

Planning for Change – **The Potential Impacts of Climate Change on Transportation Systems and Infrastructure**

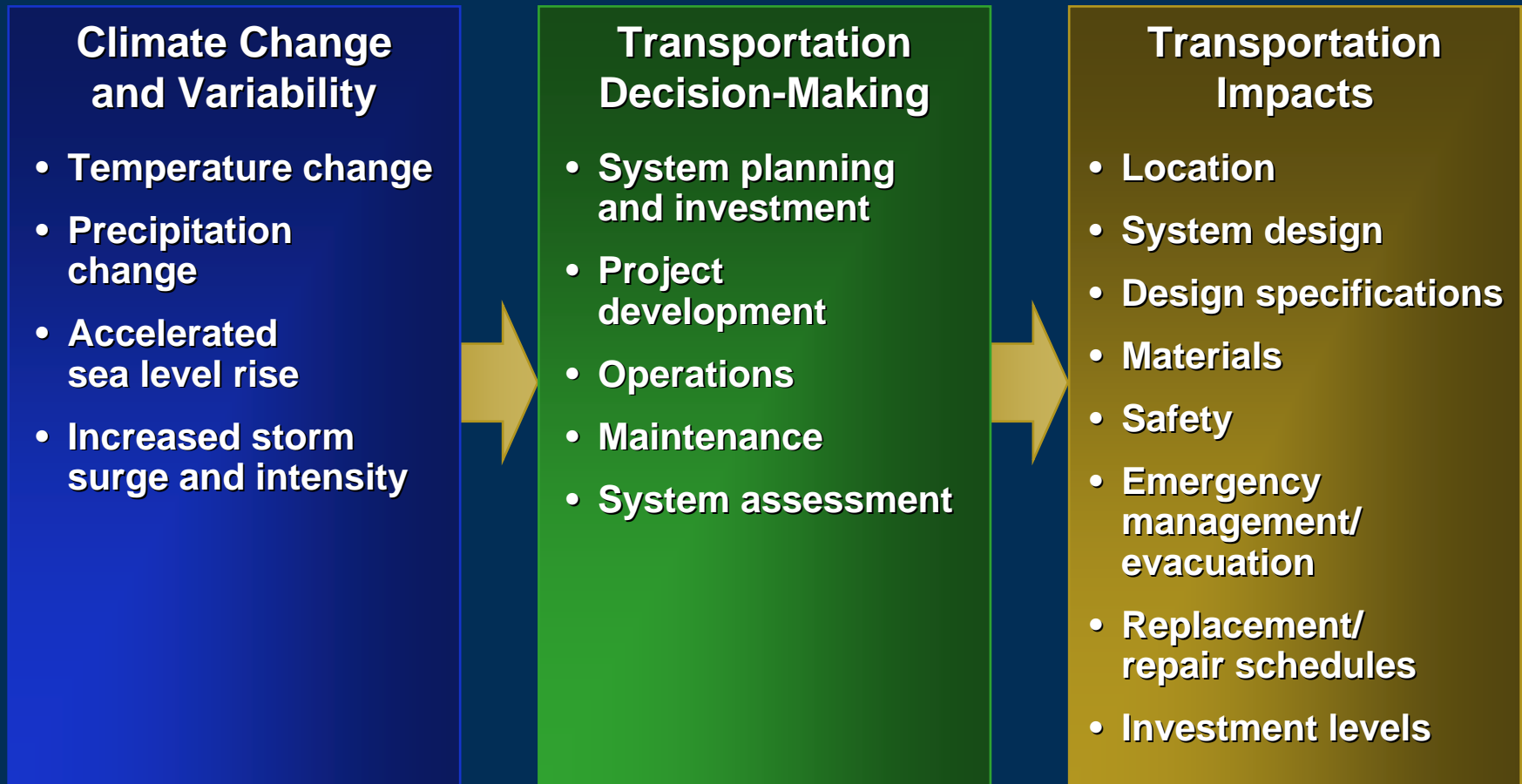
Transportation Planning Symposium

Washington DOT

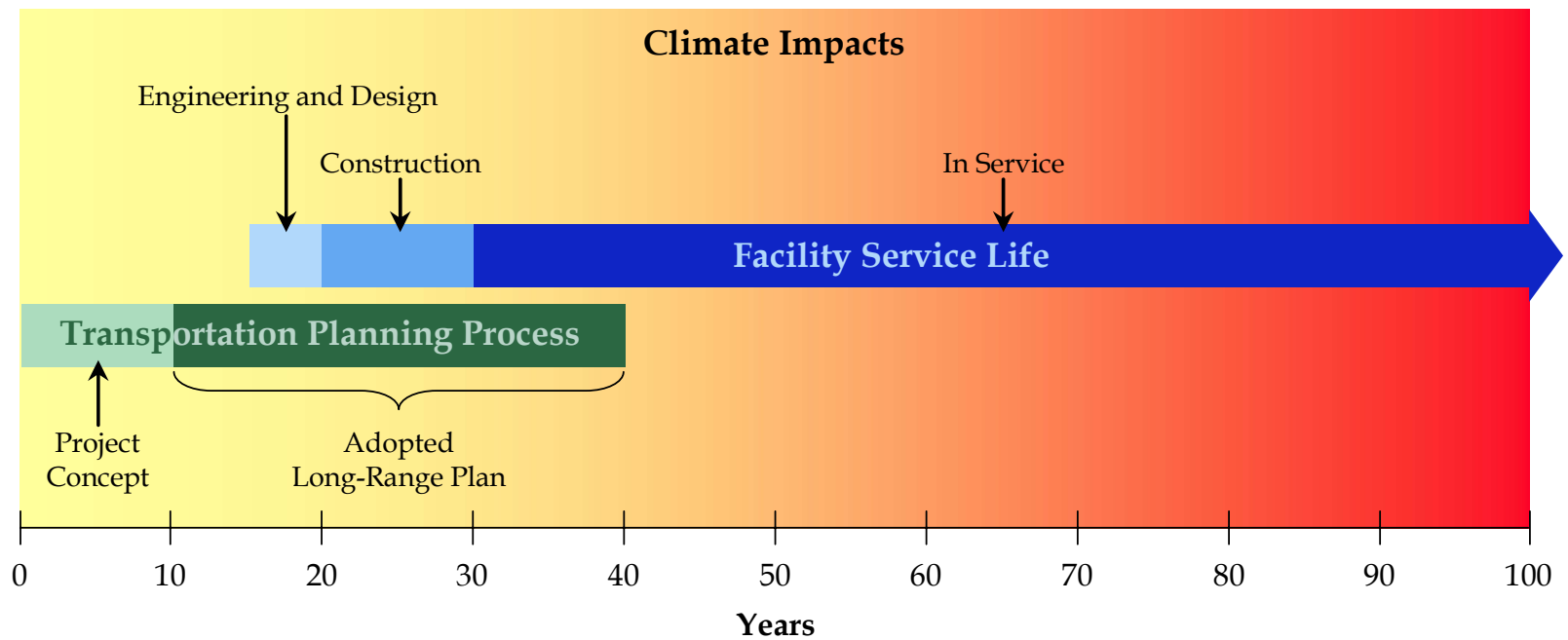
November 14, 2007

**Joanne R. Potter
Cambridge Systematics**

How Will Climate Change Affect Transportation Decisions?

