FHWA Climate Activities Update

SOH Meeting

FHWA HQ Washington, DC

October 28, 2013

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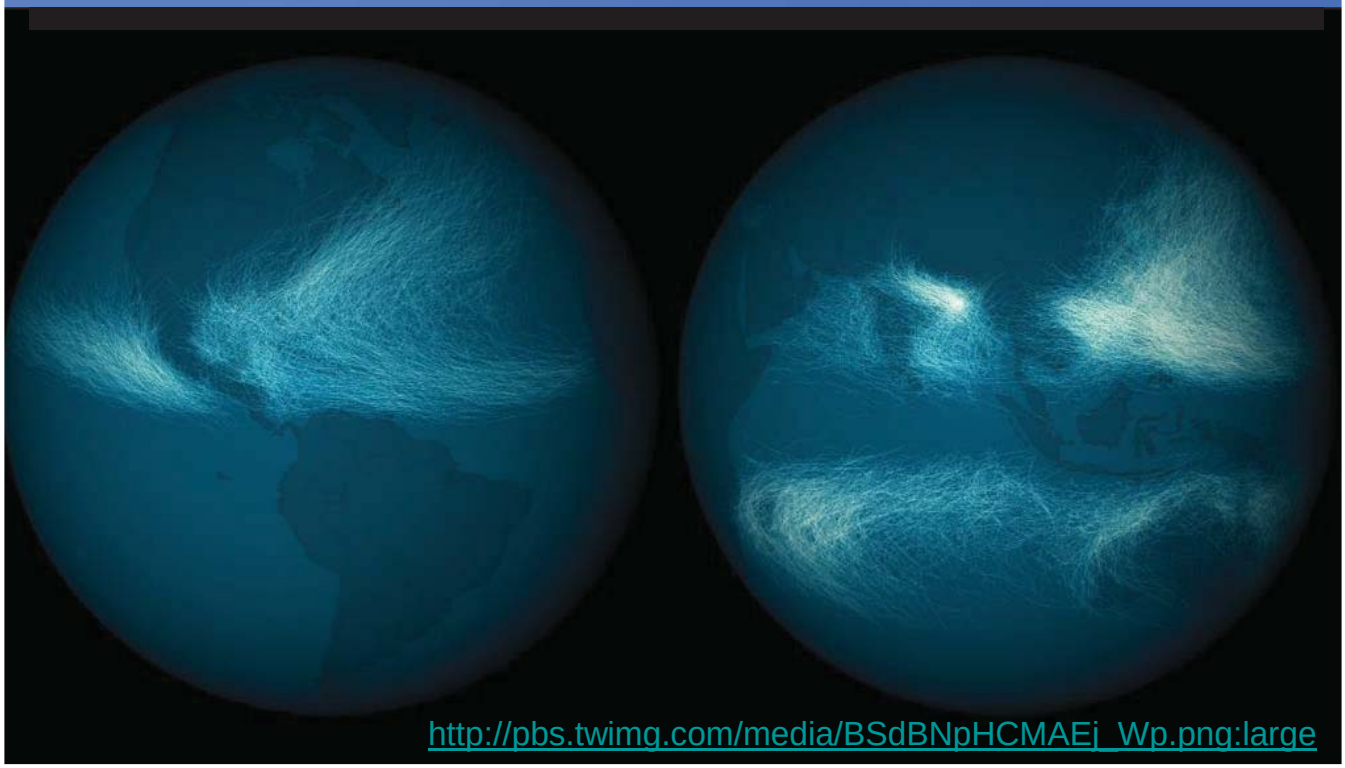
U.S. Department of Transportation
Federal Highway Administration

First a Word from Our Sponsor

(Global tropical cyclone paths for the period 1842 to 2012)



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General Questions on Climate

- Is climate changing?
- If yes exactly how so?
- Can (should) we parse climate impacts out from other impacts?
- Is the change significant?
- Can we mitigate the impacts?
- Where do we start?
- What information can we get and what do we need?
- How do we pay for it?

Recurring Issues

- Terminology changes
- Climate modeling data limitations vs. engineering data needs
- Precipitation changes vs. runoff changes
- Dealing with uncertainty
- Geographic variability
- Design standards vs. failure modes
- Climate Model projections vs. historical hydrologic data

Recurring Issues (con't)

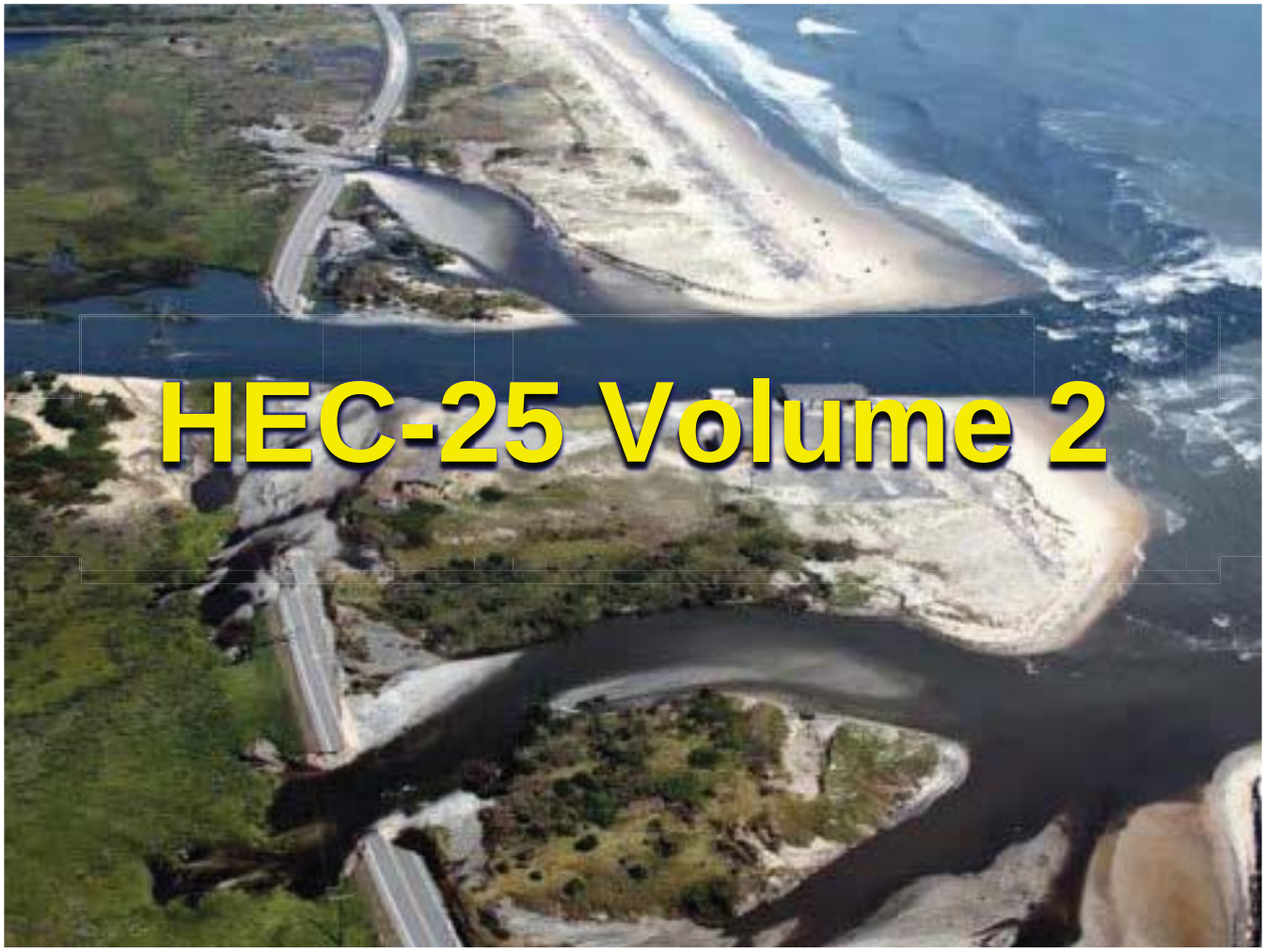
- Stationarity…if not then what?
- Obstacles to adaptation (envr. permitting, downstream considerations, filling "drowning wetlands", etc.)
- Emergency relief (justifications for betterments)
- Aging assets past design life and not meeting current design standards
- Damage (surge) vs. service interruption (SLR)

