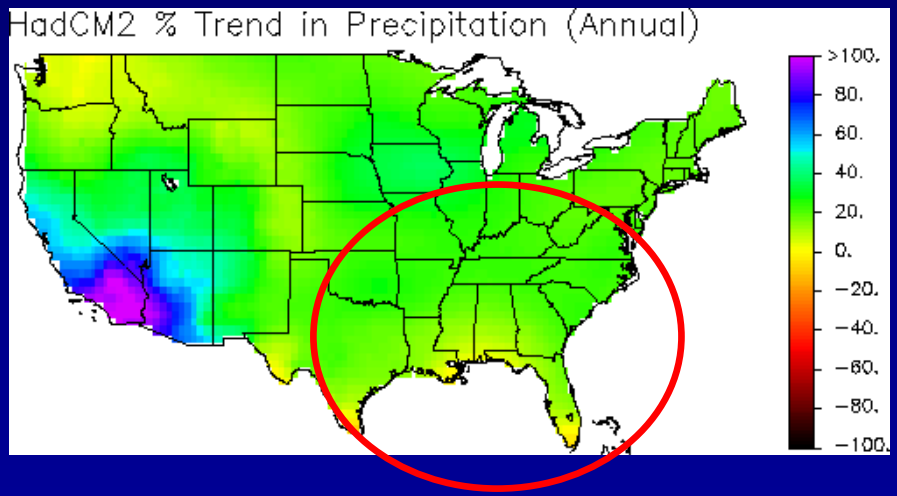
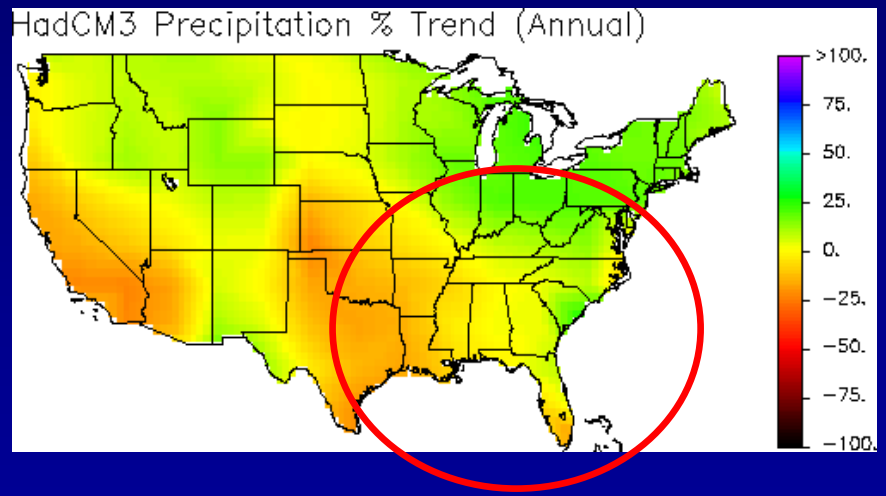


Future Annual Precipitation

(2000-2100)

simulations from 3 AOGCMs





Will the Gulf Coast get wetter or dryer??

How will seasonal rainfall and extremes be affected??

Potential stresses associated with climate/global change and variability:

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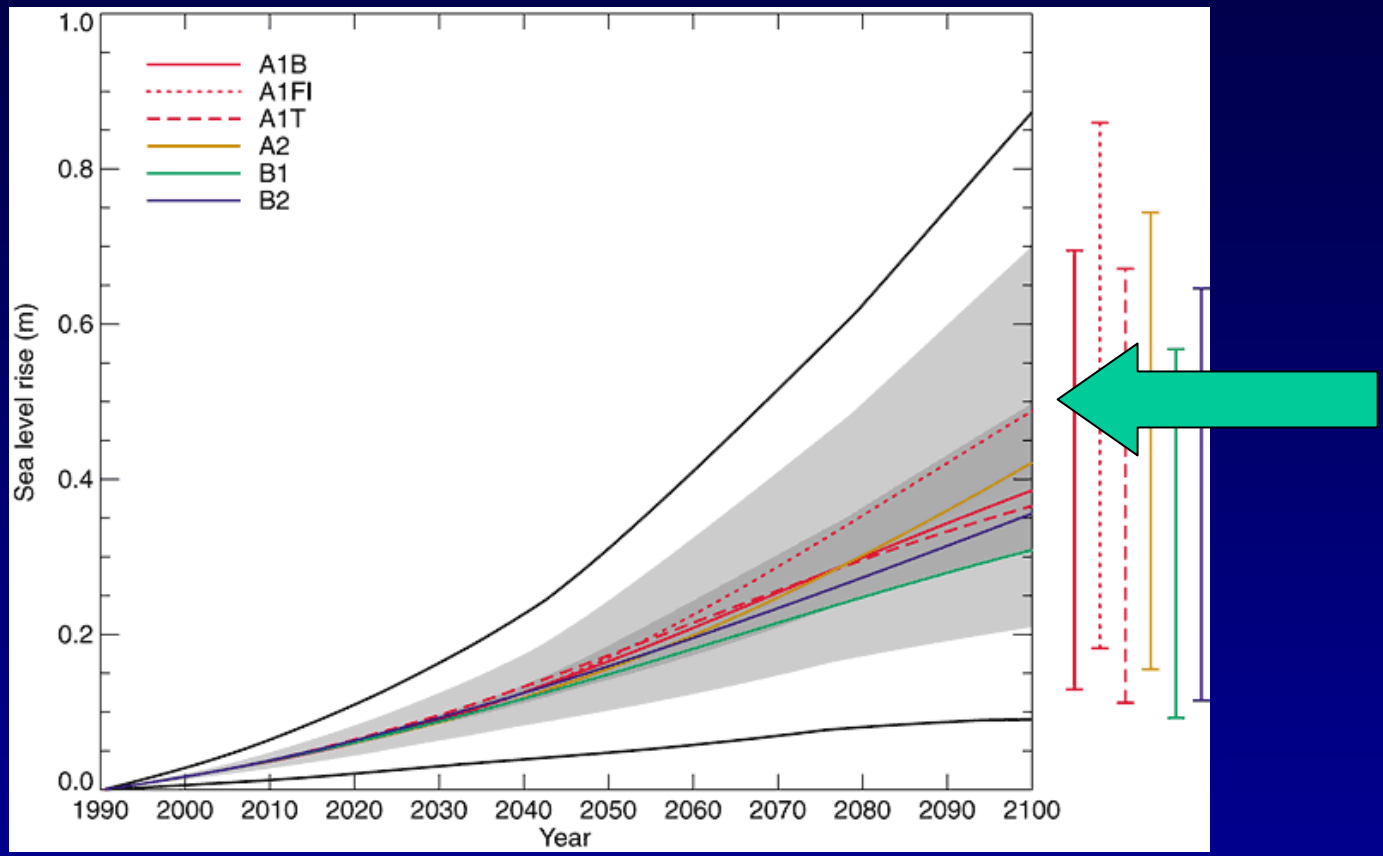
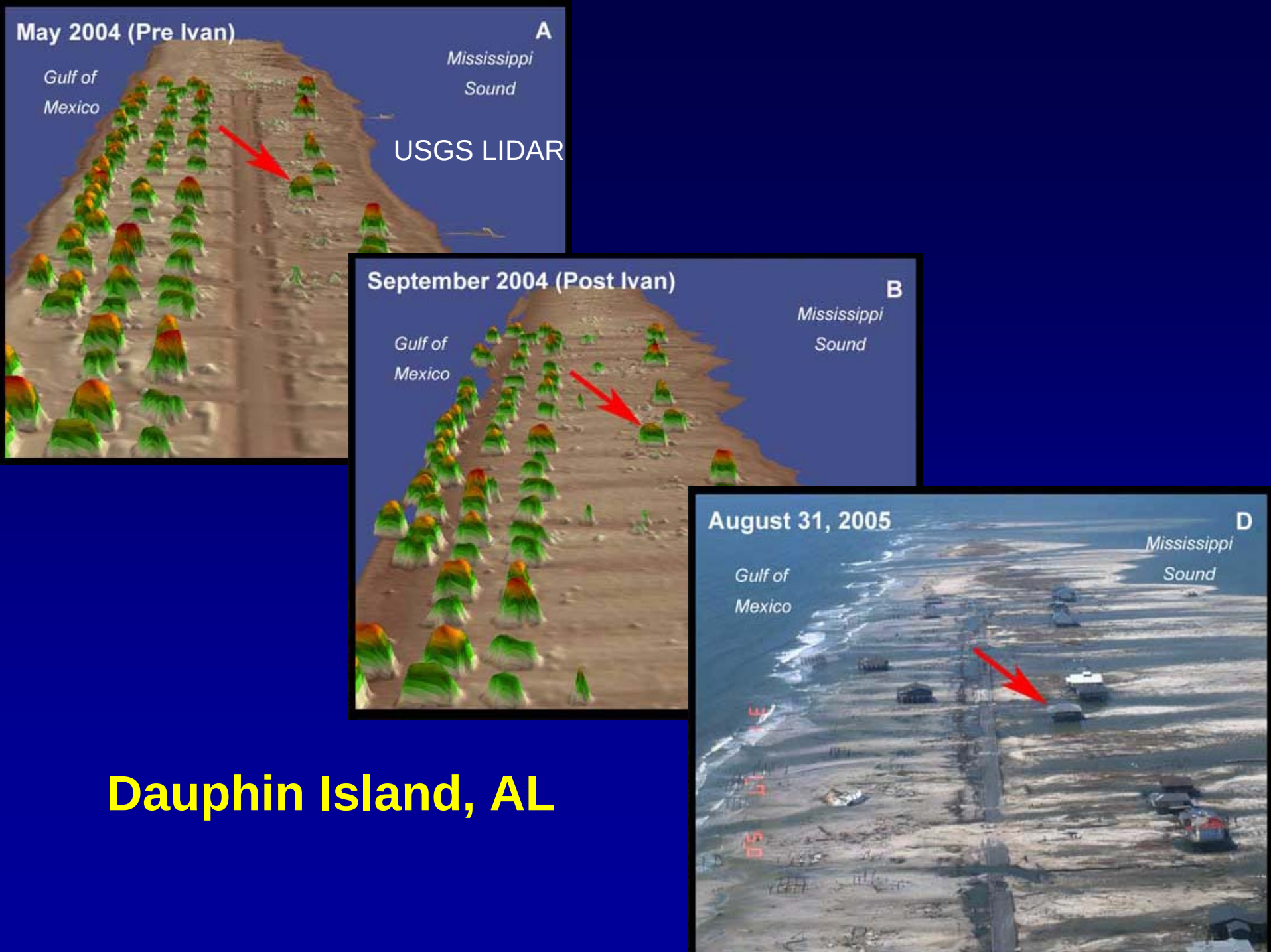
Global sea-level rise is expected to "accelerate" 2- to 4-fold over the next century (IPCC 2001).