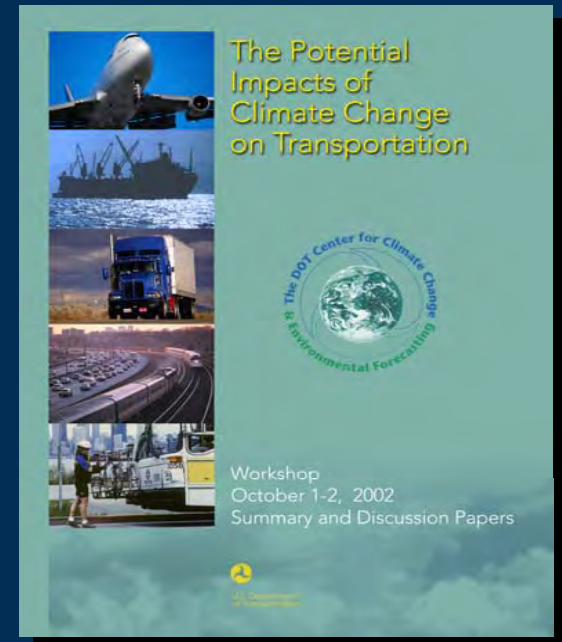


Transportation Timeframes vs. Climate Impacts



Examples of Transportation Impacts Research

- Alaska / Arctic zone research
- Canada, UK, Australia
- National Assessments (USGCRP) – e.g. Metro NYC
- U.S. cities: Seattle, Boston
- DOT / USGS Gulf Coast Study (U.S. Climate Change Science Program)
- NAS TRB / DELS Policy Study

