Overview of USACE CW Climate Change Adaptation Activities & Flood Risk

Kate White, PhD, PE

USACE Institute for Water Resources

Interagency Flood Risk Characterization Workshop

26 Feb 2014 | IWR Training Room

USACE CLIMATE CHANGE ADAPTATION STEERING COMMITTEE

USACE Climate Change Adaptation

- USACE climate change adaptation planning and implementation for new and existing, built and natural infrastructure relies on
  - Policy and guidance based on consistent approaches developed through collaboration with aligned agencies and partners
  - Science translation to inform decision-makers, based on best available and actionable science
  - Tools and methods for use at working staff level
  - Screening level assessments of vulnerability to climate change that will be refined over time
  - Training and capacity building
- Approach consistent with1 Nov 2013 EO 13653 "Preparing the United States for the Impacts of Climate Change"

Adaptation Policy and Guidance Related to Flood Risk

- Overarching Policy released by ASA-CW 3 June 2011 requires USACE to mainstream adaptation (see http://corpsclimate.us/adaptationpolicy.cfm)
- Consistent Datums:
  - ER 1110-2-8160 Policies for Referencing Project Evaluation Grades to Nationwide Vertical Datums
  - EM 1110-2-6056 Standards and Procedures for Referencing Project Evaluation Grades to Nationwide Vertical Datums
- Sea Level Change:
  - 1986, letter – consider changing sea levels
  - 2000, ER 1105-2-100 – sensitivity to historic and NRC high rate sea level change
  - 2009 and 2011 EC 1165-2-211 and 116-2-212 – use 3 scenarios
  - 2013 ER 1100-2-8162 (supersedes 1165-2-212) – use 3 scenarios
  - 2013 ETL 1100-2-xxx, adaptation, signed Feb 2014
- Post-Sandy Flood Risk Recovery Standard:
  - 2013 ECB 2013-33, Application of Flood Risk Reduction Standard for Sandy Rebuilding Projects
- Hydrology: draft ECB on use of qualitative methods, expected March 2014

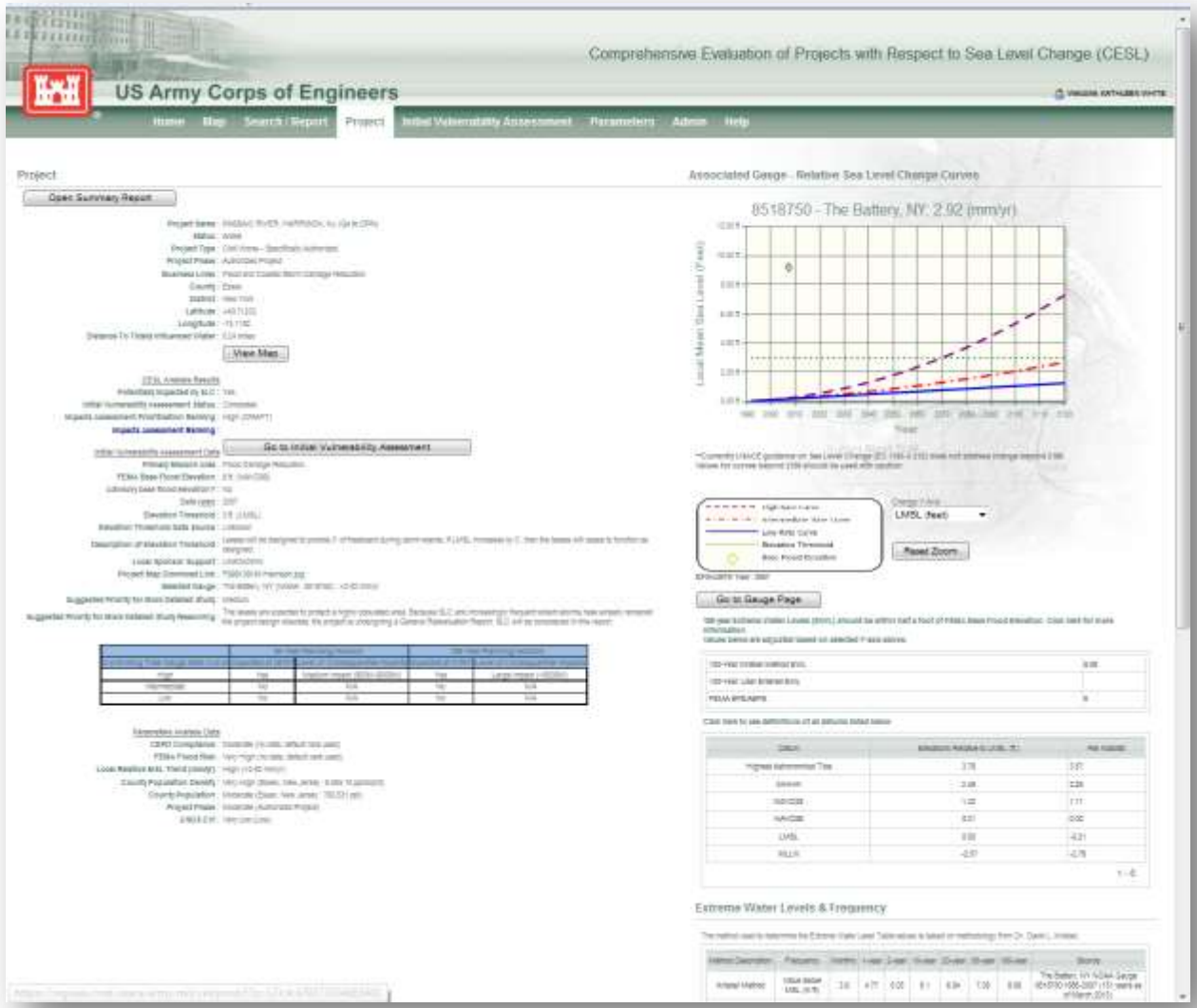
Tools to Implement Adaptation Policy and Guidance

