Climate Change and the Challenge for DOTs:

FHWA Climate Change Adaptation Activities and Lessons Learned

Mid Atlantic Geospatial Transportation Users Group Meeting

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Rob Hyman
FHWA, Office of Natural Environment

Greenhouse Gas Mitigation vs. Climate Change Adaptation?

Transportation Activity

Driving, shipping, transit, rail, operations, maintenance, etc.

GHG Emissions

CO_2, CH_4, N_2O, +……..

Changes to Climate

Sea levels (lakes and streams), temperature, precipitation, storms

Impacts on Transport

Infrastructure, operations, users, suppliers, services, travel demand

GHG Mitigation Strategies

To slow down rate of change and reduce impacts

Climate Change Preparation and Adaptation

To plan for and deal with expected impacts

What Climate Changes Will Impact Transportation?

- **Sea level rise and storm surge**
- **Precipitation changes**
  - **More intense precipitation events**
  - **Flooding**
  - **Snowpack changes**
- **Increase in hurricane intensity**
- **Increase in very hot days**
- **Permafrost thawing**

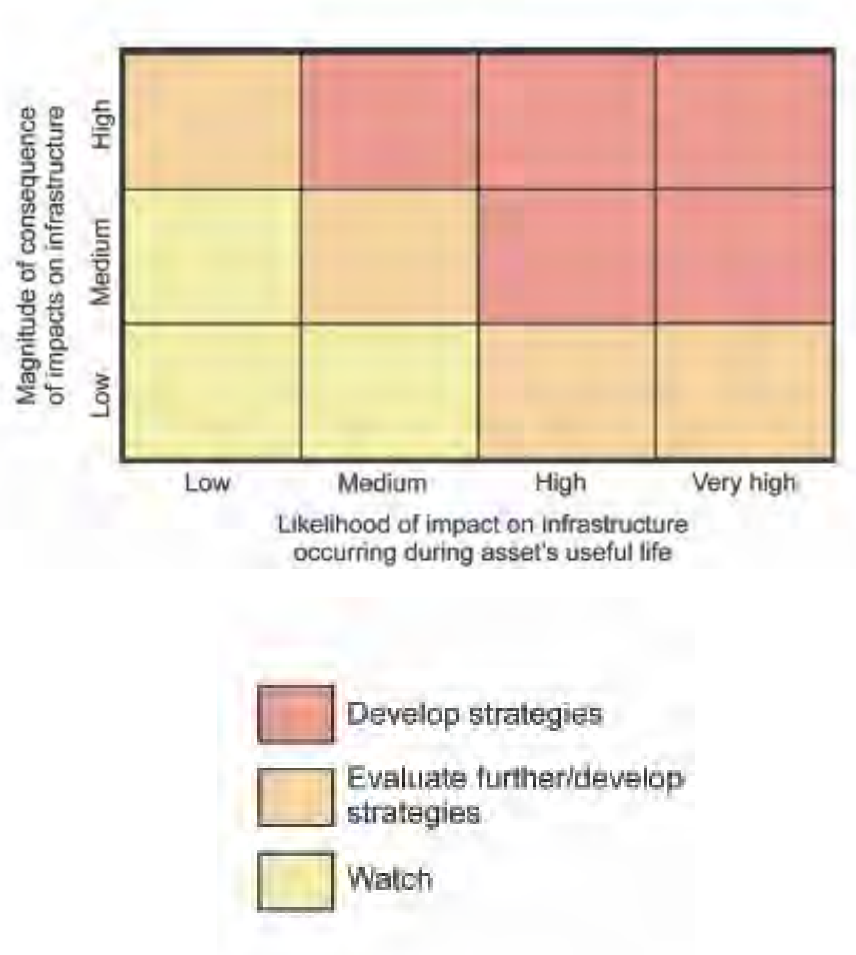
Sources: WSDOT and Caltrans

Why Does FHWA Care About Climate Change Adaptation?