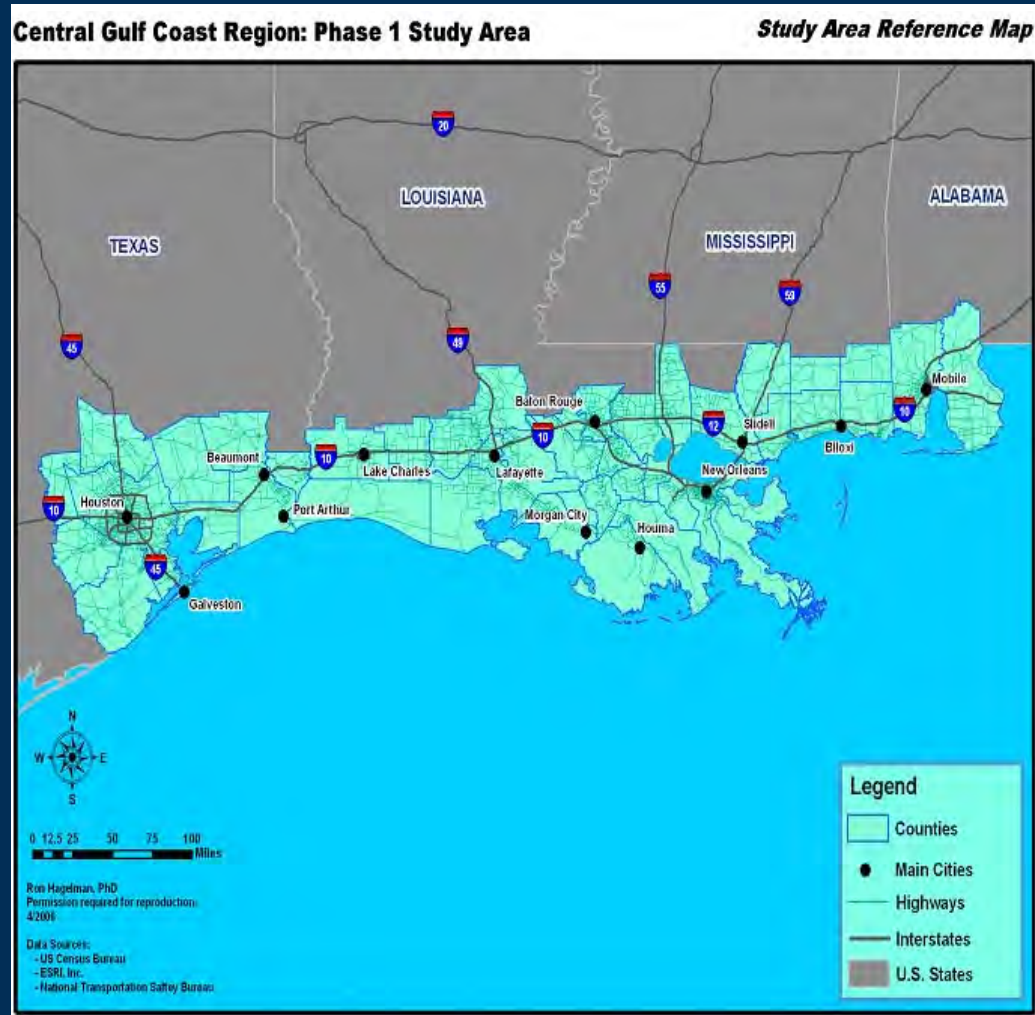


Gulf Coast Study Team - Phase I

- **United States Department of Transportation (lead agency)**
- **United States Geological Survey (supporting agency)**
- **Cambridge Systematics, Inc.**
- **Texas A&M University**
- **University of New Orleans**
- **Louisiana State University**
- **Transportation Analysis Team**
 - Cambridge Systematics, Inc.
 - Texas Transportation Institute
 - Wilbur Smith Associates

U.S. DOT / USGS Gulf Coast Study

Potential Impacts of Climate Change and Variability on Transportation Systems and Infrastructure



Gulf Coast Case Study Design

● Phase I (current effort)

- Synthesis of existing data and information
- Preliminary vulnerability assessment
- Conceptual framework for risk and vulnerability assessment

● Phase II

- In-depth assessment of impacts / risks to selected sub-locations
- Development of risk assessment tools and techniques

● Phase III

- Identification / assessment of adaptation strategies
- Techniques to evaluate adaptation options



Why the Gulf Coast?