- Datums:
  - USACE Survey Monument Archival and Retrieval Tool (U-SMART) database
  - Datum compliance tracking tool
- Sea Level Change:
  - Sea level change calculator available to public, web accessible
  - Sea level calculator supporting Interagency Sandy Sea Level Rise tool
  - Comparison tool for USACE and NOAA scenarios
  - Simplified method for extreme water levels (waves, tides, surges) in development
- Post-Sandy Flood Risk Recovery Standard (FRRS):
  - Sandy FRRS calculator supporting Interagency Sandy Sea Level Rise tool
- Hydrology:
  - Regional literature syntheses in development, complete CY14
  - Developed consistent nationwide (unregulated) hydrology at HUC-4 watershed level for CONUS based on statistically downscaled climate data
  - Web tool to easily access this hydrology is in development
- Vulnerability Assessments

USACE Vulnerability Assessment: Coastal

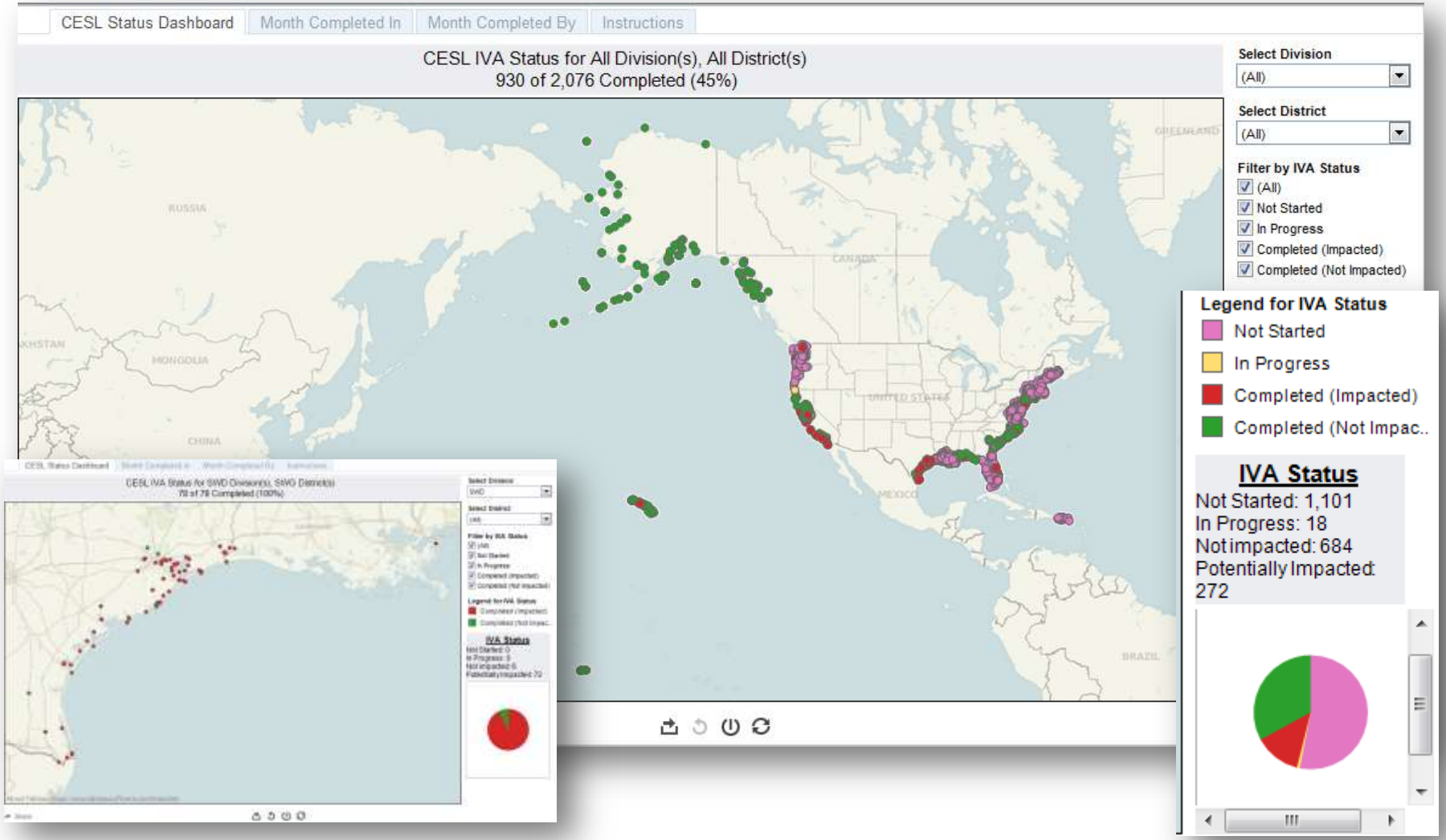
- Comprehensive Evaluation w.r.t Sea Level Change (CESL)
  - Oracle-based tool built on CorpsMap
  - Initial nationwide screening-level coastal vulnerability assessment in progress for USACE coastal projects (~2200 projects)
  - Detailed assessments to follow with priority and level of effort based on screening
- Pilot of detailed analysis underway at Stamford, CT Hurricane Barrier (NAE)
- SERDP Hampton Roads provides example of very detailed assessment

Coastal Vulnerability Assessment - CESL

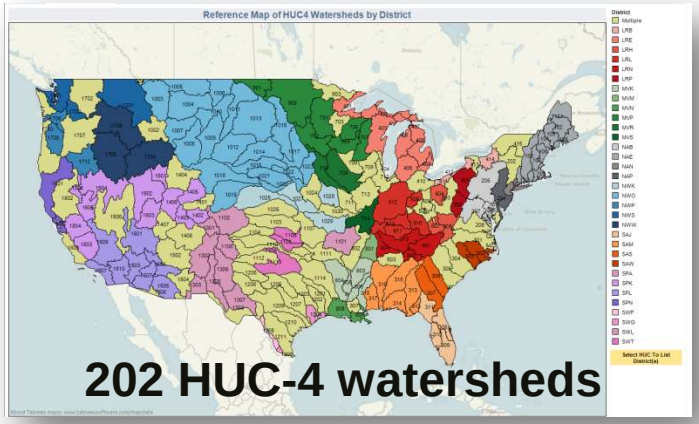


- CAC-enabled
- Oracle database
- CorpsMap GIS
- NOAA and non-NOAA Tide Gauges
- User inputs critical elevation and estimates of consequences
- PDF reports