- **Need to protect integrity of transportation investments, safety**
- **Infrastructure has long design life (decades)**
- **Infrastructure needs to handle new conditions as climate changes**
- **Adaptation is ensuring that we plan our infrastructure for the future**
- **FHWA Goal: Systematic consideration of climate change vulnerability and risk in transportation decision making, at system and project level**

FHWA Adaptation Initiatives

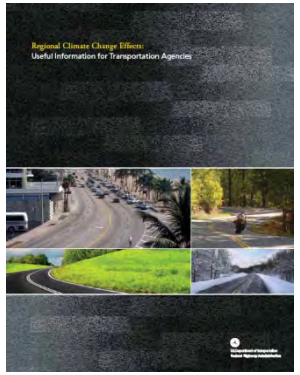
- **FHWA is developing and sharing information on tools and methodologies that states and MPOs can use to assess risk and prioritize actions:**
  - **Climate projections**
  - **Critical asset identification**
  - **Vulnerability assessment methodologies**



Source: City of New York

Regional Climate Change Effects (2010)

- **Report synthesizes information on climate change projections for transportation decision makers**
  - **Snapshot: Summarizes recent science**
- **Projected *changes* by region**
  - **Annual, Seasonal Temperature (change in ºF)**
  - **Seasonal Precipitation (% change)**
  - **Where information exists:**
    - Sea level rise, Storm activity

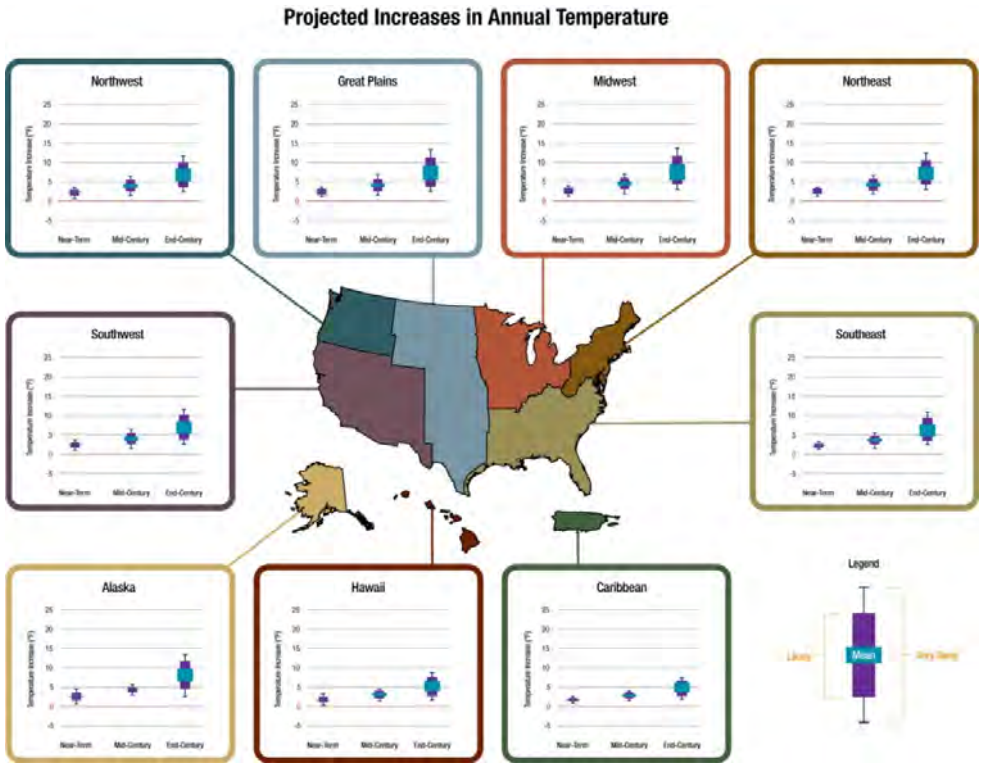


- **Also includes information at local, state scales**
- **Received assistance from climate experts at NOAA, USGS, DOE, etc.**

http://www.fhwa.dot.gov/hep/climate/climate_effects/

How Can This Information Be Applied?