An increase in the rate of sea-level rise is one of the more certain and most costly consequences of global warming.



Global average sea level rise (1990 to 2100) for the IPCC SRES emission scenarios. Mid-range estimate in 2100 is 0.48 m (IPCC, 2001).



Dauphin Island, AL

Potential stresses associated with climate/global change and variability:

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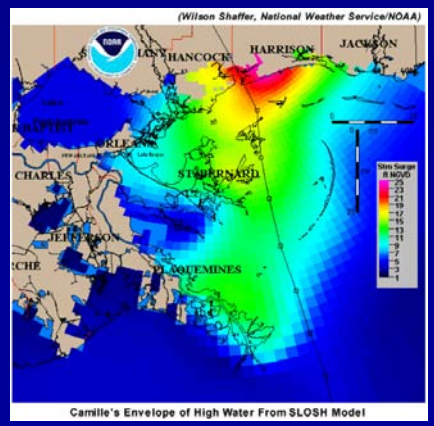
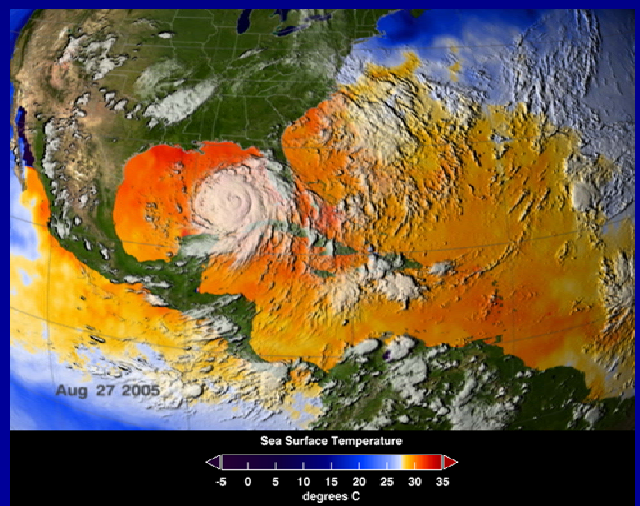
A major question for coastal transportation planners:
How will changes in temperature affect hurricane intensity?





Data for Regional Characterization

Transportation Infrastructure
Road networks
Primary evacuation routes
Railway network
Rail Networks
Amtrak Stations
Fixed guideway transit facilities
Airports
Ports
Oil and gas pipelines
Intermodal freight terminals
Navigable waterways

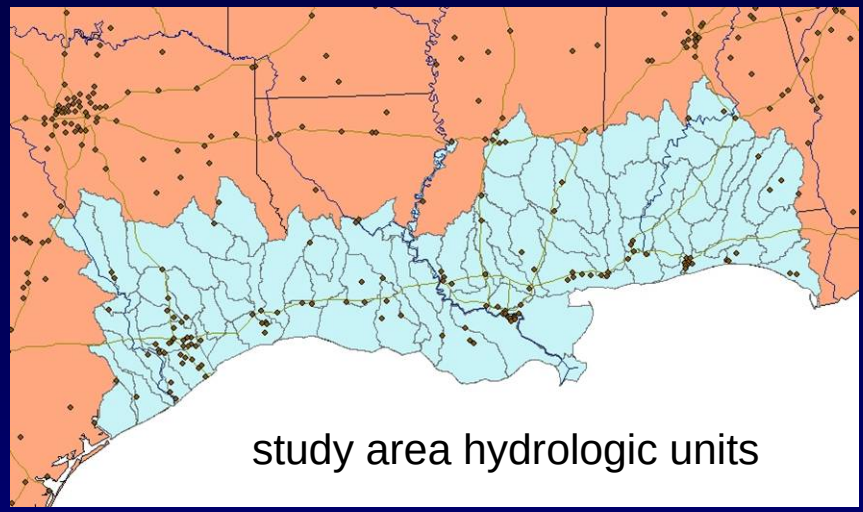
Mobile, Alabama

Imagery and Topographic Maps
Thematic Mapper (TM) Landsat 5 satellite data at 90 meter resolution
Aerial Photography at 1 meter resolution from the 1998 DOQQ
Topographic Maps (DRG) at 1:24000, 1:100000, and 1:250000 scales

Elevation/Land surface
National Elevation Dataset (NED) for Gulf Coast Study Area
LIDAR for coastal Louisiana
LSRC/NGS land surface elevation trends
Coastal erosion and vulnerability rates of shoreline and wetland loss

Earth Sciences
Geologic units
Soil Geographic Database (STATSGO)
National Land Cover Dataset (NLCD)
Ecological units

