

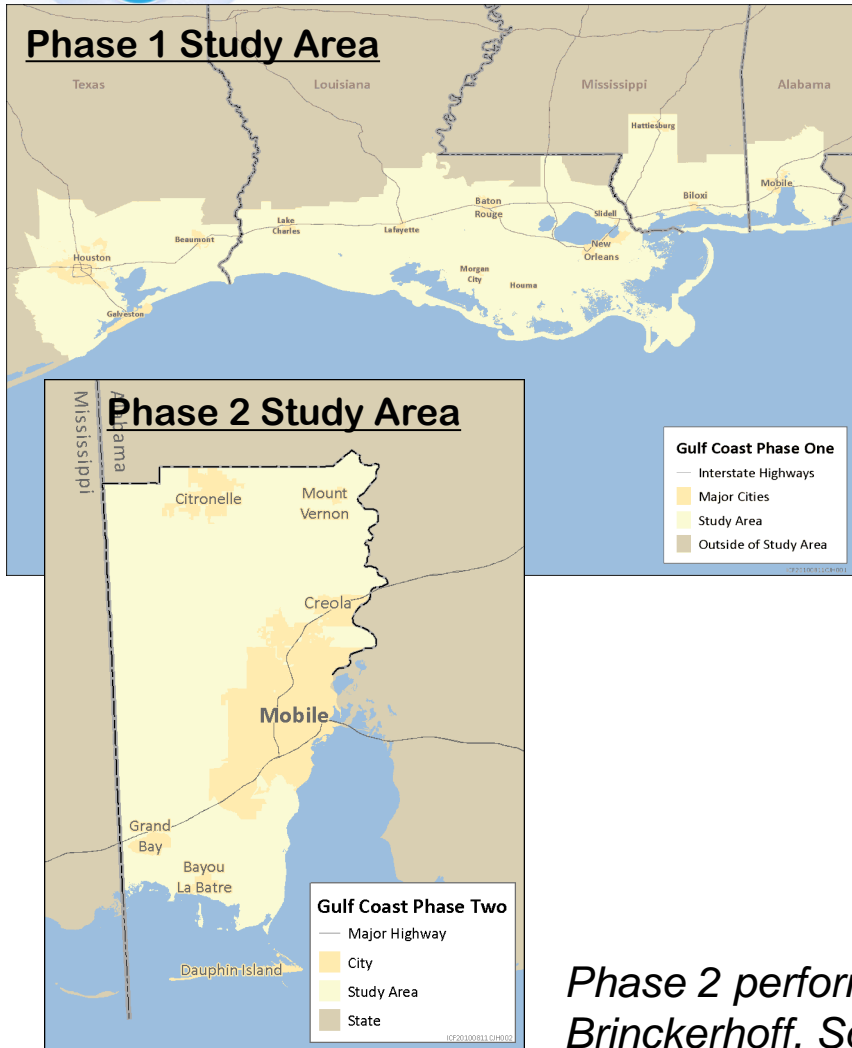
# Generating Extreme Weather Projections and Using Them to Assess Vulnerability: Gulf Coast Study, Phase 2



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# Gulf Coast 2 Project: Vulnerability Assessment at Metropolitan Scale



## ■ Primary Phase 2 Tasks

- Task 1: Identify critical transportation assets in Mobile (complete)
- Task 2: Identify climate effects, assess infrastructure sensitivity (complete)
- Task 3: Assess vulnerability of critical assets (2013)
- Task 4: Develop transferable risk management tools (2014)

## ■ Completed tasks available from the FHWA website

*Phase 2 performed by ICF International (prime), Parsons Brinckerhoff, South Coast Engineers, and Texas A&M, with support from USGS and Katharine Hayhoe (Texas Tech)*

# Gulf Coast 2: Climate Effects considered



- **Climate changes examined:**
  - **Precipitation** and **temperature** and statistically downscaled from climate models
  - **Local sea level rise** scenarios based on range of recent global SLR scenarios plus local subsidence
  - **Storm surge** modeling looked at range of storm intensities and included **wave** modeling

# Creating the Variables...



- **Much more interested in extreme events than averages**
- **Need to recognize limitations of climate model outputs (e.g. 24 hour precipitation)**
- **Sought input from engineering design specialists, climate modelers, hydrologists, planners**
- **Transportation modes involved highways, rail, transit, pipelines, ports, airports**
- **Each mode had specific design interests**