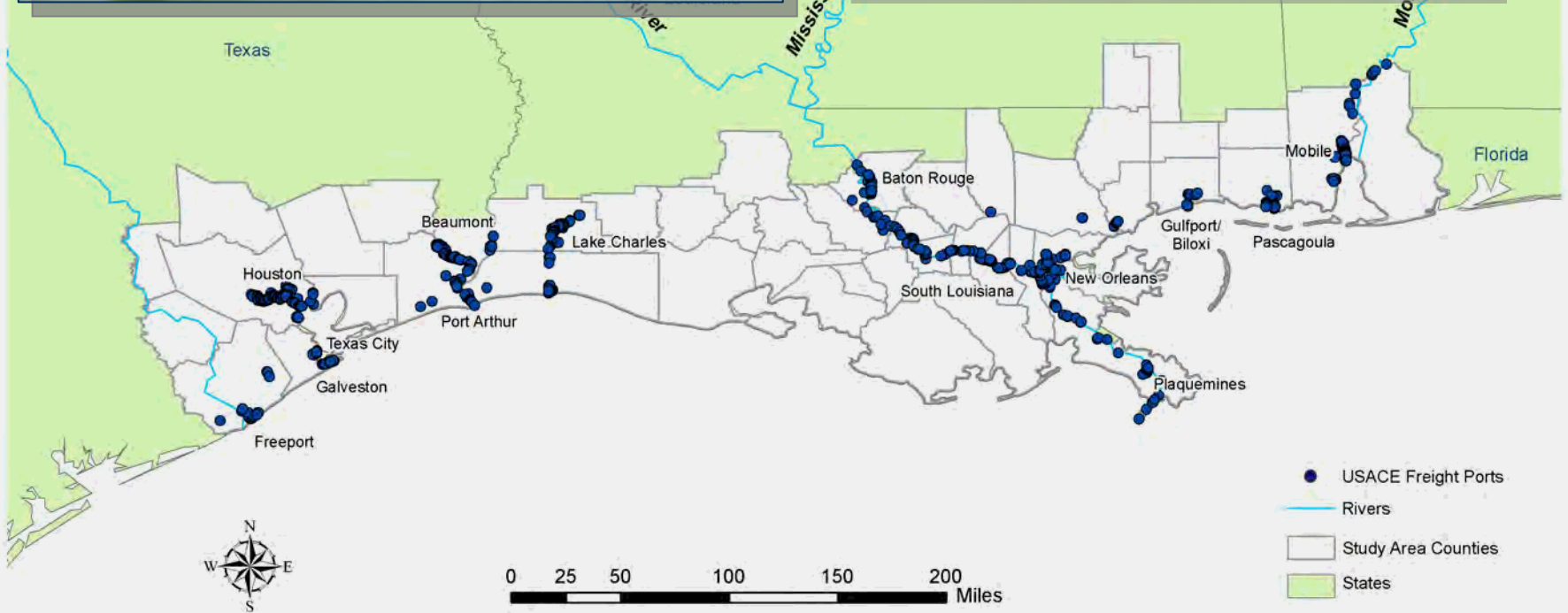
- **Nationally significant**
 - 60% nation's petroleum imports
 - Largest concentration of marine freight facilities in the U.S.
 - Major urban centers
- **Extensive intermodal network**
 - 17,000 miles of highway; 83.5B vehicle miles / year
 - 4 out of 5 top tonnage ports; 1,000 freight handling terminals
 - 6 of 7 Class I railroads
 - 3,800 aircraft at 61 airports
 - 56M passengers at 3 largest airports (2005)
- **Engaged decision-makers**