Overview

- FHWA Office of Bridges and Structures (HIBS) and Office of Environment (HEPN)
- HIBS Initiatives
  - Addendum to HEC-25, Highways in the Coastal Environment, (aka HEC-25 Vol 2)
  - Investigating the Potential Impact of Climate Change on US Precipitation Frequency Estimates (aka NWS Bonnin Precip Trends)
  - Culvert Mgt Case Studies 2 (Asset mgt lead)

Overview

- HEPN Initiatives
  - Gulf Coast 2 Project Status
  - New Round of 19 Climate Pilots
  - Post Sandy Study
  - NCHRP 20-05 (44-08) Impacts of Extreme Events on Transportation Systems
  - Transportation Engineering Approaches to Address Adaptation and Resiliency



HEC-25 Volume 2

1. Assessing Extreme Events in a Coastal Highway Environment
2. 5 Regional Peer Exchanges in May/June
   - FL, NY, WI, WA, CA
3. Preliminary Reference Manual Outline approved recently
4. 50% walkthrough on Nov 13
5. Completion July 31, 2014
6. Contract w/KCM, SCE

HEC-25 Volume 2: Peer Exchanges

- Wide range of professionals attended including DOTs, coastal modelers, climate experts, planners
- Sought regional input on:
  - Coastal and Climate processes of concern
  - Guidance on levels of effort
  - Latest research (AM presentations)
  - Case studies
  - Feedback on manual contents/usefulness

HEC-25 Volume 2: Peer Exchanges

- Some interesting feedback:
  - Surge response to SLR is non-linear…3ft SLR+20ft surge≠23ft WSEL
  - SLR of greatest concern in FL
  - Express risk in probability of occurrence rather than return period, consider damage mechanisms, present decision tree process
  - Tides/Rainfall peaks of concern in NE
  - Falling lake levels, bluff erosion, seiching, reduced ice coverage, meteotsunamis, poor quality rock riprap of concern in Great Lakes

HEC-25 Volume 2: Peer Exchanges

- Some interesting feedback:
  - NW: Tsunamis, transient rain/snow basins will increase in peaks and sediment transport, channel instability and aggradation; coincidence of king tides, low pressure systems (Pineapple express, ENSO) and streamflow cause flooding; AK coastline rising; ice-picking of steeper riprap slopes
  - CA/HI: Waves not surge, king tides, tsunamis, wind patterns depress SLR, earthquakes effect subsidence, rising groundwater table contributing to flooding in HI

HEC-25 Volume 2: PRMO

Chap 1 – Introduction

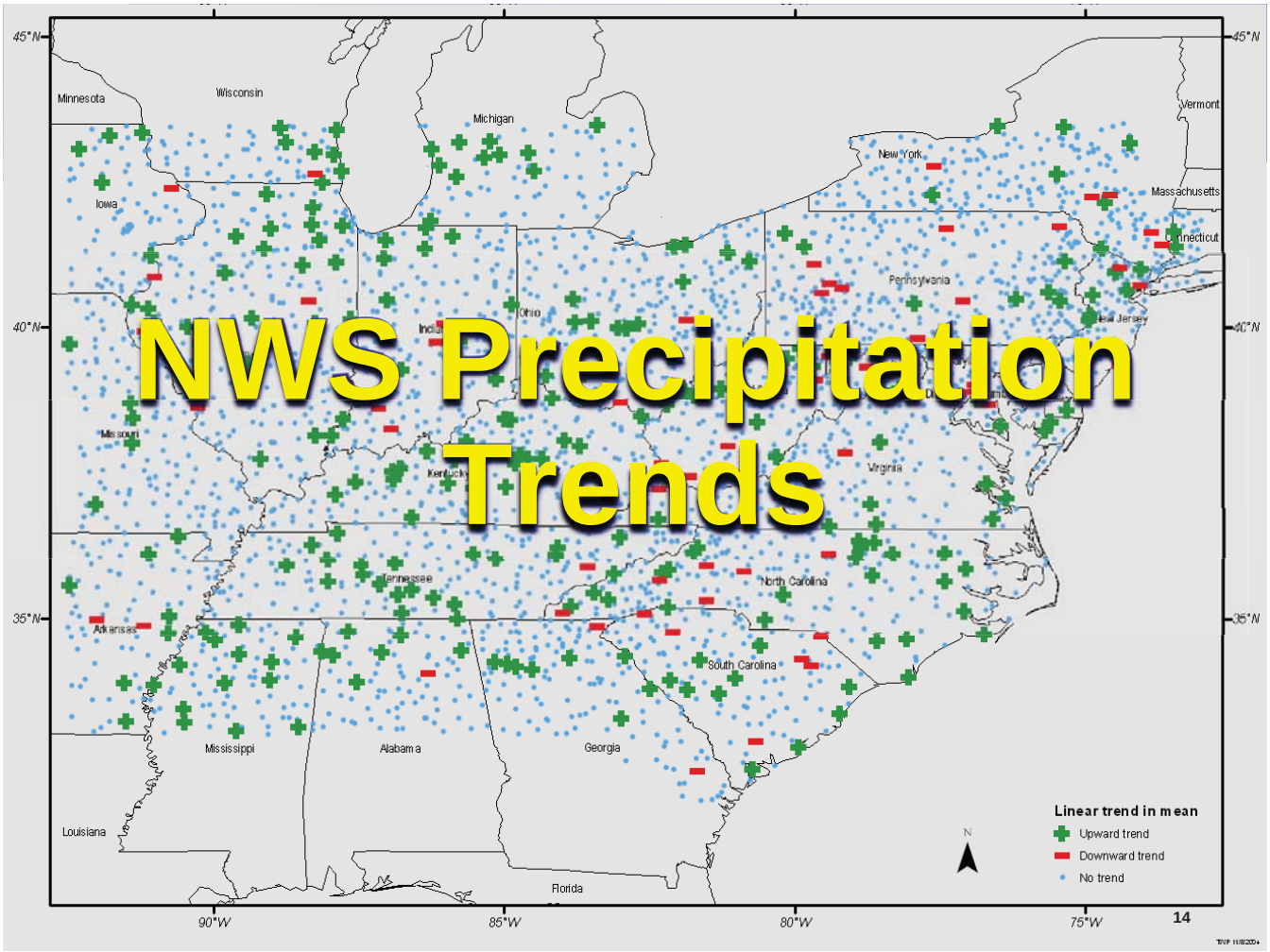
Chap 2 – Identification of critical coastal processes and climate change impacts