# Use Relevant Thresholds To Determine Climate Data Needed...

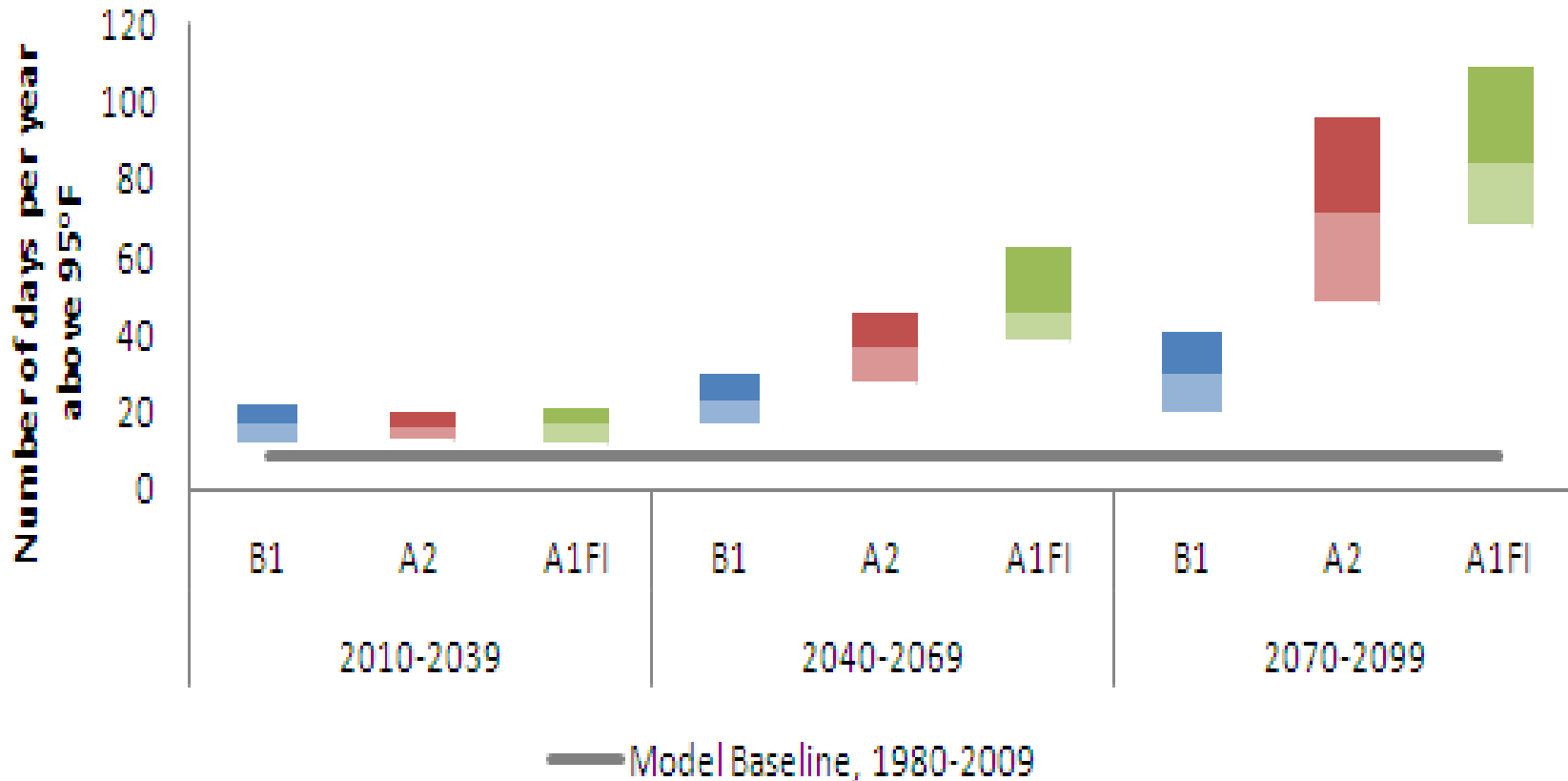


Variable	Analysis
Annual, Seasonal and monthly precipitation	Pavement Design
Annual, seasonal, and monthly average minimum, maximum, and mean temperature	Runway Design
Daily high temperature: mean, 50 %ile, 95 %ile, and warmest day in the year during each 30-yr period	AREMA Rail design / buildings
Maximum 7-day average air temperature per year with the % probability of occurrence during each 30-yr period (mean, 50%, 90%, 95%, 99% occurrence)	Pavement Design (Asphalt)
Exceedance probability precipitation for 24-hour period with a 0.2%, 1%, 2%, 5%, 10%, 20%, and 50% exceedance precipitation events (e.g., 500-yr, 100-yr, 50-yr, ..)	Drainage Design / Stormwater Volume Control