- **Inform planning efforts with a <u>consistent</u> set of projections**
- **Inform consideration of vulnerability of key assets**
- **Not detailed/certain enough for definitive decisions on specific projects**



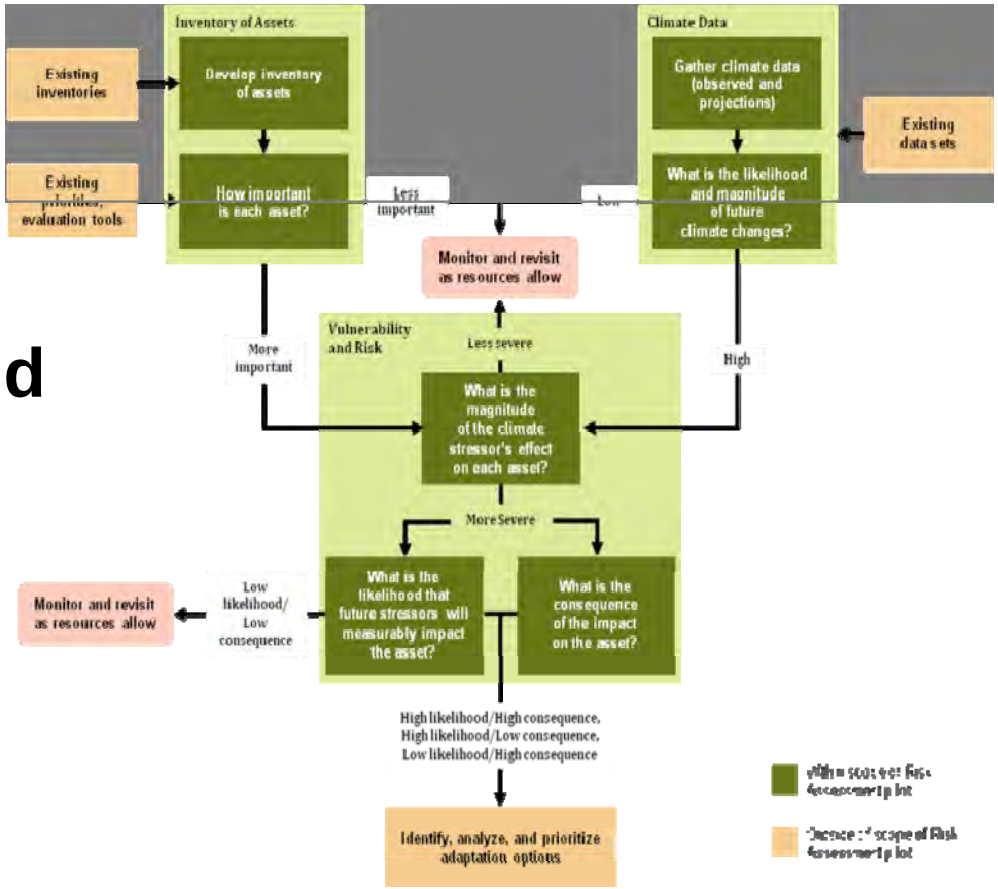
Vulnerability/Risk Assessment Conceptual Model

- **Goal: Help transportation decision makers identify vulnerable assets and adaptation strategies**
  - **most exposed to the threats from climate change; and/or**
  - **could result in the most serious consequences as a result of those threats**
- **Conceptual model completed**
- **Pilots - Use by State DOTs and MPOs (2010-2011)**
- **Update the conceptual model**