Combined Truck Flows Shipped Domestically from Louisiana

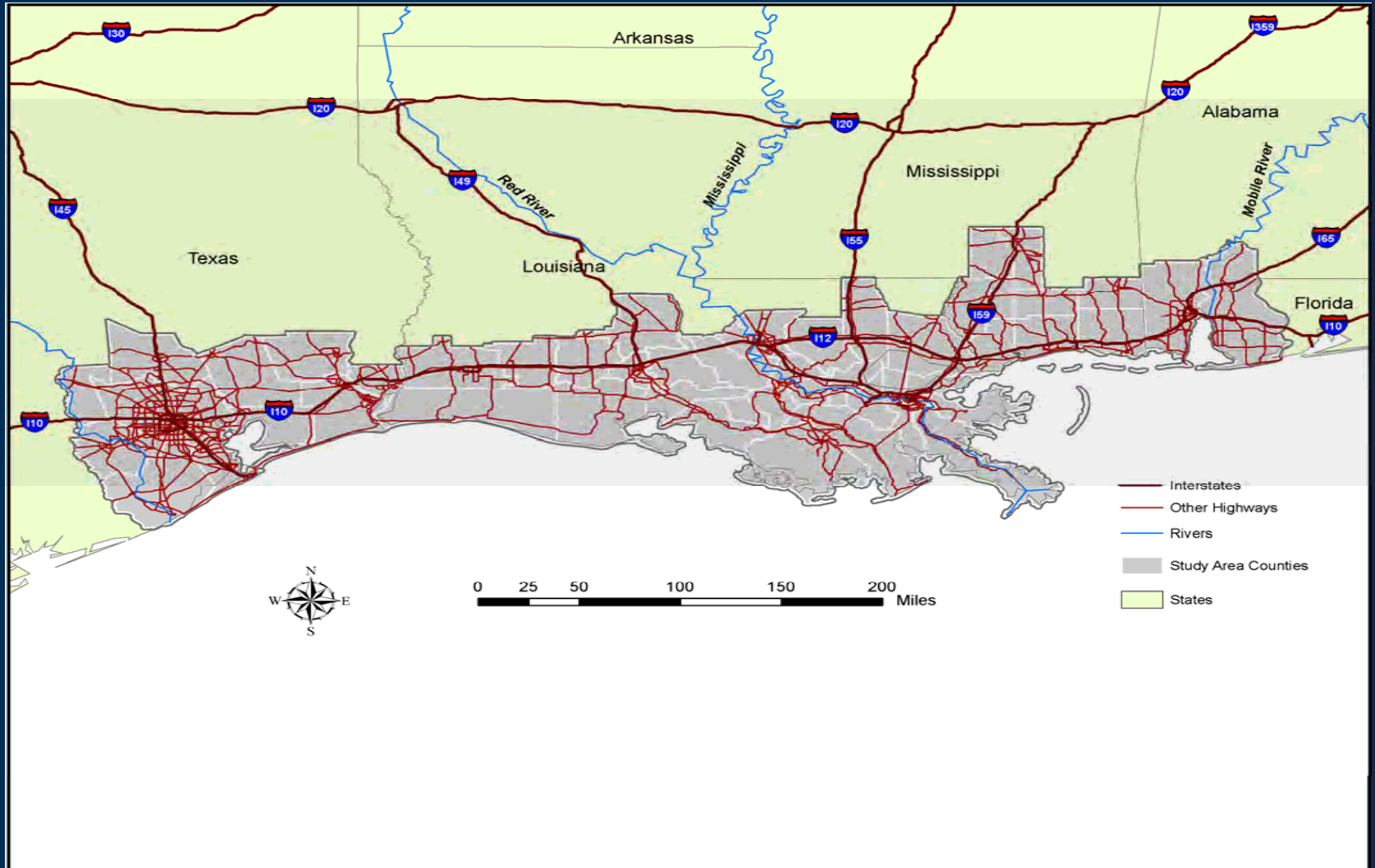


Study Area Ports are Critical National Assets

40% of US marine tonnage, 60% of petroleum imports



Highways in the Study Area



Overall Climate Impacts - Key Drivers for Analysis

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



Draft Results – Gulf Coast Study

Trends in Climate and the Natural Environment

- **Relative sea level will likely rise 1 to 6 feet**
 - **Massive inundation due to relative sea level rise**
 - **Relative sea level includes:**
 - **Climate-induced impacts of thermal expansion and ice melt;**
and
 - **Sinking land masses (subsidence) in the central Gulf Coast**
- **Hurricane vulnerability is bad today and may worsen**
 - **Potential for 5 – 20% increase in storm intensity due to climate change**

Draft Results – Gulf Coast Study

Trends in Climate and the Natural Environment (cont.)

- **Average temperature is likely to increase by 1 - 8° F**
 - **More hot days: Extreme daily high temps will also increase**
- **Models show mixed results for changes in average precipitation**
 - **Intensity of rainfall events, however, will likely increase**
- **The magnitude of impacts worsen as emissions increase under the IPCC scenarios**

***Draft Results* – Gulf Coast Study**

Trends in Climate and the Natural Environment

- **The central Gulf Coast is particularly vulnerable to climate and other coastal changes over the next 50-100 years**
- **Climate change impacts need to be integrated with other coastal / environmental effects**
- **The timing of impacts is not clear; abrupt change cannot be ruled out**



Implications for...

- Highways and transit
- Rail
- Ports and waterways
- Airports
- Pipelines
- Emergency management
- Long-range planning and investment