# Temperature: Trend is Clear



## Projected days per year > 95°F

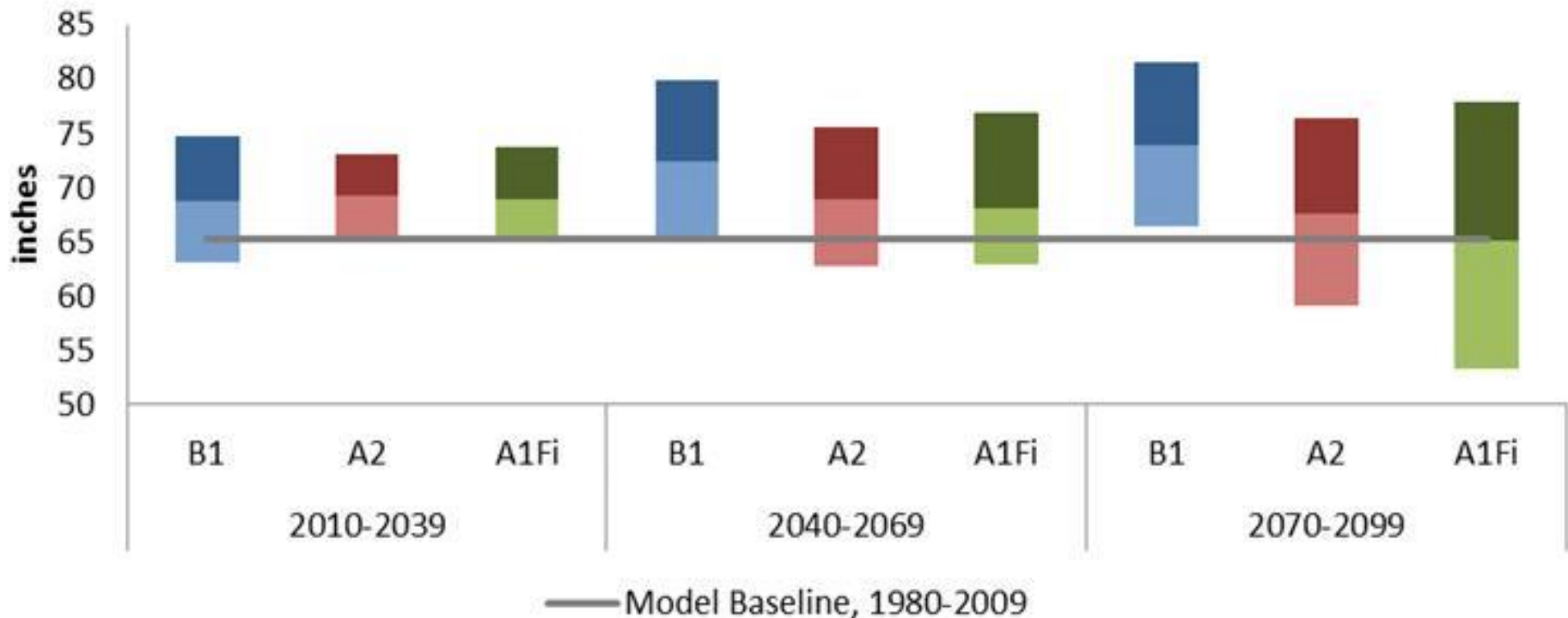


Methodology: In the 30-year period, the number of days where the maximum temperature is at or above 95°F for each year was counted, and then averaged across the 30 data points.