http://www.fhwa.dot.gov/hep/climate/pilots.htm

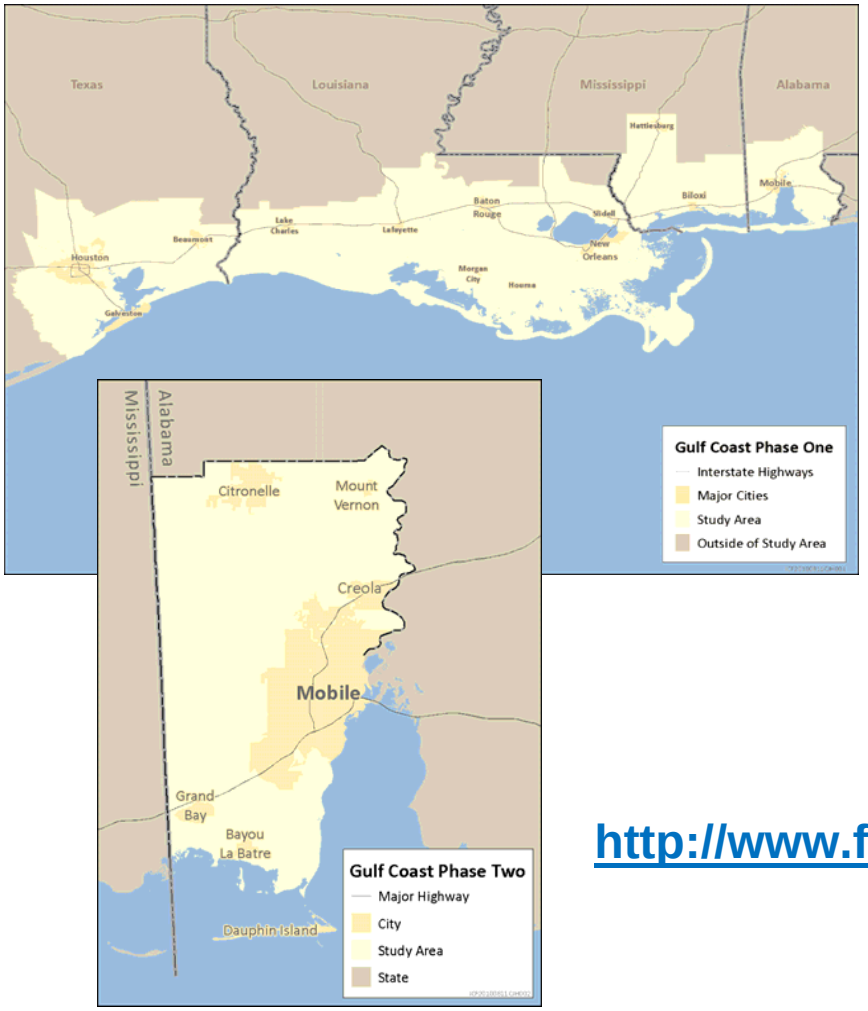
Vulnerability/Risk Assessment Conceptual Model

- Develop inventory of infrastructure assets
- Gather climate data
- Assess vulnerability and risk of assets to projected climate change
- Analyze, prioritize adaptation options
- Monitor and revisit



Climate Change Vulnerability and Risk Assessment Pilot Locations

Gulf Coast Project Examines Issues at Metropolitan Scale



- **Phase 1**
  - Overview of climate change impacts on transportation infrastructure in central Gulf Coast (completed 2008)
- **Phase 2**
  - Focus on one metropolitan area – Mobile, AL
  - Development of adaptation tools and strategies that will be transferable to other areas
  - Timeframe: 2010-2013