Draft Results – Gulf Coast Study

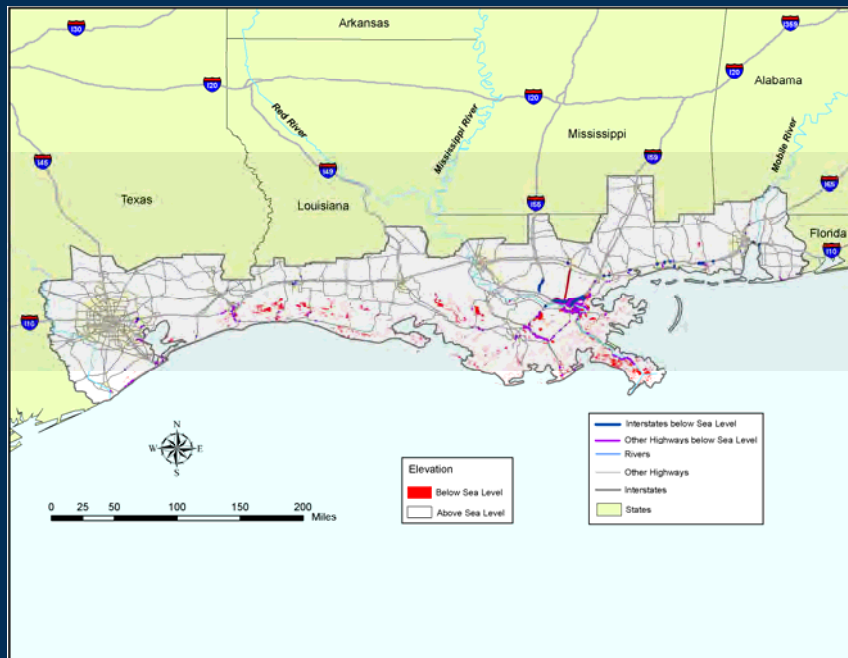
Vulnerability Due to...**Relative Sea-Level Rise**

- **Relative sea level rise (due to climate change and subsidence) of 4 feet could permanently flood:**
 - ✓ **24% of interstate miles, 28% of arterial miles, New Orleans transit systems**
 - ✓ **72% of freight / 73% of non-freight facilities at ports**
 - ✓ **9% of the rail miles operated, 20% of the freight facilities, no passenger stations**
 - ✓ **3 airports**

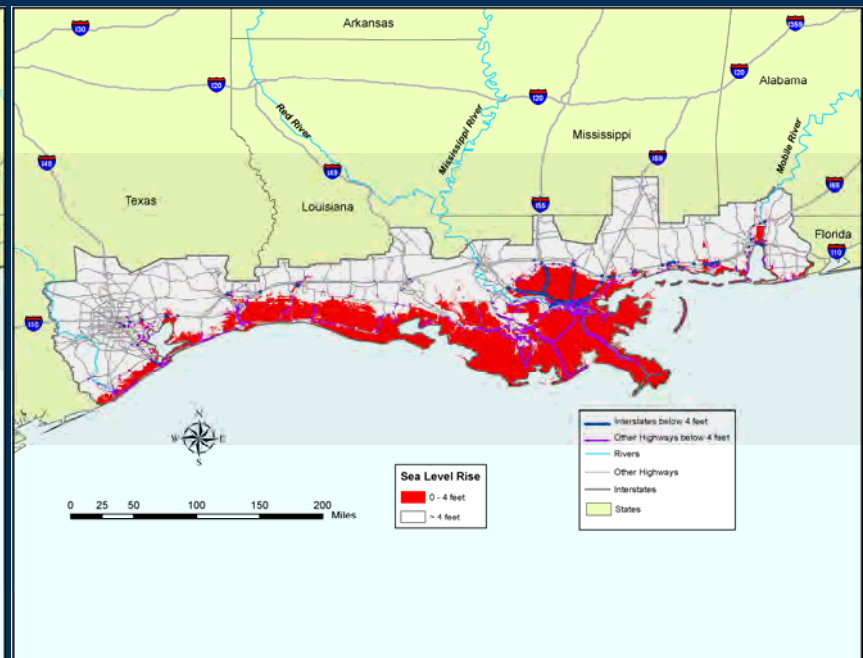
Draft Results – Gulf Coast Study

Highways Vulnerable to Relative Sea Level Rise

Baseline (Present Day)



4 Feet of Sea Level Rise



Source: Cambridge Systematics analysis of U.S. DOT Data.

Draft Results – Gulf Coast Study

Vulnerability Due to...**Storm Surge**

- As witnessed by the 2005 hurricane season, transportation in the central Gulf Coast is already vulnerable to large hurricanes
- That vulnerability will be exacerbated if hurricane intensity increases, absent adaptation strategies