Coastal Vulnerability Assessment - CESL



HUC-4 Watershed-Scale Vulnerability Assessment



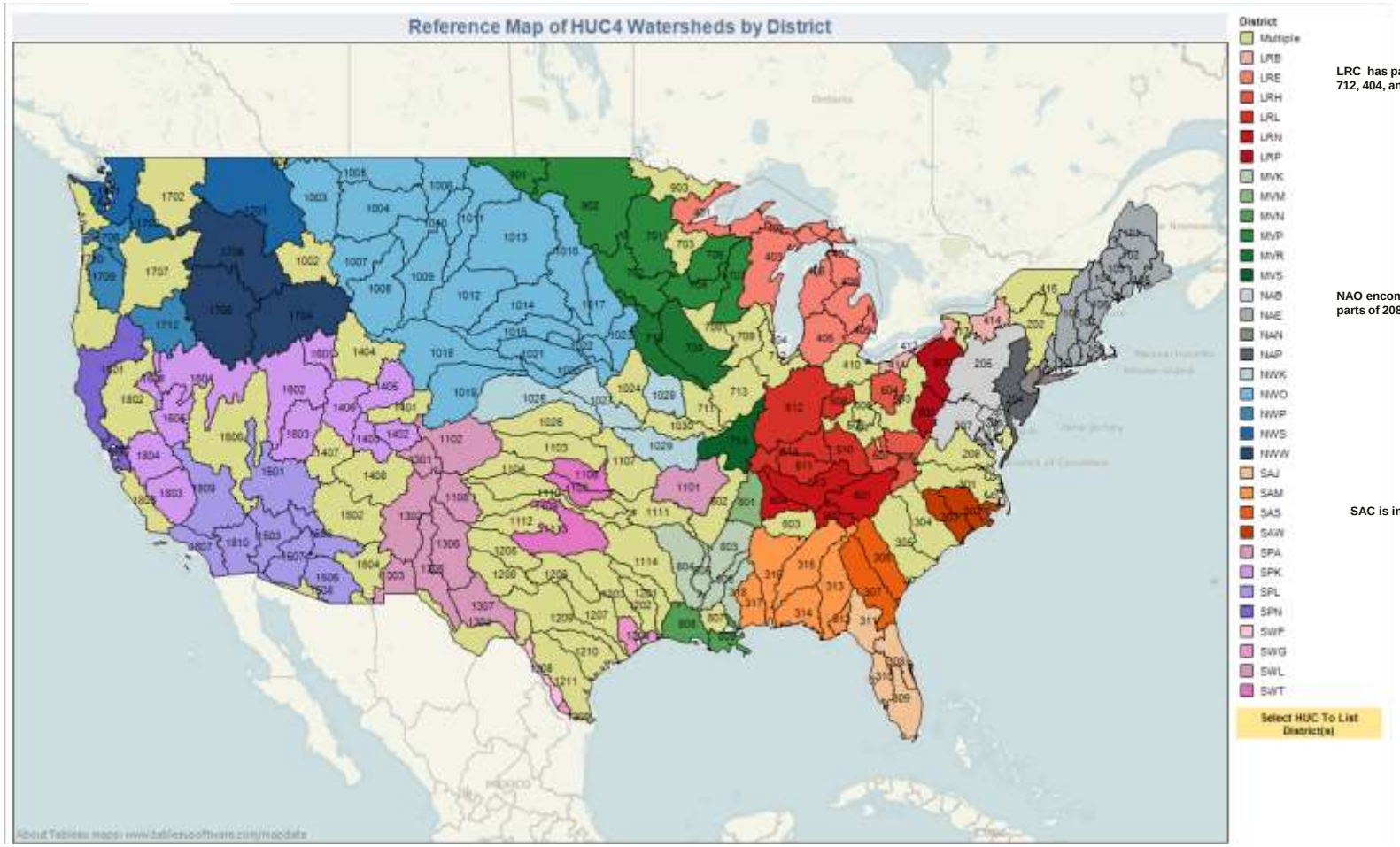
- Phased Development
  - Proof of concept: exploratory, off-the-shelf data, peer-reviewed indicator methods, CONUS, not for release
  - Phase II: built on new nationwide hydrology dataset, refine and customize data, automate, in soft roll-out now
- Modularity allows for incorporating new information/understanding
- Visualization supports QA/QC, interpretation
- Integrates with corporate transformation efforts
- Web publishing with CAC access provides easy and secure access for exploration