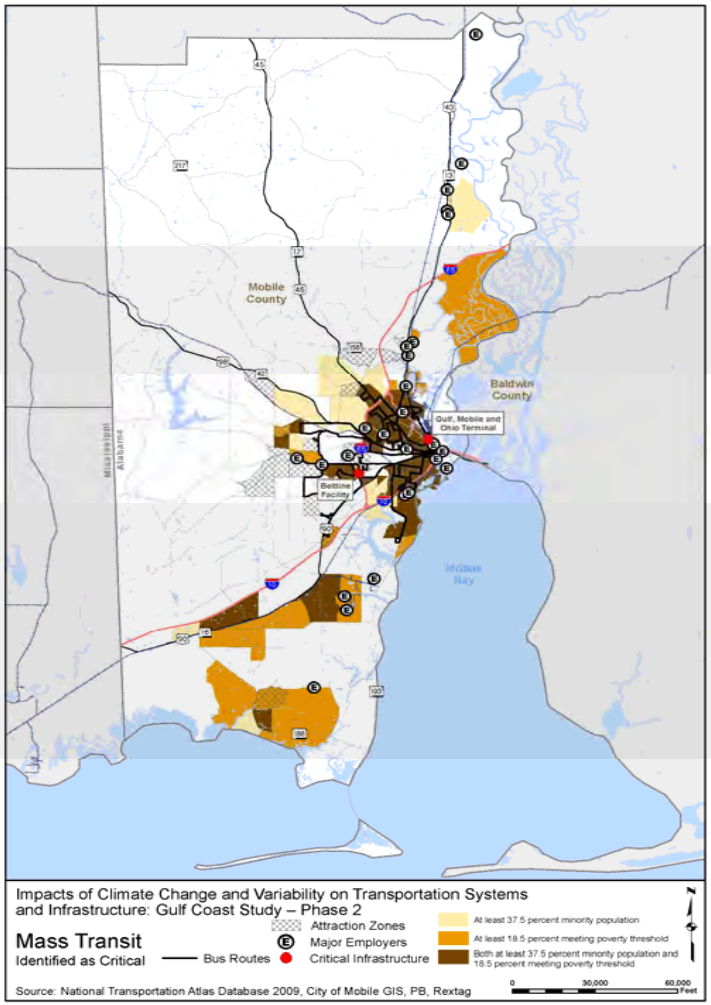
http://www.fhwa.dot.gov/hep/climate/gulf_coast_study

Identifying Critical Transportation Systems

- **Delineate important assets**
- **Develop scoring summary based on available data**
- **Apply engineering judgment to fill data gaps**
- **Consider redundancy**

	HIGHWAYS											
	SocioEconomic					Ops.		Health and Safety				
	Component of National/International Commerce System	Important Multi-Modal Linkage	Functions as Community Connection	No System Redundancy	Serves Regional Economic Centers	Functional Classification (Interstate, etc.)	Usage	Identified Evacuation Route	Component of Disaster Relief and Recovery Plan	Identified Hazardous Materials Route	Component of National Defense System	Provides Access to Health Facilities
Facility List												
Facility A												

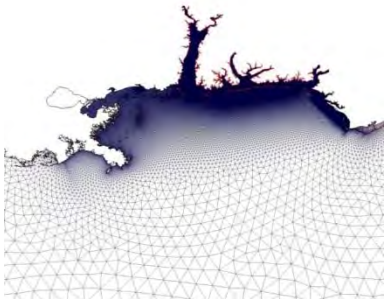
Identifying Critical Transportation Systems (continued)

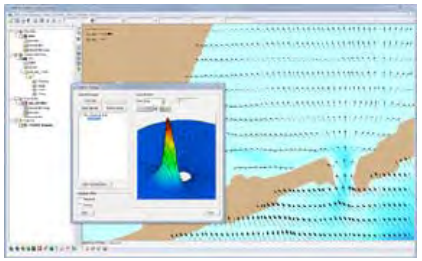


- **What is "critical" will vary by community**
- **Important to consider community priorities as well as traditional measures**
- **Professional judgment is important:**
  - **Cannot always find data for the "boxes"**
  - **Not all critical criteria are quantifiable**