Chap 3 – Risk, vulnerability and adaptation

Chap 4 – Analysis methods for assessing extreme events and climate change

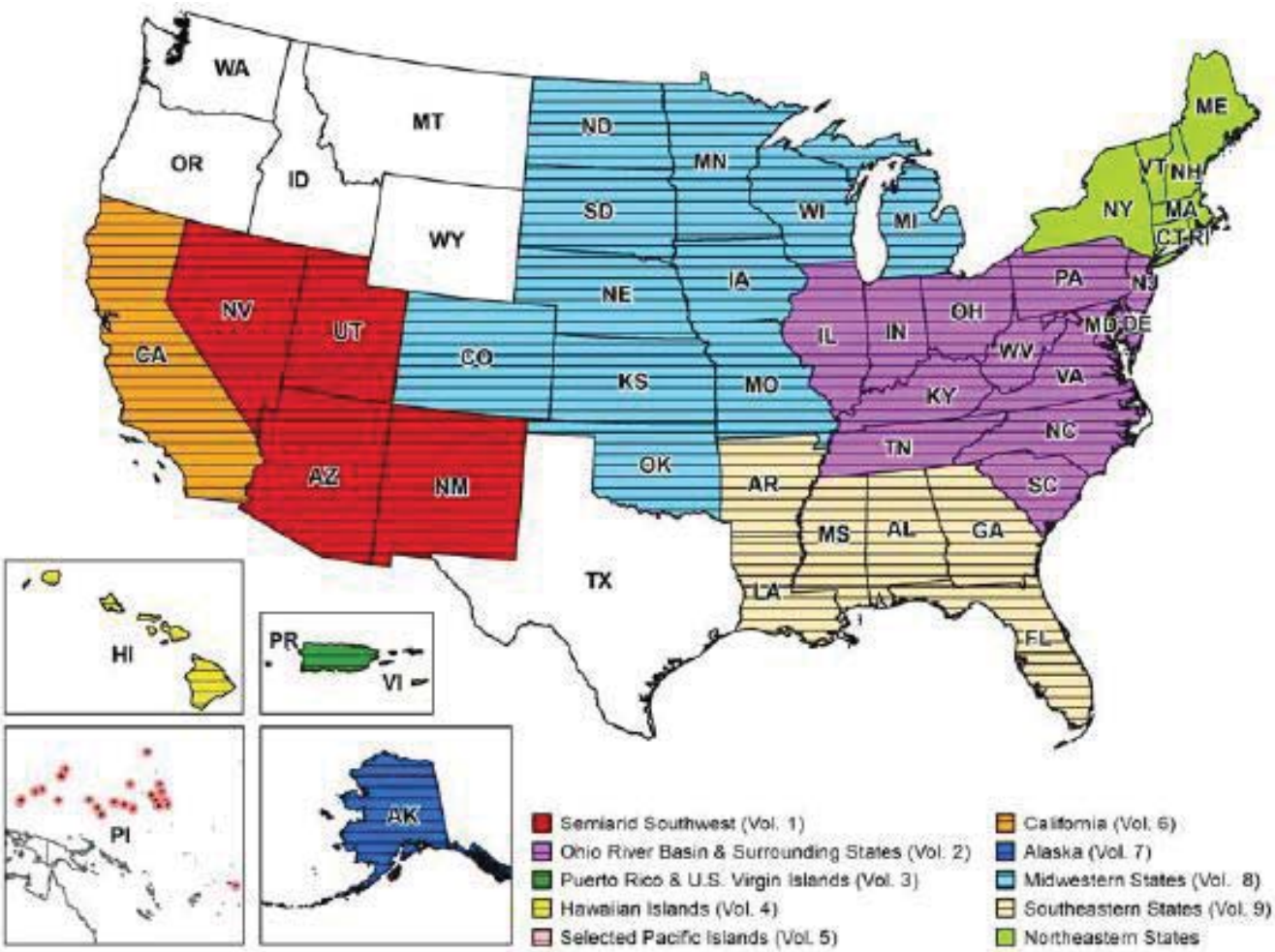
Chap 5 – Case studies of exposure and vulnerability assessment

Chap 6 – References

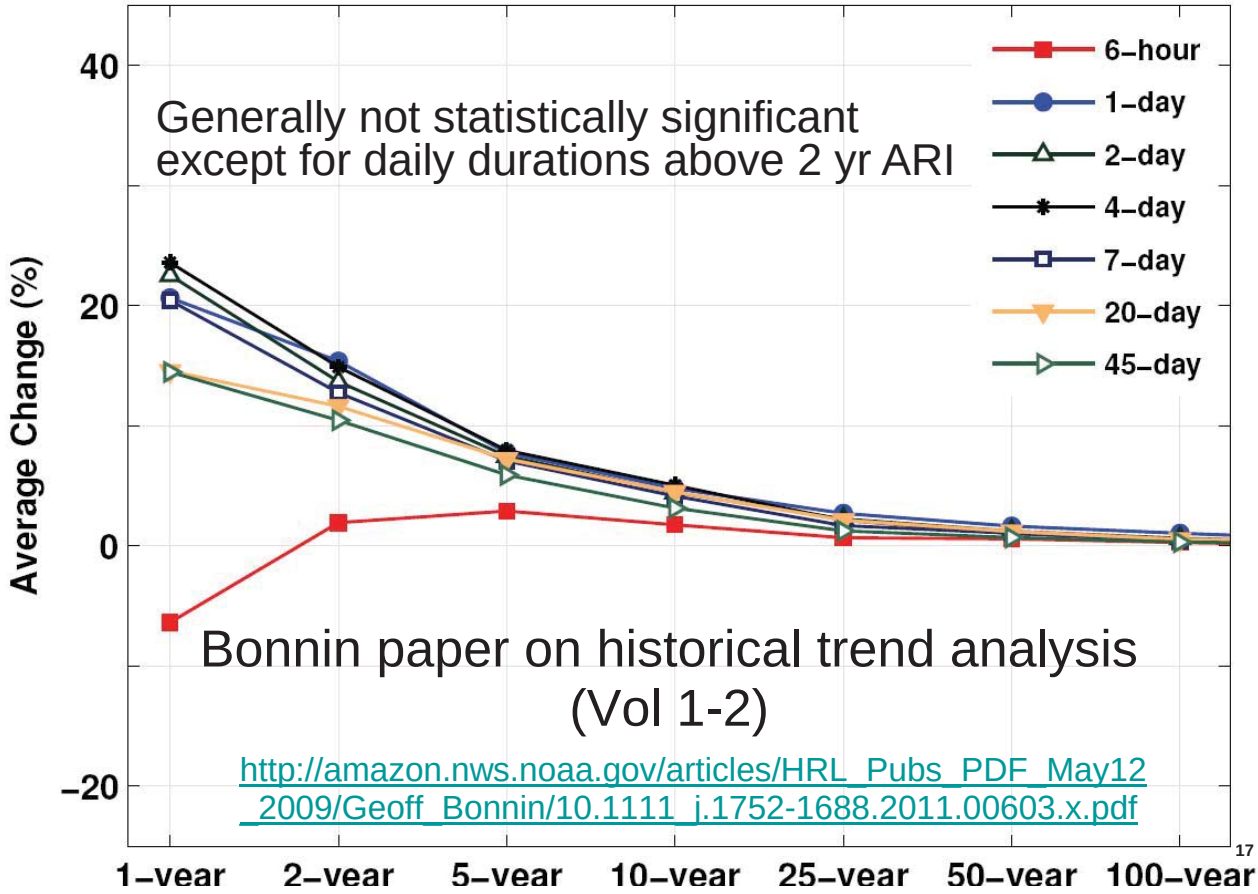


NWS Precip Trend Study

- 18 mo. contract with Geoff Bonnin, NWS Office of Hydrologic Development (mod. to current NOAA Atlas 14 Update contract)
- 3 tasks
  1) Extend trend analysis of historical rainfall exceedances per Bonnin et al 2012 to most of country (Vols 3-9)
  2) Examine if climate community trend results can be shown to be consistent w/ NWS results: “symantic gap”
  3) Research into recommended approach for trend analysis of IDF curves nationally