Draft Results – Gulf Coast Study

Vulnerability Due to...Storm Surge

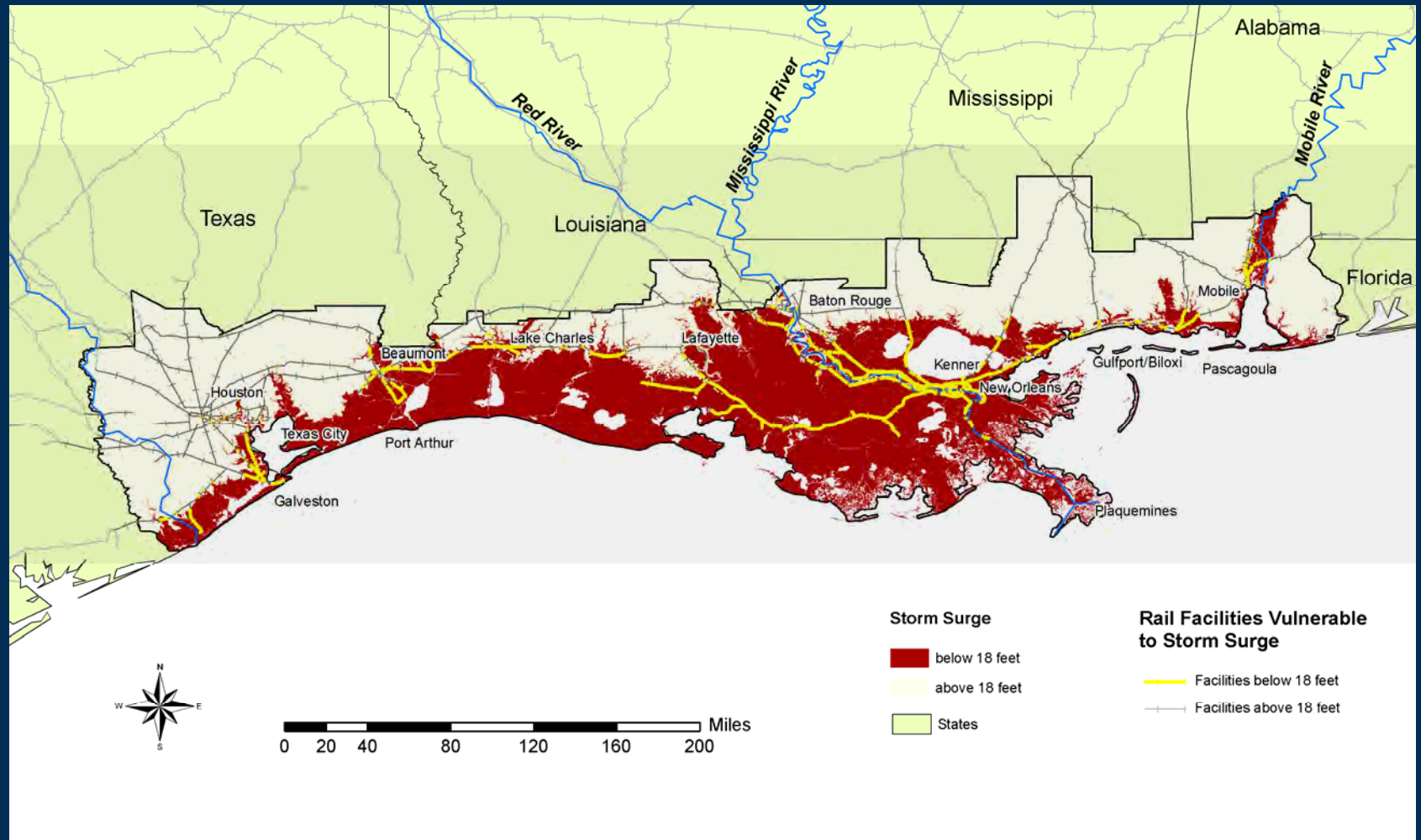
- **Transportation infrastructure that is vulnerable to 18 feet of storm surge includes:**
 - ✓ **56% of interstate miles, 51% of arterial miles, and most transit authorities**
 - ✓ **98% of port facilities vulnerable to surge and 100% to wind**
 - ✓ **33% of rail miles operated, 43% of freight facilities, 9 passenger rail stations**
 - ✓ **22 airports in the study area at or below 18 feet MSL**
 - ✓ **Potentially significant damage to offshore facilities**

Hurricane Katrina Damage to Highway 90 at Bay St. Louis, MS



Source: NASA Remote Sensing Tutorial.

Freight Rail Lines Potentially Vulnerable to Storm Surge of 18 feet



Source: Cambridge Systematics analysis of climate projections and Federal Railroad Administration data.