Developing Projected Climate Data

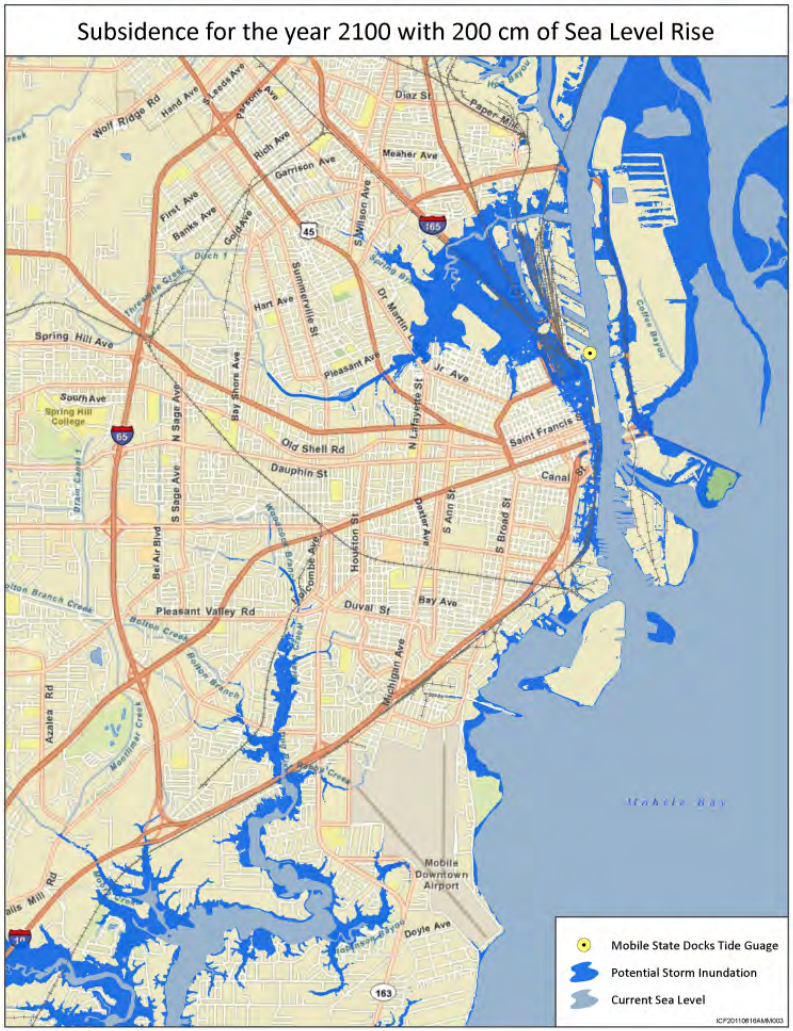
- **USGS providing statistically downscaled projections for T and P**
  - 4 to 7 Climate models (PCM, Hadley, …)
  - 3 emission scenarios (A1fi, A2, B1); 3 time horizons out to 2100
  - Secondary variables calculated from daily T and P, e.g., 24-hr precip with 5%/yr prob
- **Sea level rise analysis**
  - Range of recent global SLR scenarios used
  - Accounts for local subsidence
- **Storm Surge Modeling – ADCIRC**
  - Range of storm intensities
  - Output includes surge distribution and dynamics
- **Wave Modeling – STWAVE**
  - Inputs from ADCIRC output and boundary conditions
  - Outputs include key aspects of wave energy