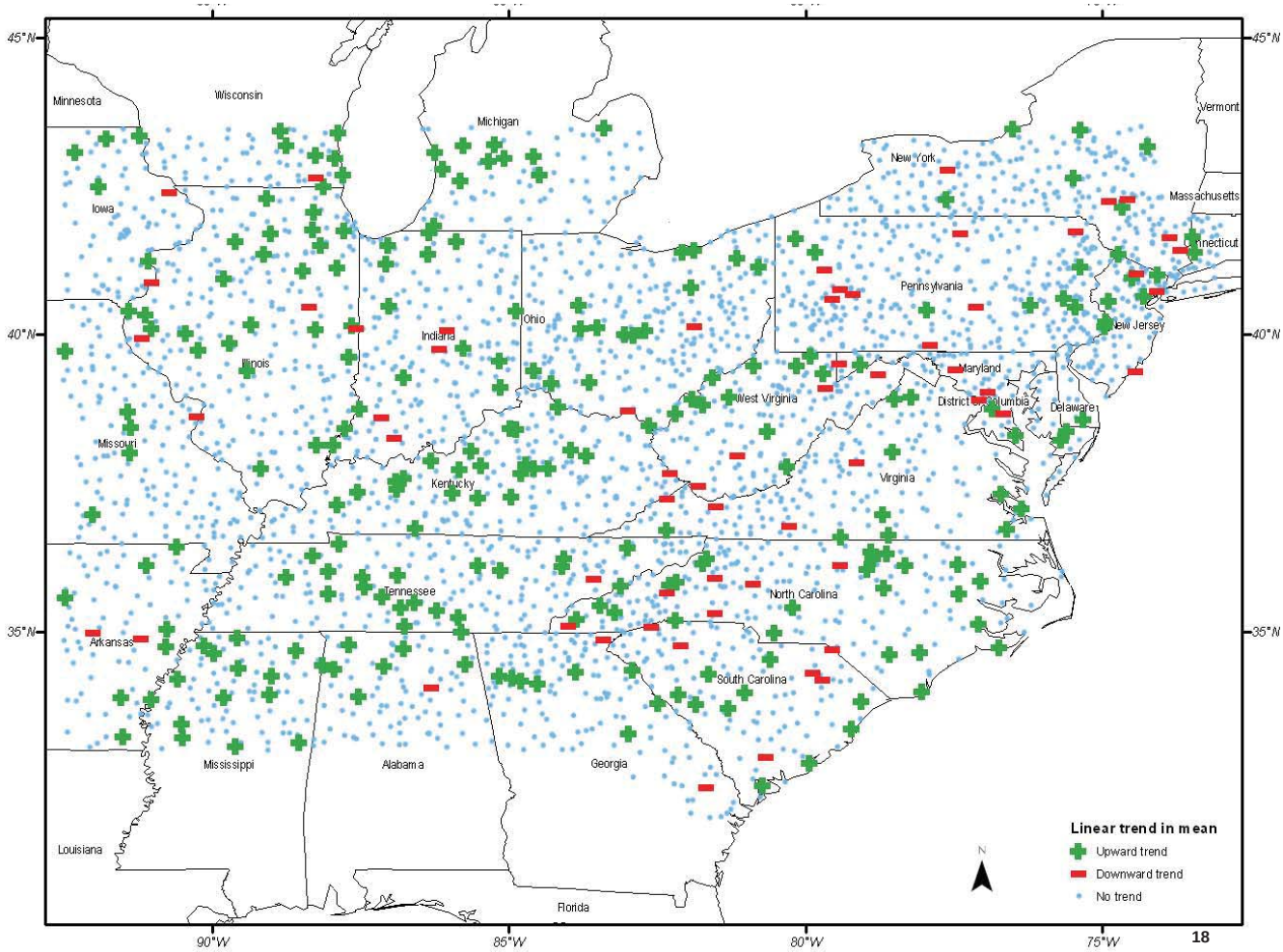
Average % Change in Number of Exceedances per Station per Century, Ohio Basin

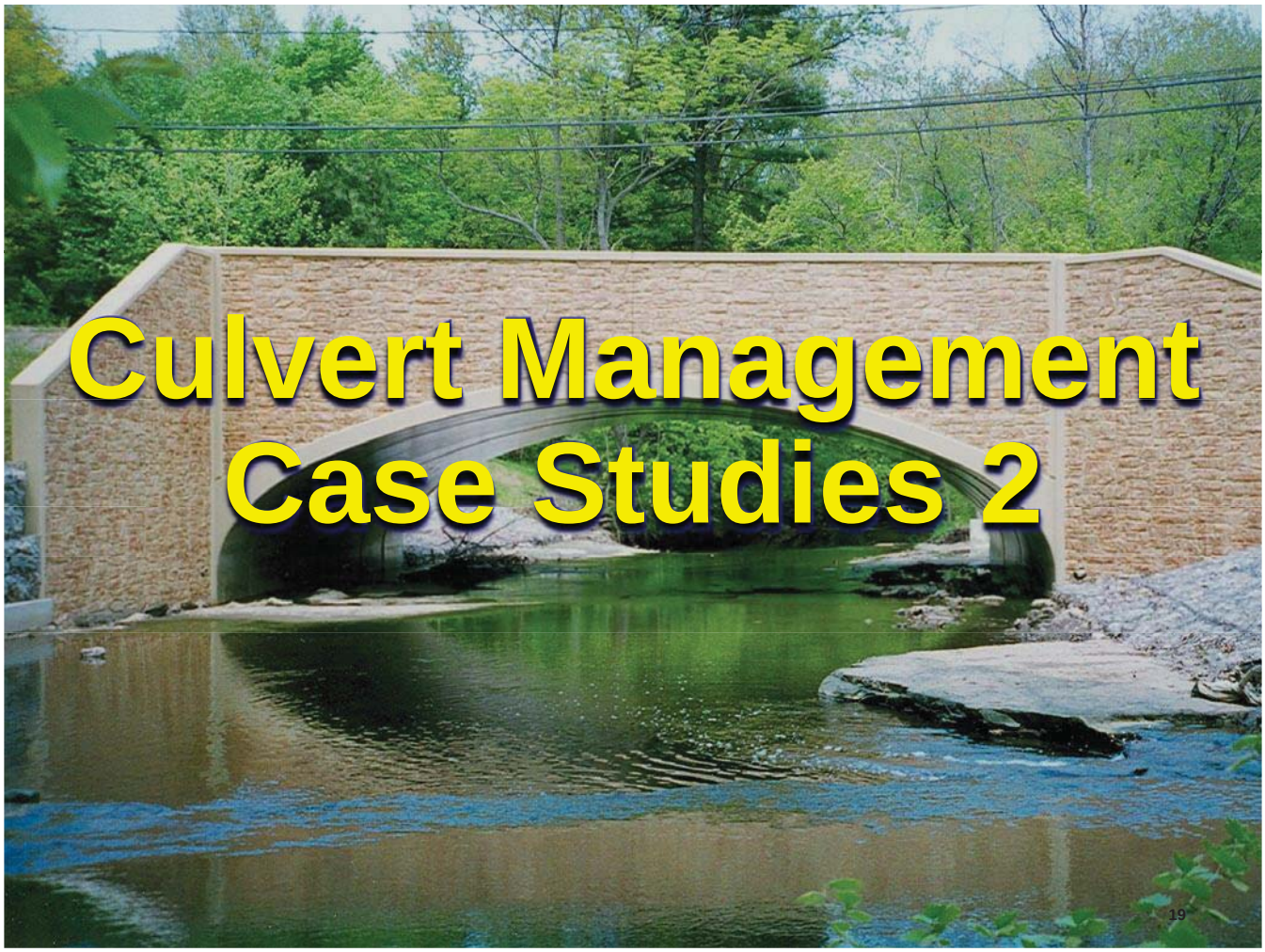


Generally not statistically significant except for daily durations above 2 yr ARI

Bonnin paper on historical trend analysis (Vol 1-2)

http://amazon.nws.noaa.gov/articles/HRL_Pubs_PDF_May12_2009/Geoff_Bonnin/10.1111_j.1752-1688.2011.00603.x.pdf

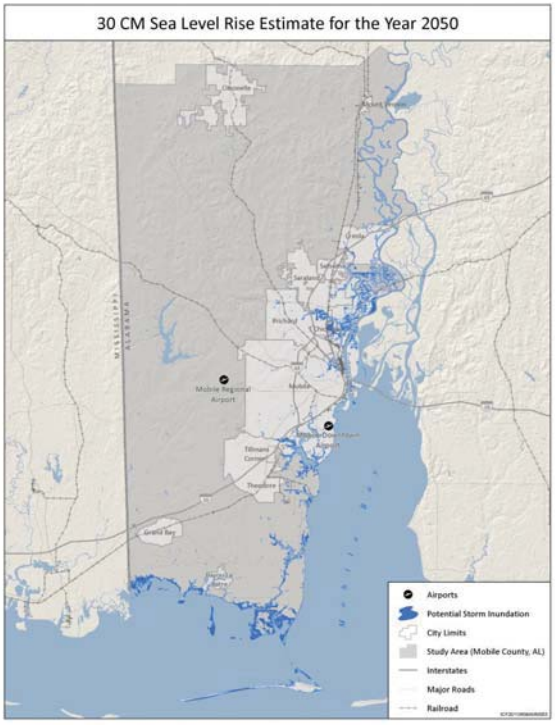




Culvert Case Management Studies 2

- 18 mo. contract w/ Louis Berger (Venner Consulting sub) end date 3/2014
- Interviews conducted with:
  - VTrans (VT) Ohio DOT
  - Oregon DOT LA County (MPO)
- Questions on asset mgt approach, staffing, program size, software systems, climate impacts
- Except for VT agencies not considering climate in asset mgt decisions (VT considering geomorphology post Irene)