BL/FA — How are we vulnerable?

Indicators — How do we represent key aspects of vulnerability?

Analysis — Aggregate and integrate indicators of business and functional area vulnerabilities

Watershed Vulnerability: HUC-4 watersheds



LRC has parts of 712, 404, and 709

NAO encompasses parts of 208 and 301

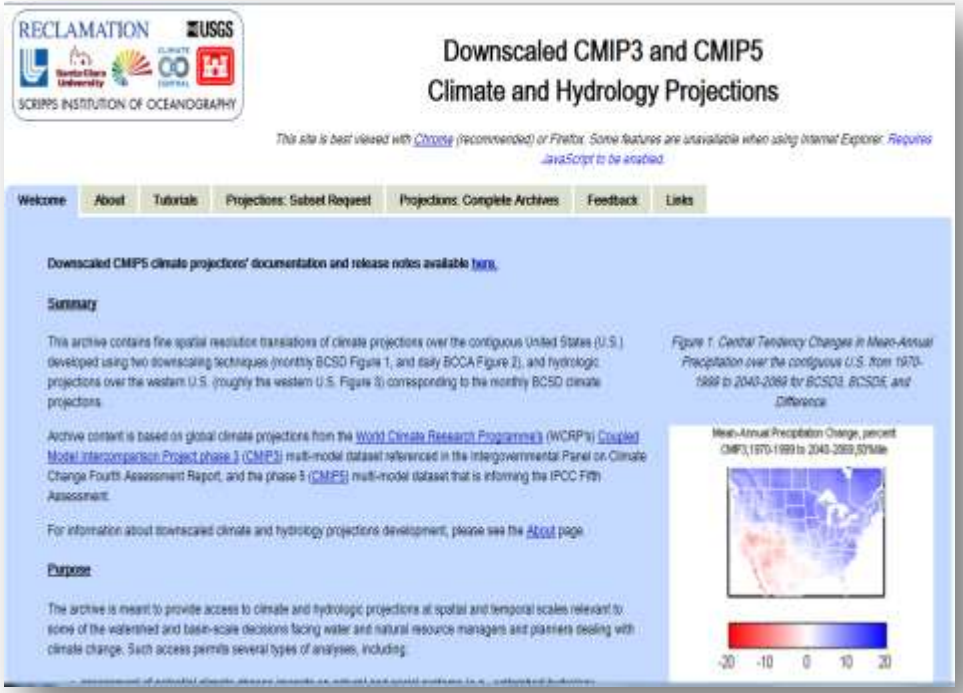
SAC is in part of 305

Watershed Vulnerability: Composite Indices

- Evaluated various methods to construct composite indices, characterizing them within four broad assessment categories:
  - tradeoff
  - subjective weighting
  - data standardization
  - interpretation.
- Selected the Weighted Order Weighted Average (WOWA) method because it is a flexible method that performs well across these four broad assessment categories
  - With a tradeoff (OR-ness) of 0.5, this is ~ commonly-used Weighted Linear Combination Method
  - If we use a more pessimistic tradeoff (e.g., OR-ness value 0.7 as is used in the Phase II screening), we decrease the likelihood of a false negative (i.e., we predict a watershed is not vulnerable when it actually is vulnerable).