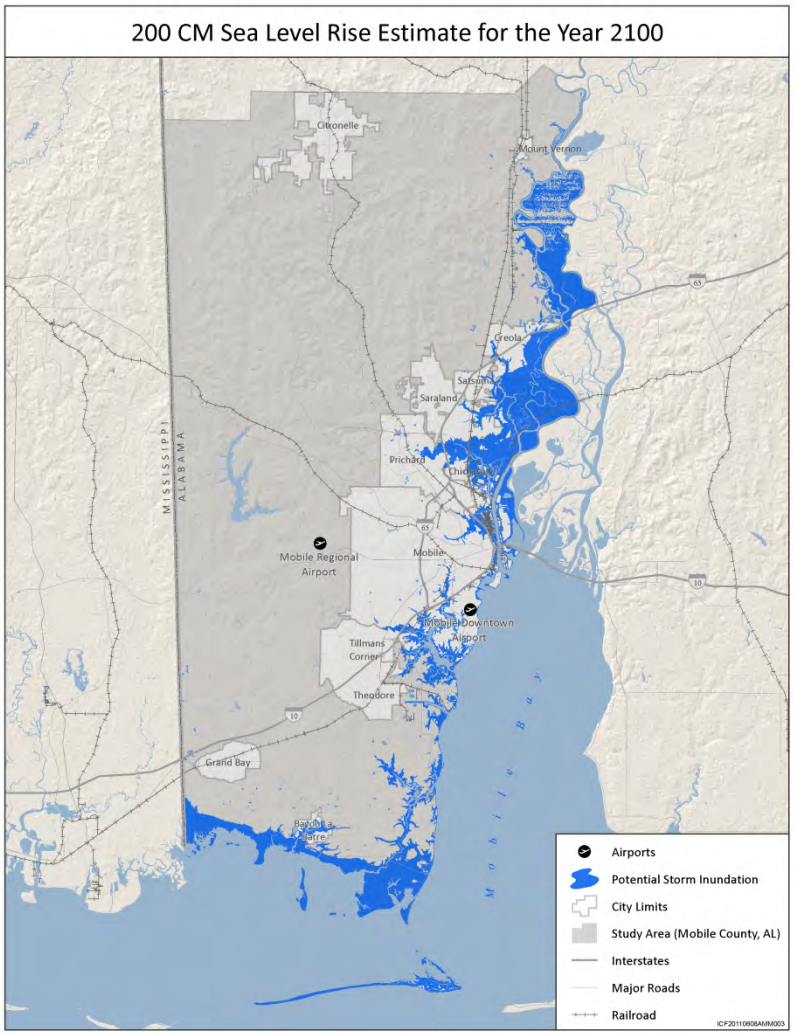




- **Exposure of transportation systems will be assessed using a GIS analysis**

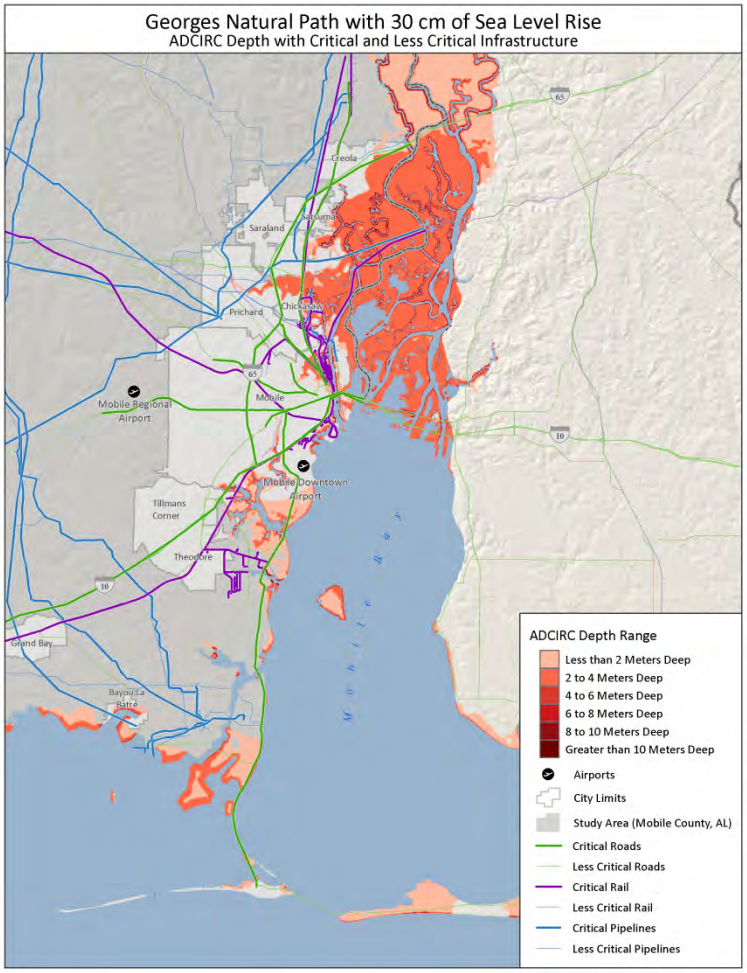
Projected Climate Data—Relative Sea Level Rise (200cm)