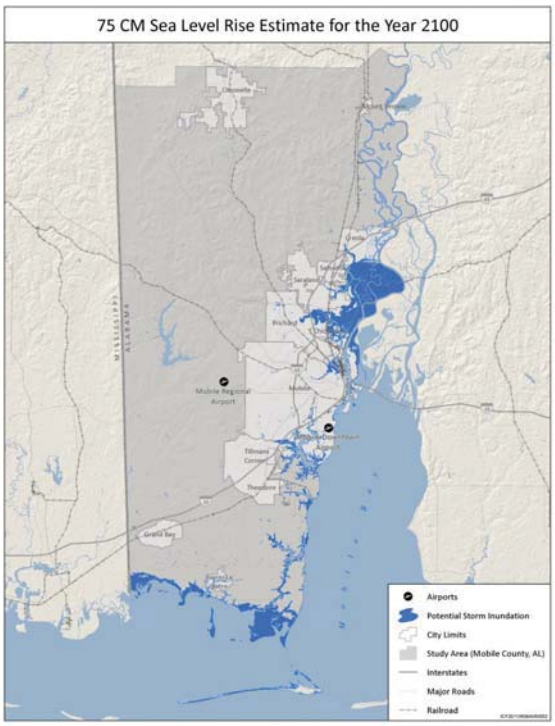
GC2: Projected Sea Level Rise 30 cm in 2050



GC2: Projected Sea Level Rise 75 cm in 2100

Subsidence for the year 2100 with 75 cm of Sea Level Rise

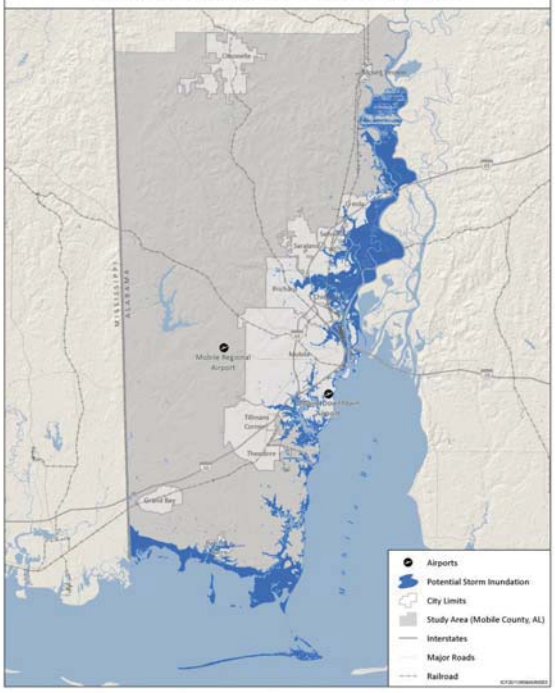
75 CM Sea Level Rise Estimate for the Year 2100



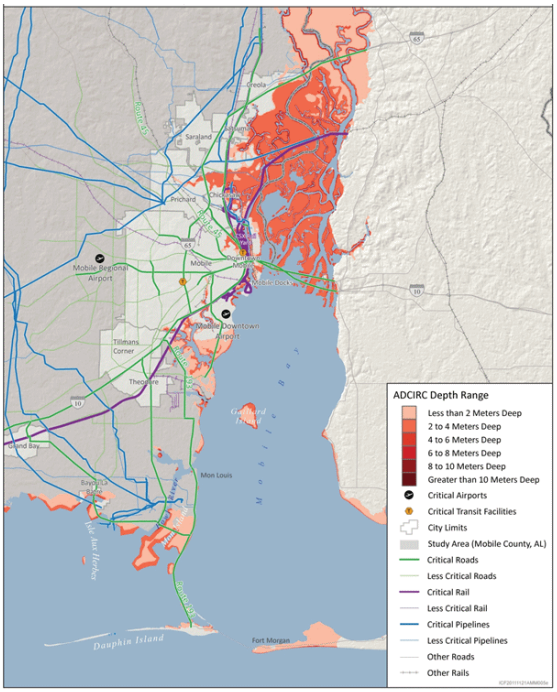
GC2: Projected Sea Level Rise 200 cm in 2100

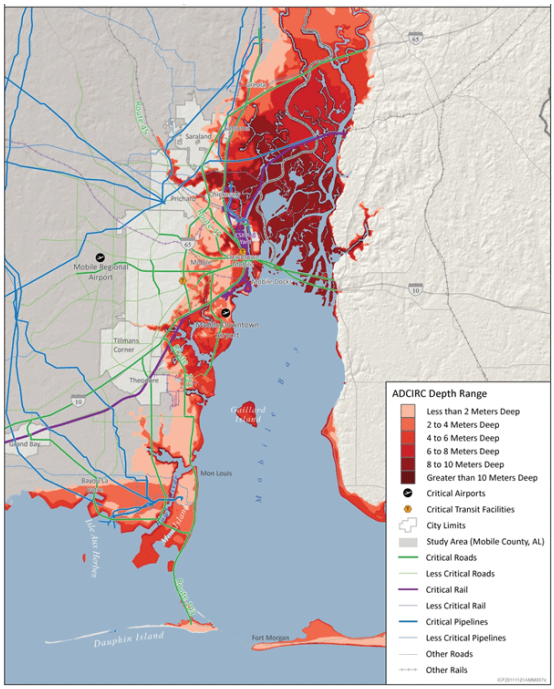
Subsidence for the year 2100 with 200 cm of Sea Level Rise

200 CM Sea Level Rise Estimate for the Year 2100



GC2: Katrina Natural and Shifted w/Max Sustained Winds and 75 cm SLR





Gulf Coast 2 Status

Criticality and Climate work completed and posted

http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_and_current_research/gulf_coast_study/index.cfm

Task 3.2

- Engineering Analysis of Selected Assets by PB
- They have completed a culvert analysis
- Conservative assumptions, black box hydrology

Task 4

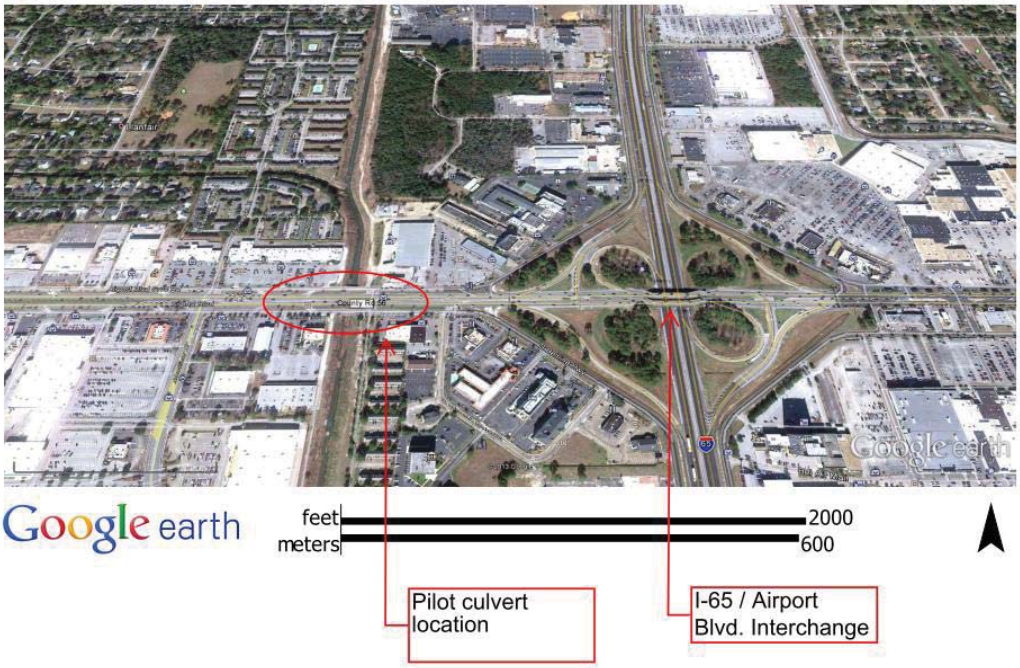
- Climate Portal Website development including videos
- Layers of complexity from intro to detailed resources