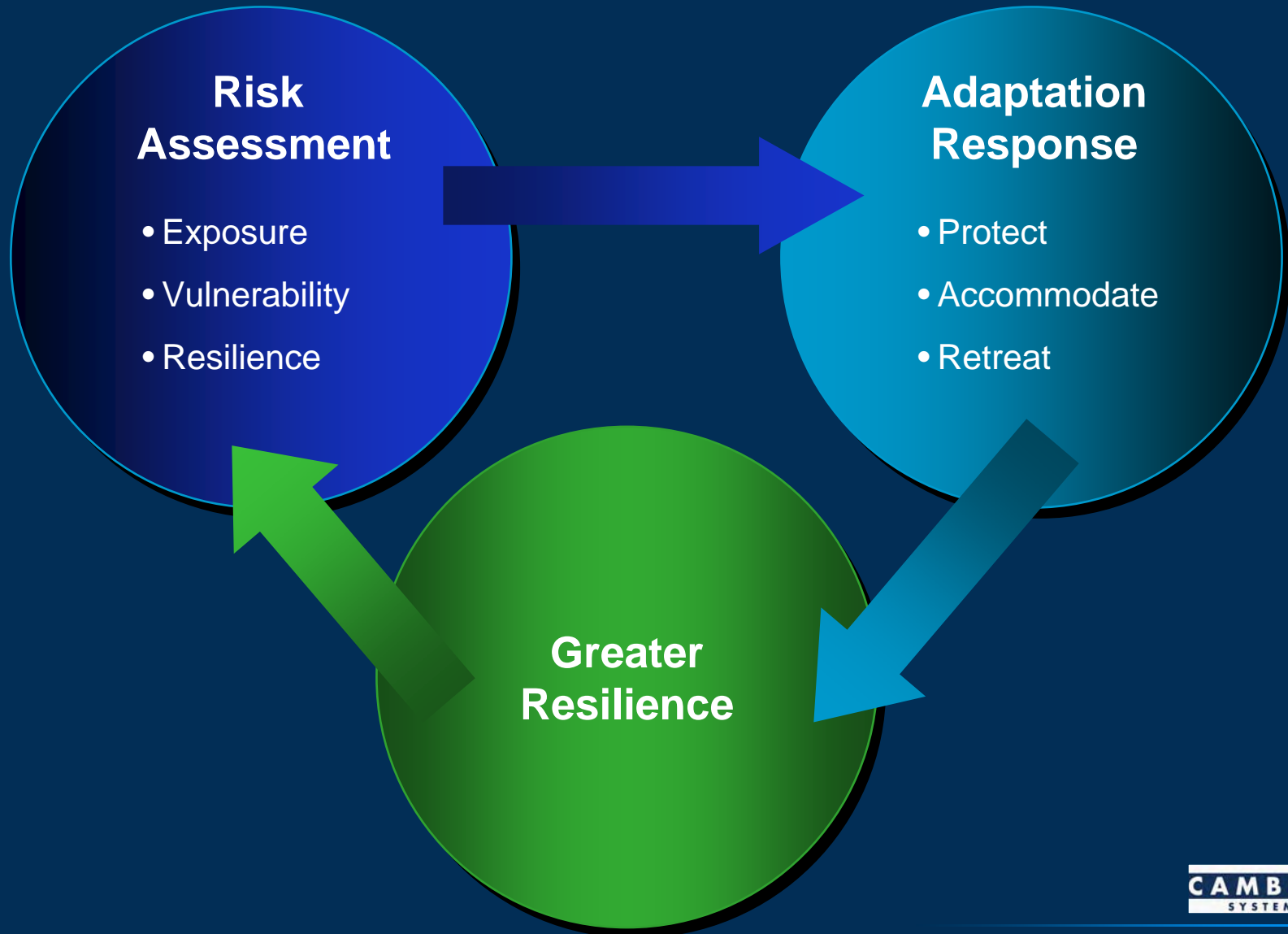
Draft Results – Gulf Coast Study Transportation Planning

- **Climate change is rarely considered today, but the longevity of infrastructure argues for its integration**
- **Current practice focusing on a 20-year time frame is not well-suited to the assessment of impacts due to the natural environment**
- **It is useful to examine the vulnerability of the intermodal system in addition to specific facilities**

Preparing for change...

- **Robust transportation systems – reliability under a range of conditions**
- **Use of new approaches to decision-making**
 - Scenario planning
 - Integration of climate change with other regional dynamics
 - Probabilistic rather than deterministic approach
 - Consider both incremental and abrupt change
 - Risk assessment approach

A Risk Assessment Approach to Transportation Decisions



Implications...

Range of Adaptation Responses

- **Maintain and manage**
 - Absorb increased maintenance / repair costs
 - Improve real-time response to severe events
- **Strengthen structures / protect facilities**
 - Design changes when rebuilding / new investment
 - Promote buffers
- **Enhance redundancy**
 - Identify system alternatives
- **Relocate / avoid**
 - Move or abandon existing facilities
 - Site new facilities in less vulnerable locations

Degree of Risk + Value of Performance Inform Level of Adaptation Investment



Draft Report for Public Comment

- U.S. Climate Change Science Program:
<http://www.climatechange.gov/Library/sap/sap4-7/default.php>
- jpotter@camsys.com
(301) 347-9129