# Precipitation: Trend is Not Clear

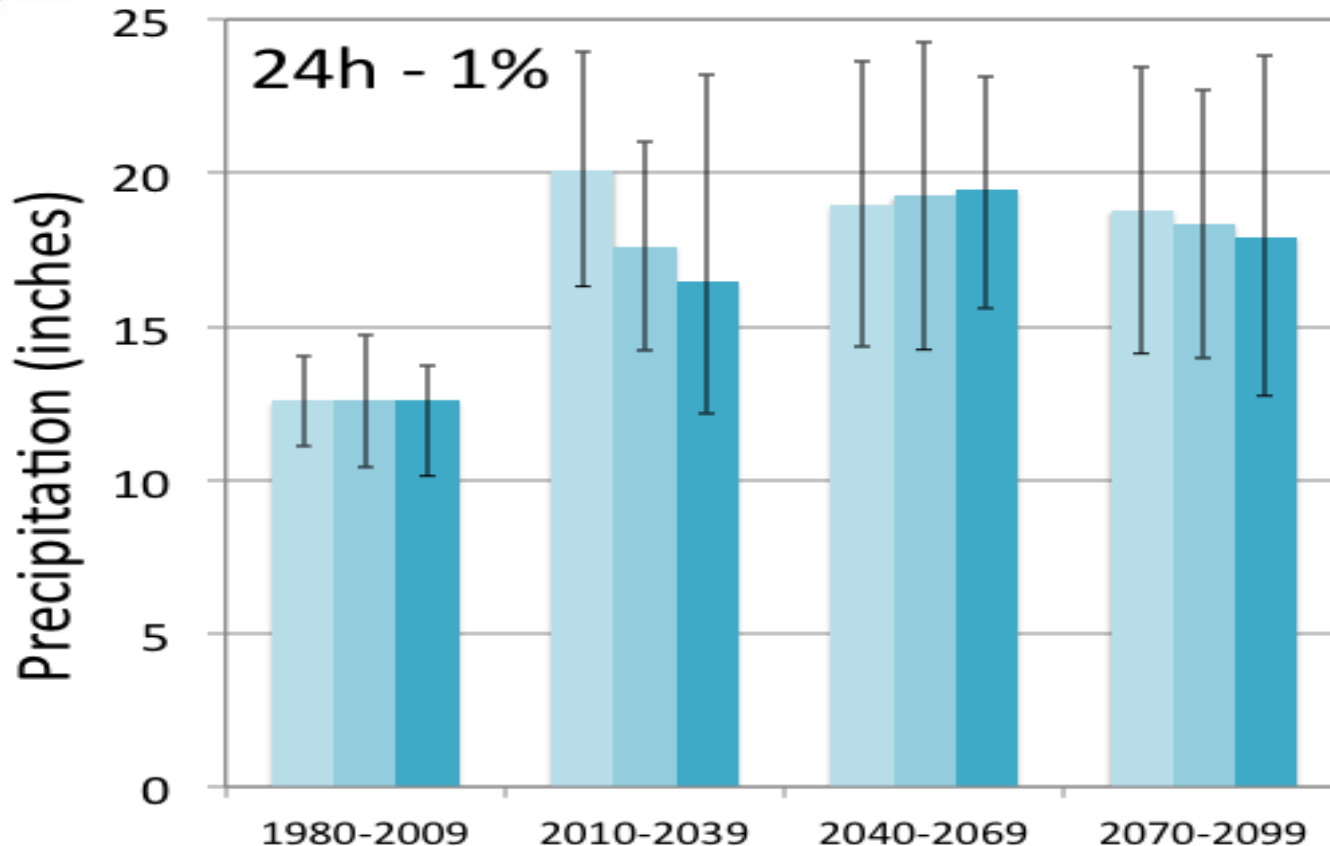


## Total annual precipitation



Methodology: In each 30-year period, the daily values for annual precipitation were summed for each year, and then an average was done across all 30 data points.

# Precipitation: Trend is Not Clear



Methodology: In each 30-year period, the 1% exceedance threshold was computed from the highest daily precipitation values for each of the 30 years, and then averaged across the climate models. Colored bars represent the three climate scenarios B1, A2 and A1Fi.