Gulf Coast 2 Task 3: Engr. Case Studies Under Consideration

- Bridge
  - Sea-level rise (vertical clearances)
  - Storm surge (scour depths, wave action)
- Culvert
  - Precipitation (flooding, outlet scour)
- Asphalt and Concrete Pavement
  - Temperature (mix design, joints)
- Causeway and Road Embankments
  - SLR and Surge (slope protection, overtopping)
- Operations/Maintenance (practices, OSHA)
- Rail (Temperature – operating speeds/buckling)

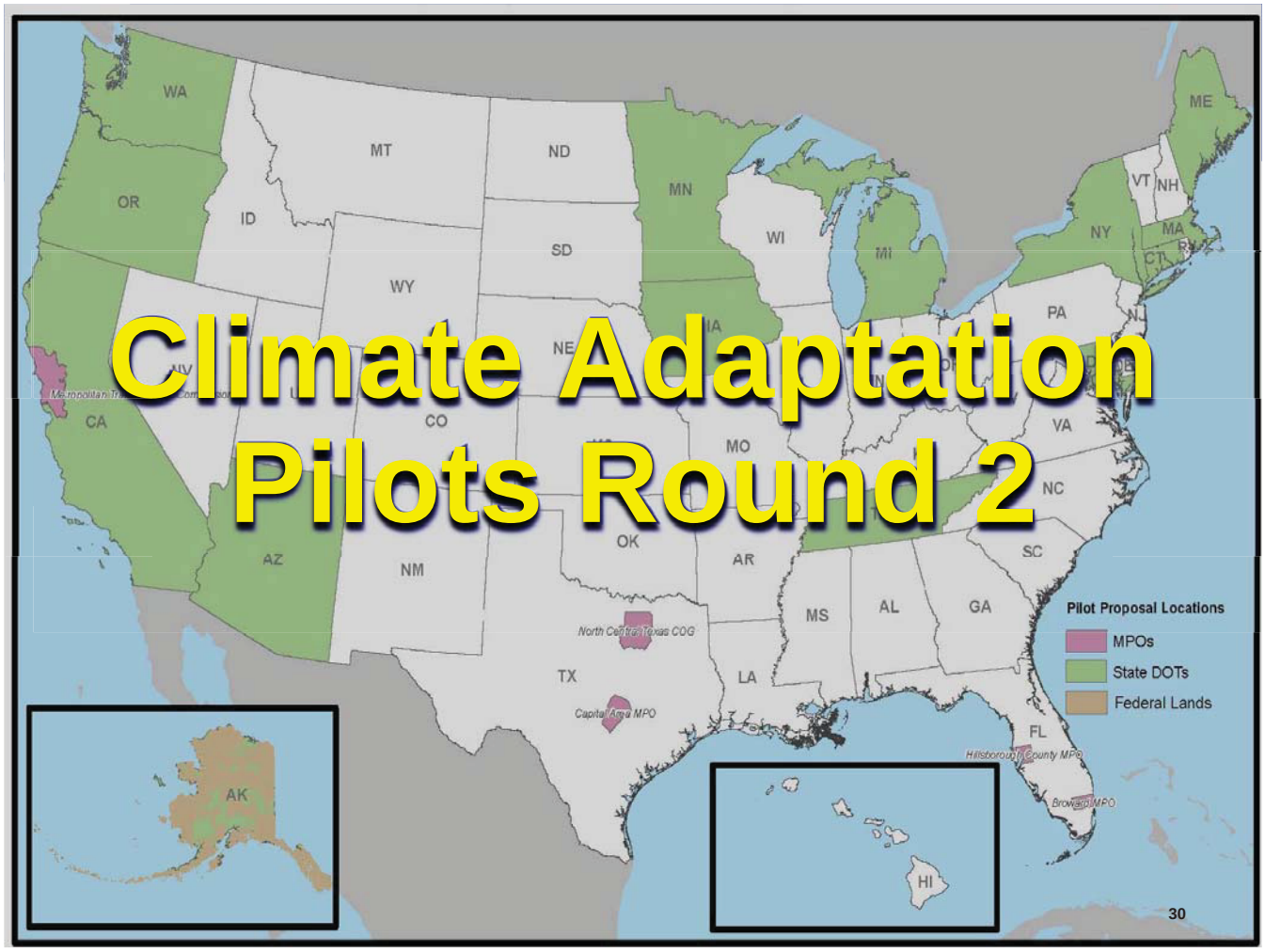
Gulf Coast 2: Task 3 Engr. Analysis on Culvert

- **Airport Boulevard Culvert (Vulnerability asset R9)**



Gulf Coast 2: Task 3
Engr. Analysis on Culvert

- Man-made channel surrounded by urban development
- Trapezoidal channel with grassy vegetation on the side slopes
- Approximate top width of 120 ft. and an approximate depth of 10 ft.
- Total drainage area to the culvert is 3.34 square miles



Climate Adaptation Pilots Round 2

19 Pilots, focus on inland areas

http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_and_current_research/vulnerability_assessment_pilots/2013-2014_pilots/index.cfm

Based on vuln assessment framework

http://www.fhwa.dot.gov/environment/climate_change/adaptation/resources_and_publications/vulnerability_assessment_framework/page01.cfm

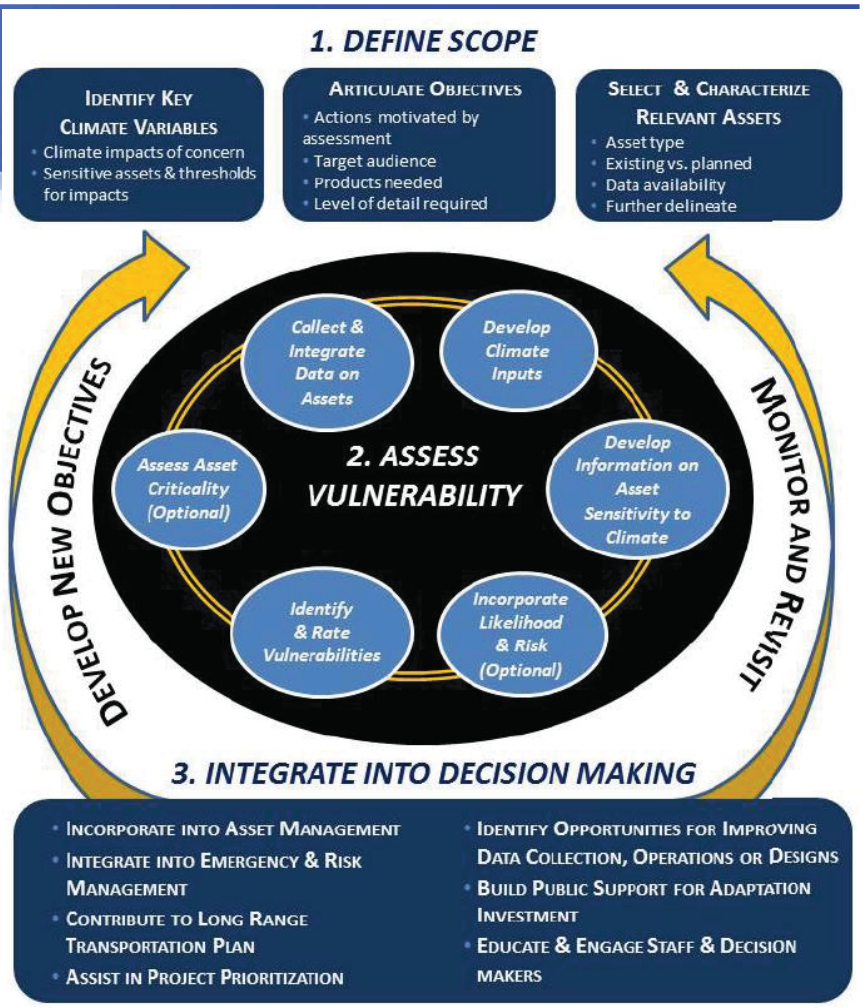
Vuln assessment and Engr analysis

Involved on 5 myself (IA, MN, NY, CT, MA)