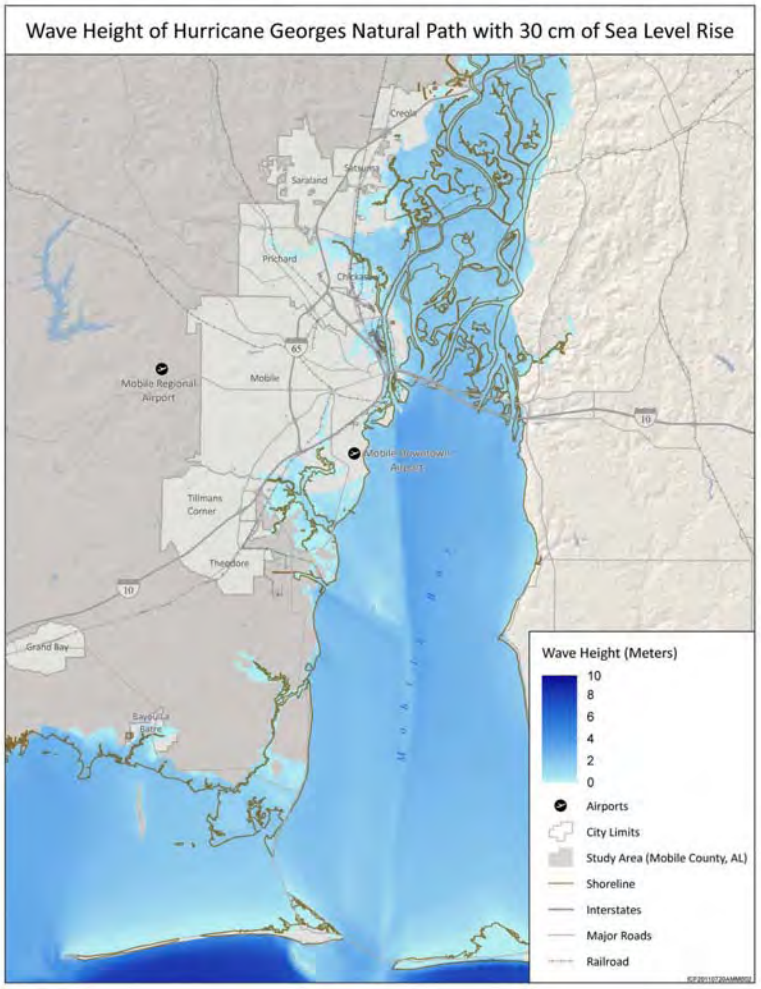




Projected Climate Data—Storm Surge

Georges Natural Path, 30 CM Sea Level Rise





Lessons Learned: Needed Data Can Be Difficult to Obtain

- **Site specific climate projections are difficult to find**
  - **Downscaling global models is a complex activity**
  - **Universities are often important players in developing this data – have been partners in many assessments**
  - **But, downscaled data is becoming more readily available**
- **Transportation asset inventory data time consuming to assemble**
  - **Many different sources - even within one agency!**
  - **Many different formats**
  - **LIDAR data does not capture all needed details**

Lessons Learned: Improving Transportation Data

- **Asset management provides adaptation opportunities**
  - **Knowing where assets (ex: culverts) are located throughout a floodplain can help identify assets at risk**
  - **Better monitoring of today's problems can provide useful clues to identifying tomorrow's vulnerabilities**
- **Hazard mitigation plans provide a natural vehicle for climate change adaptation**
  - **Defining critical assets for hazard mitigation is similar to defining criticality in adaptation planning**
  - **Plans need to focus more on transportation**

Lessons Learned: Institutional

- **Interdisciplinary cooperation is key**
  - **Need to include science information, engineering specifications, planning processes, etc.**
  - **Multi-disciplinary stakeholder communication is not easy**
  - **Understand existing decision-making processes and frameworks**
- **Successful communication strategies help**
  - **Tailor the message to each audience's needs – hazard mitigation, improved operations, sustainability, etc.**
  - **Share information with both internal (DOT) and external stakeholders - both are important audiences**
  - **Leadership from the top (governor, legislature, secretary of transportation) is key to motivating adaptation work**

Thank You

http://www.fhwa.dot.gov/hep/climate

http://www.fhwa.dot.gov/hep/climate/climate_effects

http://www.fhwa.dot.gov/hep/climate/gulf_coast_study

Rob Hyman

Sustainable Transport and Climate Change Team

FHWA Office of Natural Environment

202-366-5843

Robert.Hyman@dot.gov