Hydrology
National Hydrographic Dataset (NHD)
FEMA Q3 flood data
Hydrologic Unit Watersheds


study area hydrologic units

Administrative Geography and Other Infrastructure
Political Boundaries
Demographic data
Urbanized areas
MPO planning boundaries
Coastal and Hazard Planning Districts
Key petrochemical and energy resources
Industrial centers
Employment centers
Government/Federal facilities
Military bases
Public health, education, service facilities
Emergency response and safety facilities

Temperature/Precipitation

Historic temperature/precipitation, 16 NOAA climatic divisions
Drought severity and frequency probabilities
Model ensemble predictions for future temperature and precipitation in the study area (from NCAR)

Streamflow

Streamflow gage network locations, peak flood probabilities
Historical flood frequency analysis of select drainages

Hurricane Windfields and Surge

Historic windfield reconstruction on 10km Grid Network
15, 30, 50, 150 yr storm return frequency by grid location
Wind speed and direction analysis (1851-2100) by storm category I-V
Simulated effects of increasing storm intensity 5-20%
Hurricane surge records analysis and synthesis
Simulated surge flood heights and extent for Cat. I-V storms (SLOSH)
Simulated ADCIRC model surge scenarios for SE Louisiana

Historic Sea-level Trends

NOAA Tide Stations

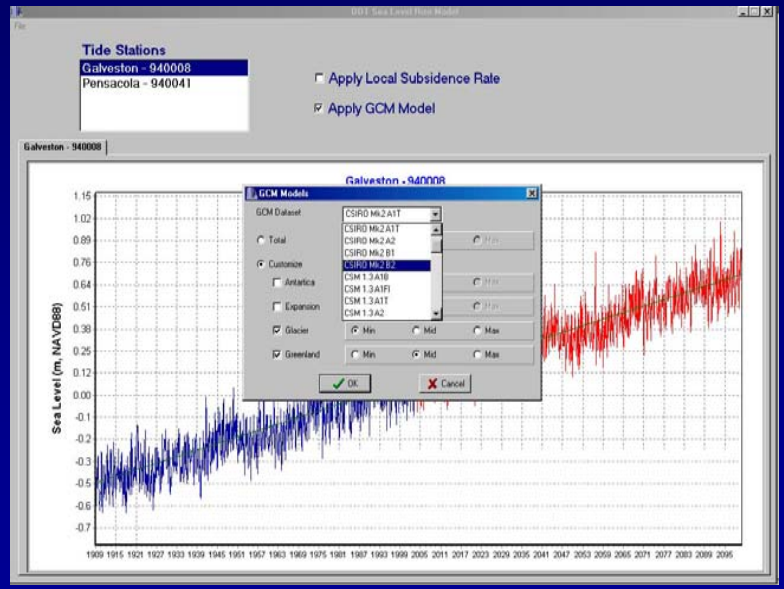
- Annual average for station and period of record
- Monthly means for station and period of record

Projected Sea-level Change

SimClim Program (P. Urick, NZ) Future Eustatic Sea-level rise 2000-2100 Based on numerous GCM model output and emission scenarios

USGS/DOT SLR model (Doyle) of historic and future sea-level rise 1900-2100

Rectified to NAVD88 datum based on 42 IPCC GCM model scenarios



Gulf Coast Study - Status

- Phase 1 underway. Completion expected in late 2007.
  - Hurricanes Katrina and Rita caused:
    - Significant disruption to study team
    - 4-5 month delay
    - Potential changes in scope
- Phases 2 and 3 to follow.

Gulf Coast Study - Status

- ✓Research Team complete
- ✓Expert Panel/Advisory Comm. identified
- ✓Database developed
- ✓Preliminary climate analysis completed
- *Preliminary analysis of transp. impacts*
- *Selection of sites for Phase 2*
- *Risk Template*

Impacts and Adaptation Key Questions

- What climate information or data would make a difference to the decisions being made today regarding transportation?
- What is the best way to handle uncertainty in assessing future changes and impacts?
- Can thresholds be set for risk to specific infrastructure?
- Can new techniques be developed to help assess future risks due to climate change?