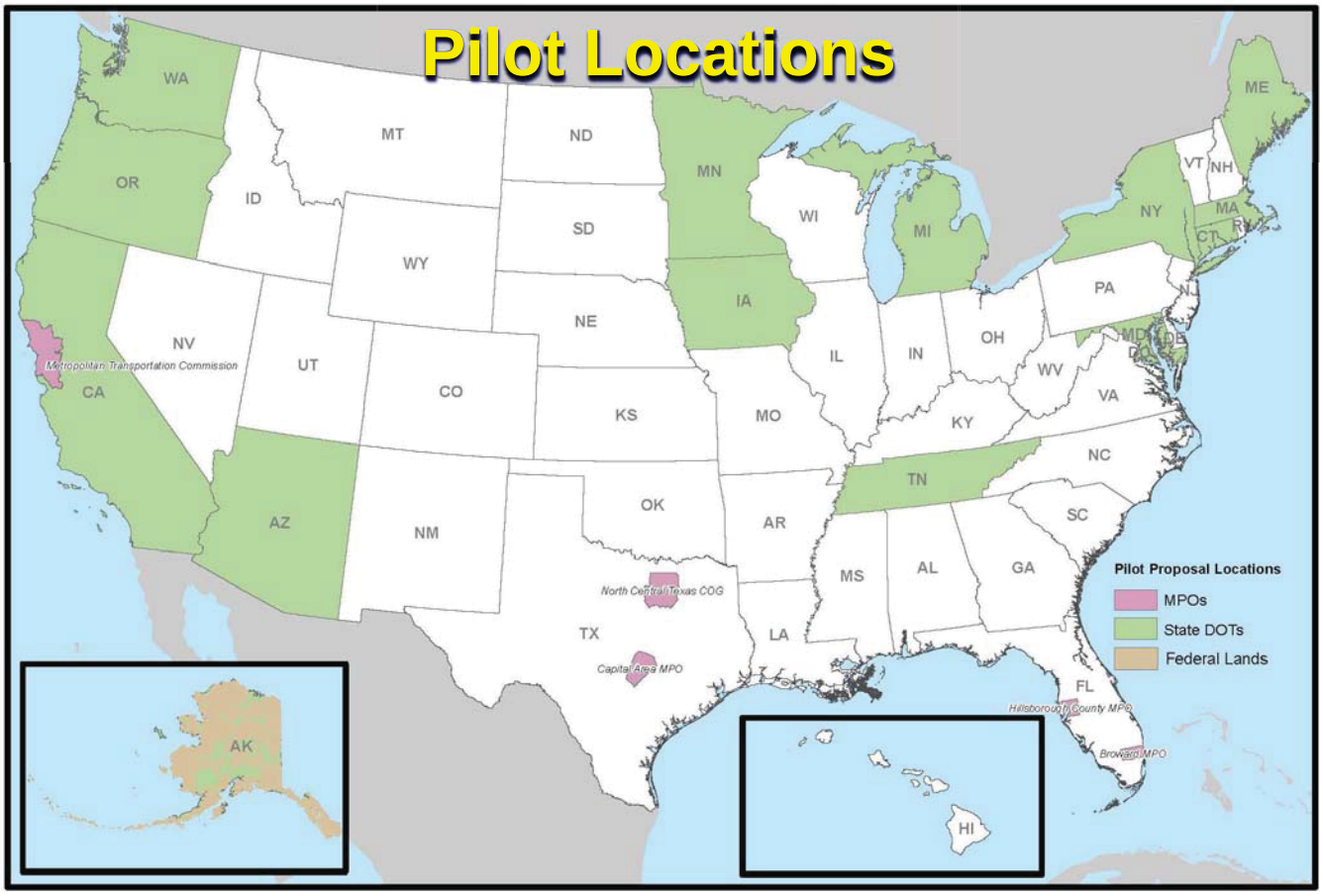
Touchbase meetings in Sept. Austin/Portland

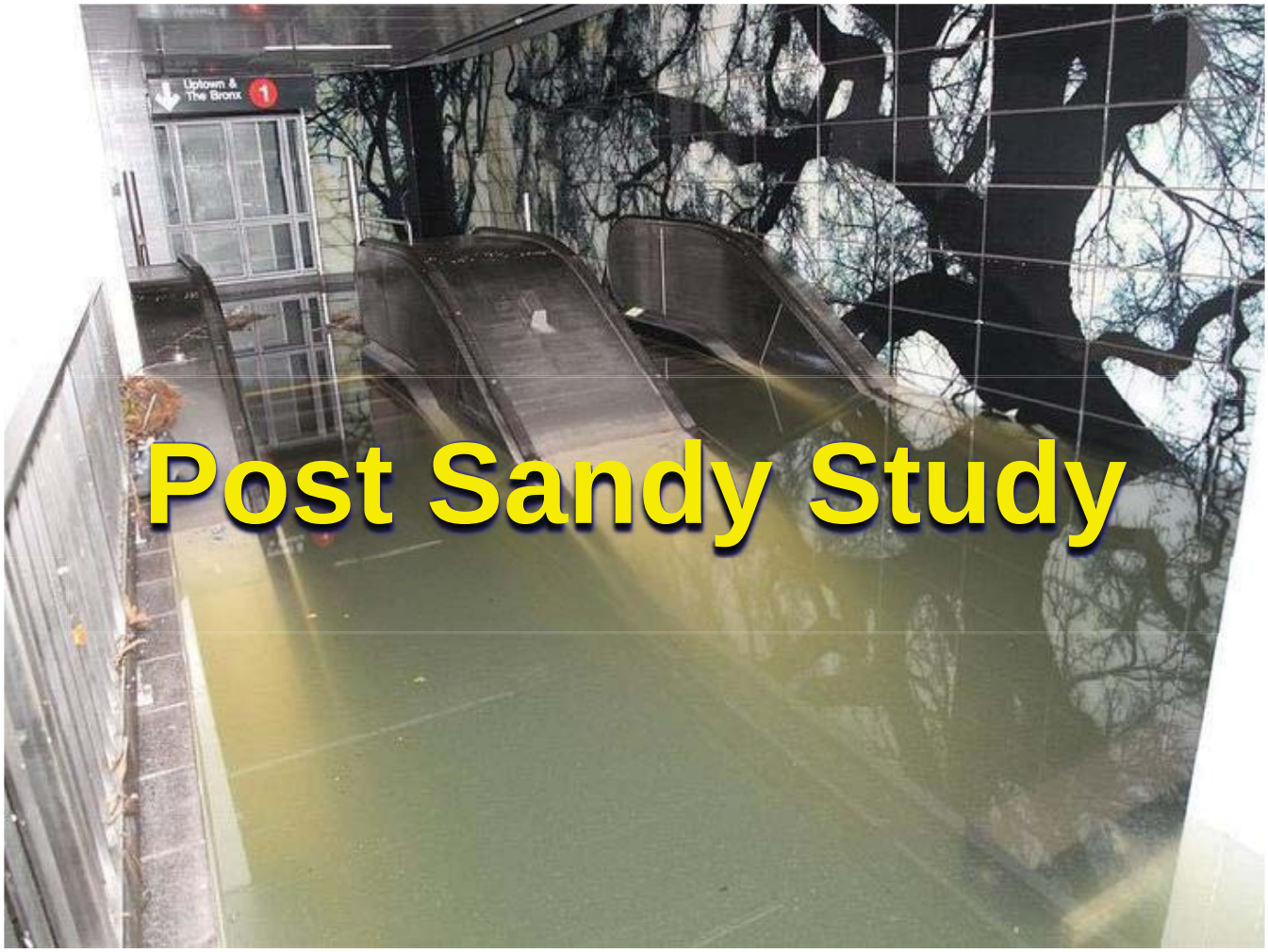
Complete by 2014? Present at NHEC?