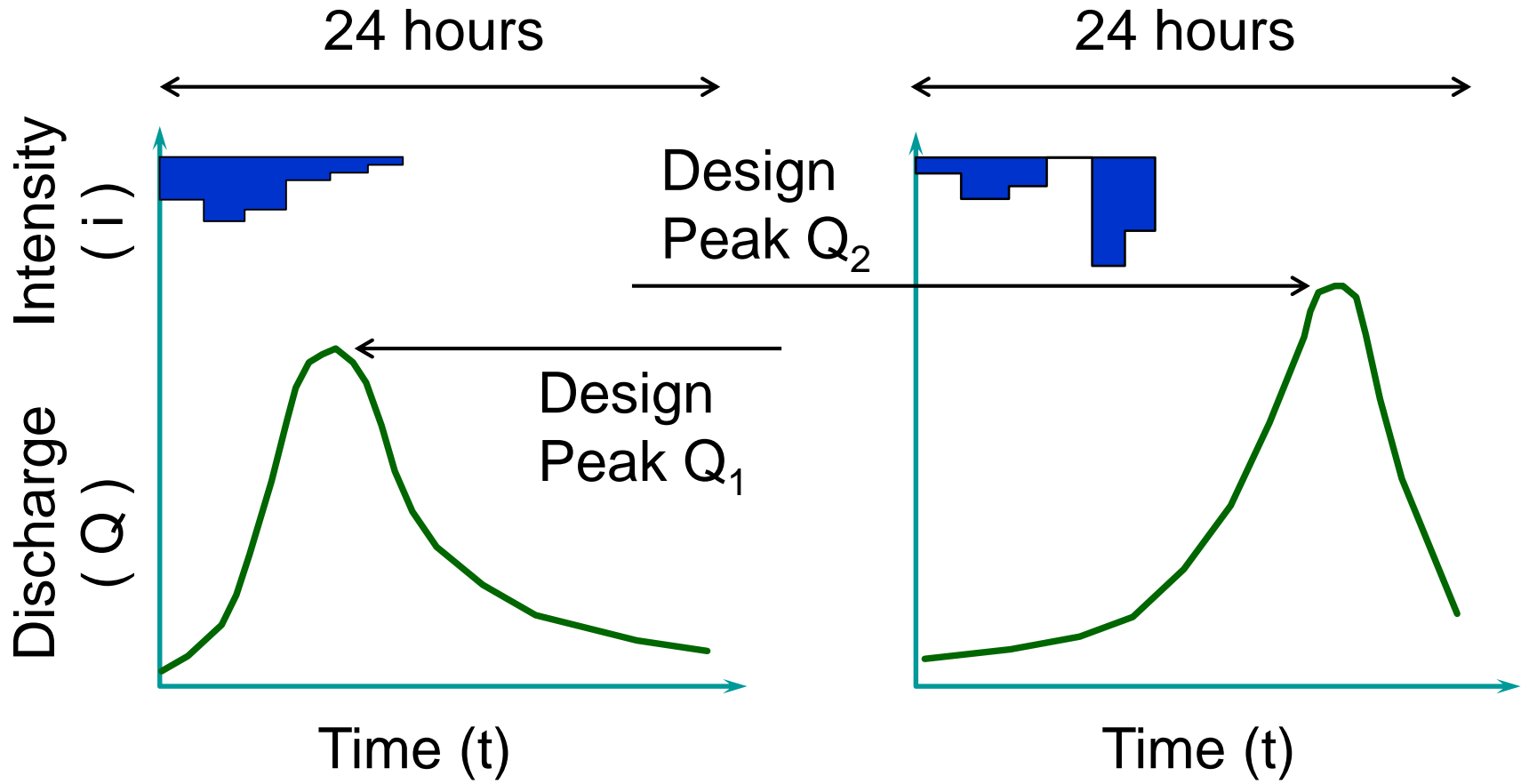


# Challenges with Variables...



- For storm data, designs normally based on peak flows – engineers want 6 hour duration precip totals or even shorter! [\(See TP 40\)](#)
- Climate models can give us 24 hour precip totals
- Annual duration series for 24 hours is not robust – data is “coarse” – esp. for 1% exceedance probability
- Vulnerability screen and Sensitivity analysis approach may be best
- How can 24 hr precipitation volumes be converted to runoff to estimate peak flows?

# Hyetographs vs. Hydrographs



# Considering Climate Change in Design Procedures



**How do you take modeled precipitation and use it to compute design flows?**

**(Incomplete information)**

- **Rational Formula**
- **TR-55 formula, HEC-HMS**
- **Regression equations**



# Approach used in the Vulnerability Assessment



**How make best use of incomplete information?**

- **Vulnerability: F (Exposure, Sensitivity, Adap Cap)**
- **Exposure: two scenarios**
- **Exposure score: percentage of historic**



# Ways to Work with Uncertainty...



- **Sensitivity analyses (bottom up approach) identify thresholds of concern**
- **Look at existing and projected conditions to understand what is already vulnerable and may become more vulnerable in the future**
- **Create “robust” or “adaptive” solutions optimized to work across a range of possible futures**
- **Not abandoning traditional hydraulic design processes**

# Thank You

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

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

[http://www.fhwa.dot.gov/hep/climate/gulf\\_coast\\_study](http://www.fhwa.dot.gov/hep/climate/gulf_coast_study)



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