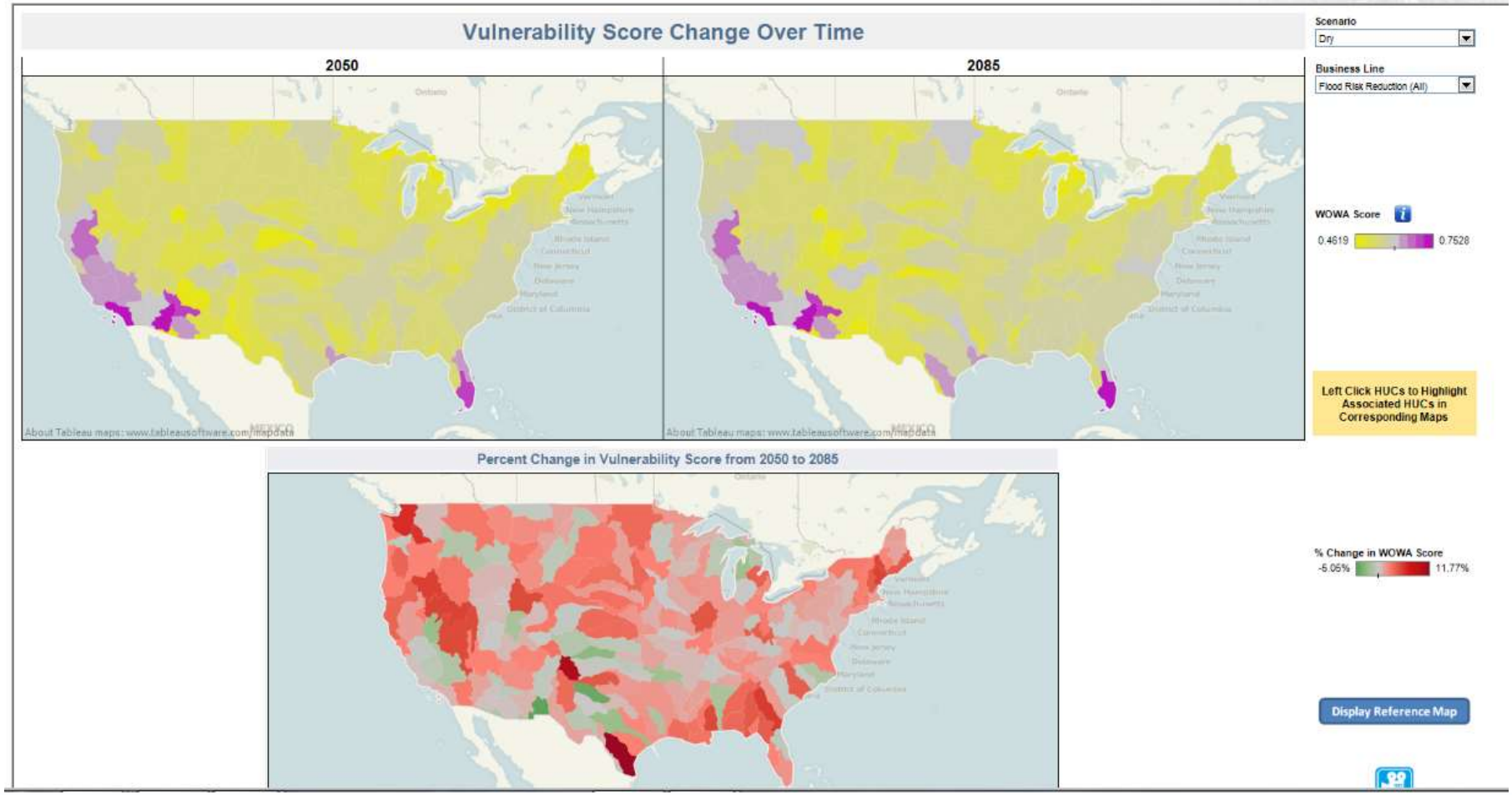
Watershed Vulnerability: Climate Hydrology