FHWA Vulnerability Assessment Framework



Pilot Locations

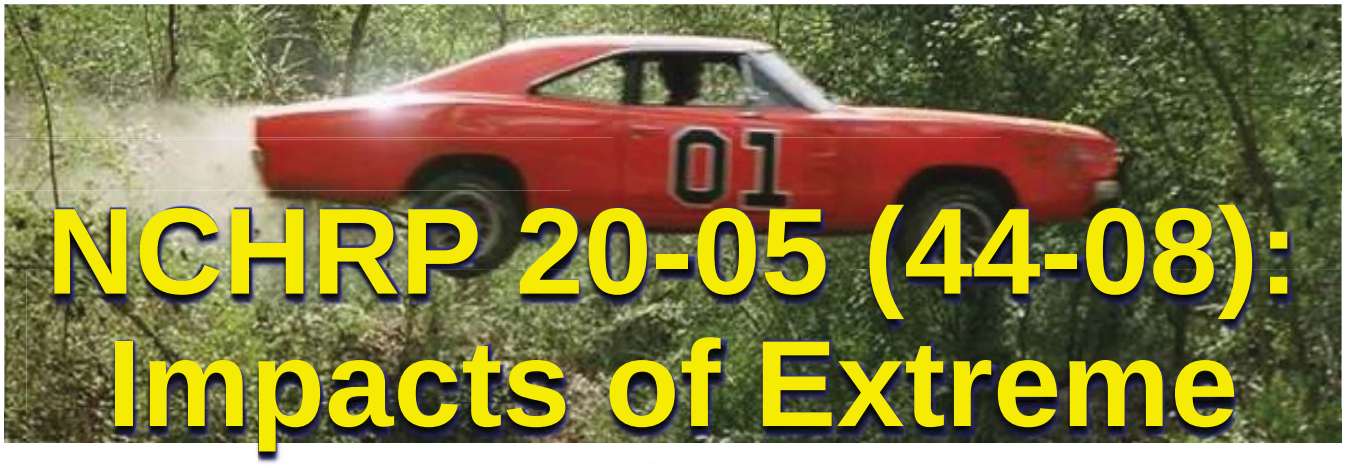




Post Sandy Study

Post Sandy Study

- Tri State study (NJ/NY/CT/4 regional MPOs)
- FHWA-led, but stakeholder group and technical experts group leading direction of efforts
- 18 mo. contract w/Cambridge Systematics and AECOM
- Identify regional assets damaged by Sandy and other major storms
- Correlate historical storm characteristics and extent to damage and interruption costs
- Conduct engineering analyses on selected assets



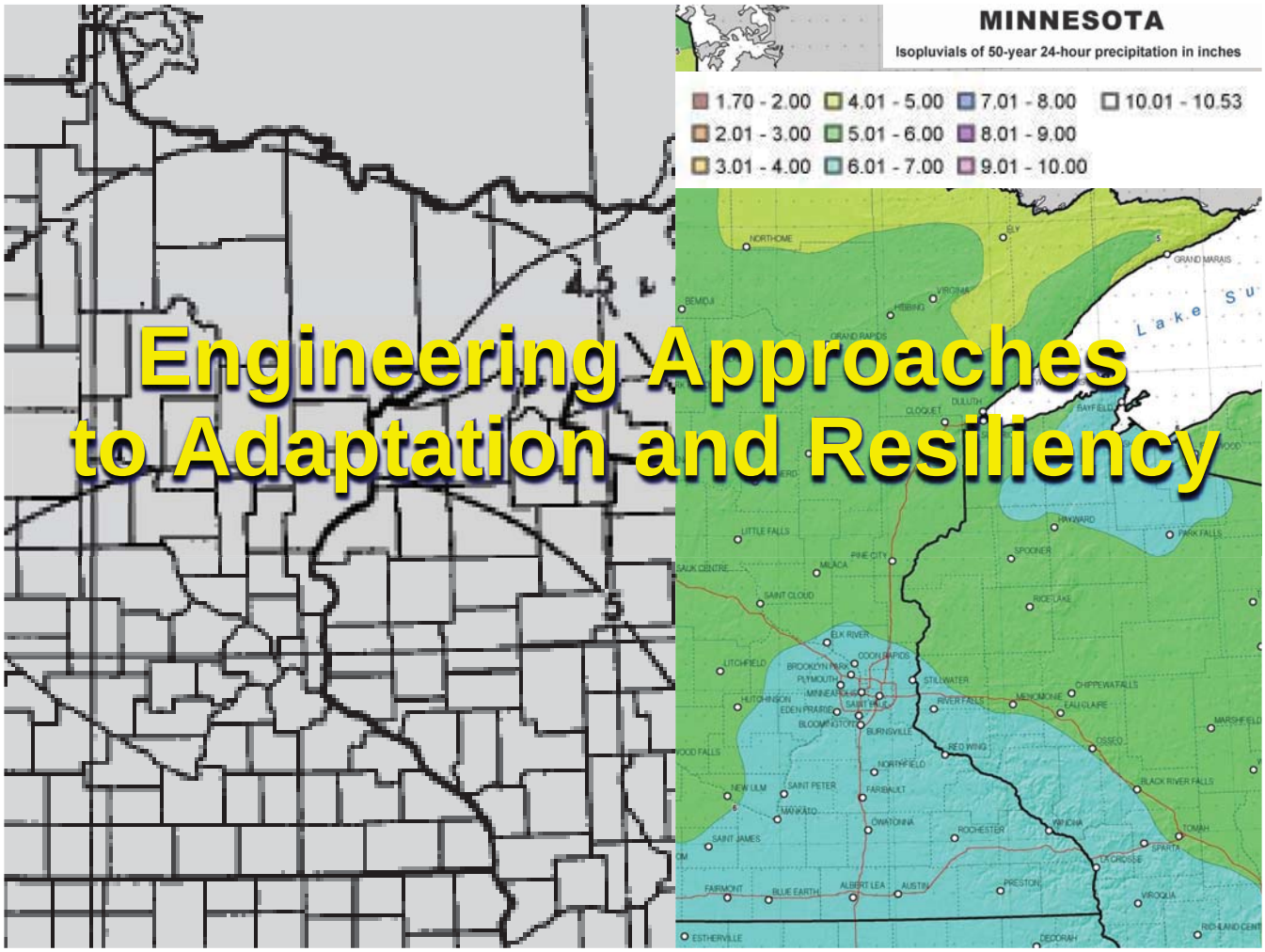
NCHRP 20-05 (44-08): Impacts of Extreme Weather on Transportation Systems

NCHRP 20-05 (Task 44-08)

- Synthesis of ten case studies of extreme weather events on transportation systems
- Awarded to Project Performance Corporation (Christine Baglin)
- Events may be:
  - Riverine flooding (two or more case studies)
  - High intensity rain events
  - Hurricanes Tornadoes
  - Wildfires Prolonged Heat
  - Drought Snow Storms

NCHRP 20-05 (Task 44-08)

- Case studies to address:
  - What happened, size and impact of the event
  - Preparedness (nature and extent of prior preparations)
  - Geographic scope and setting of the event
  - Multimodal/state/local highway system information- extent and type of affected transportation infrastructure
  - How agencies responded, including PR communications
  - What is important for different types of events
  - Lessons learned, including strategies that were helpful
  - Cost information Research needs
  - Evacuation/relocation Recovery activities



Engineering Approaches to Adaptation and Resiliency

- 2 yr contract to be awarded November 2013?
- Engineering based analyses of diverse set of up to 20 transportation assets
- Focus on hydrology/hydraulics/coastal engineering
- Analysis processes to be incorporated into FHWA Vulnerability Assessment Framework
- Includes gap analysis between engineering needs/practices and available climate data

Questions?

STOP CLIMATE CHANGE
BEFORE IT CHANGES YOU.
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for a living planet