- Collaborative agency team produced a consistent set of statistically downscaled climate hydrology March 2013
- CMIP5, BCSD, VIC (unregulated) hydrology
- Various combinations of GCMs and RCPs resulting in 100 traces per watershed per time period
- Top 50% called “wet”
- Bottom 50% called “dry”



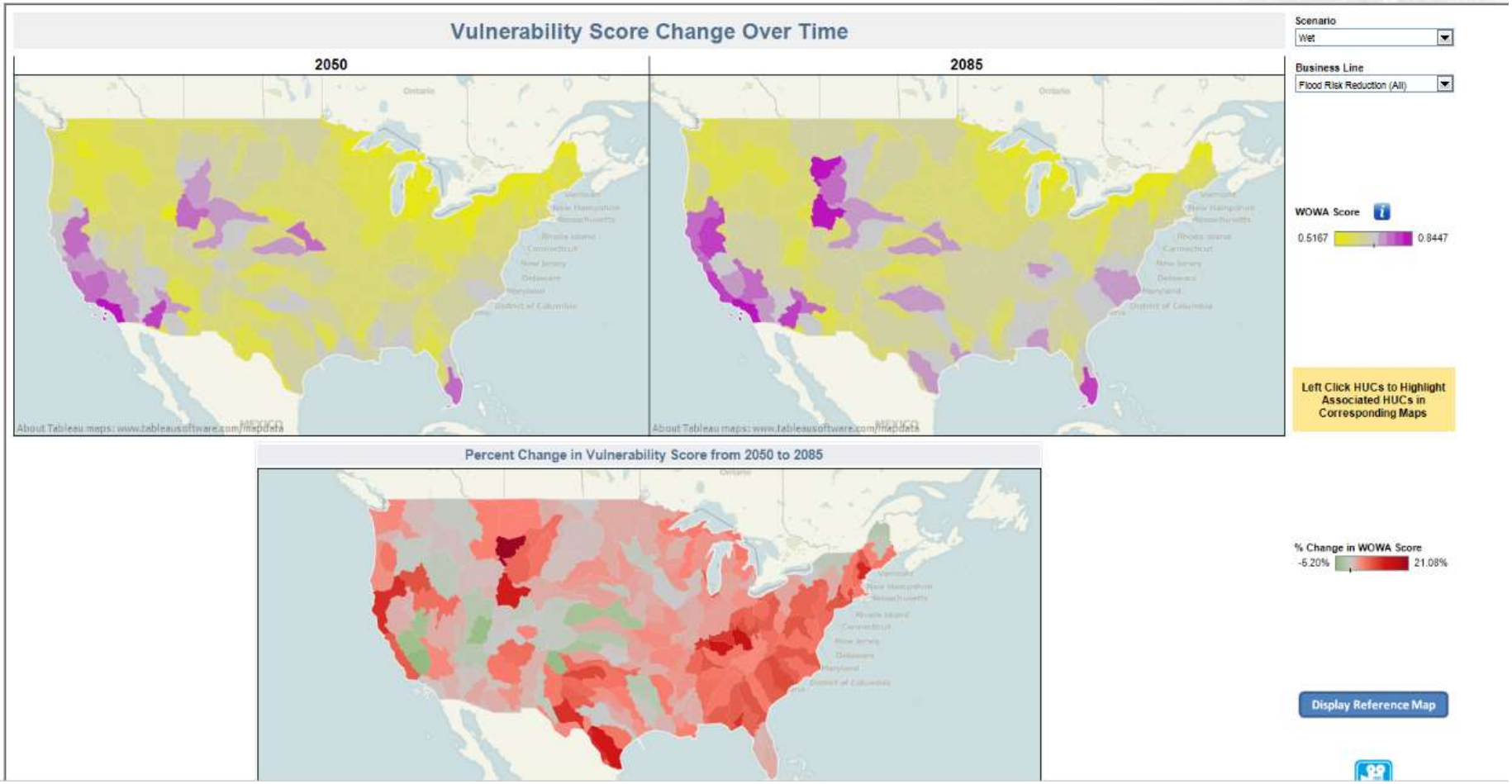
Vulnerability Score – Change Over Time

Dry, Flood Risk Business Line



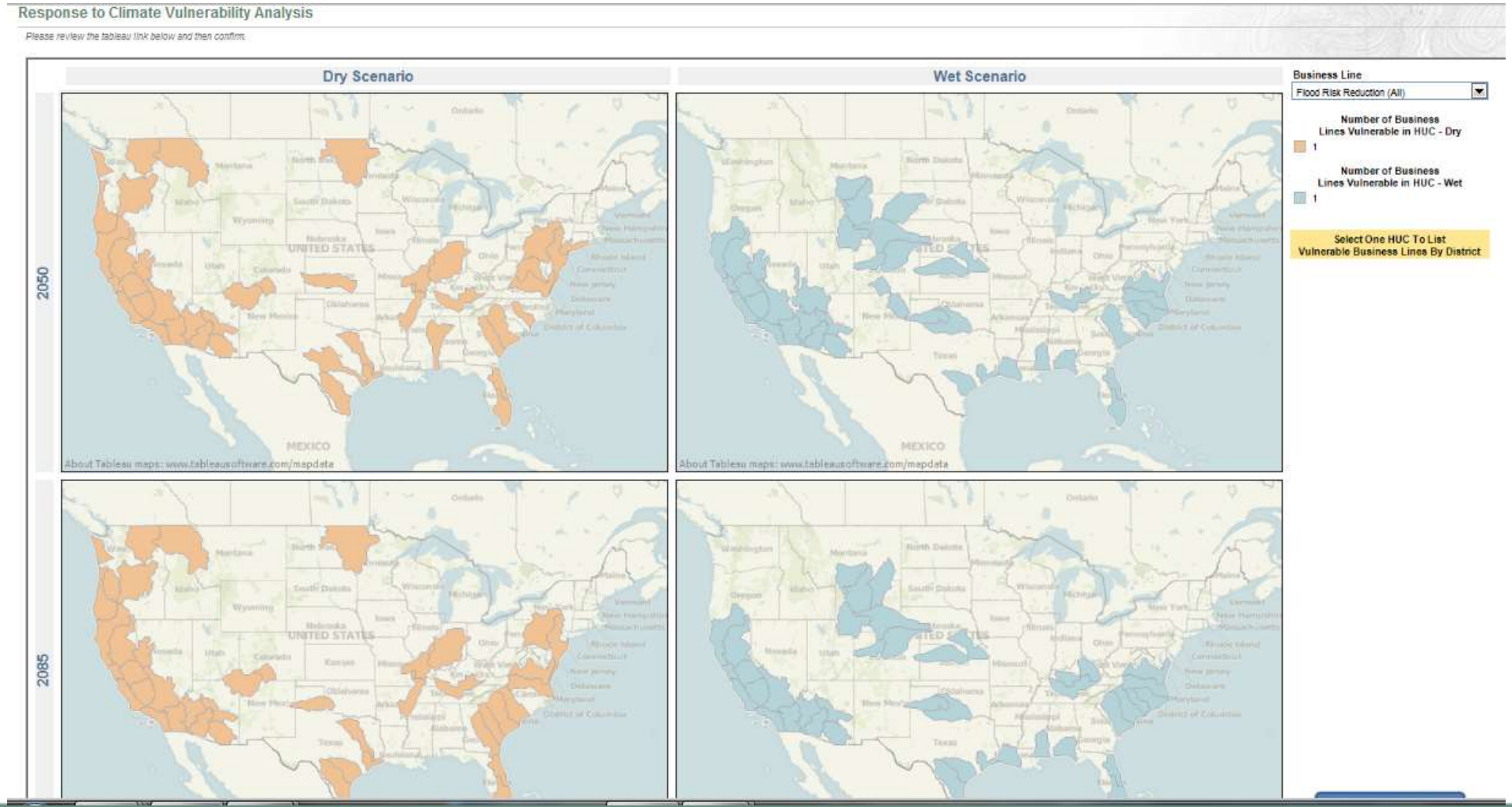
Vulnerability Score – Change Over Time

Wet, Flood Risk Business Line



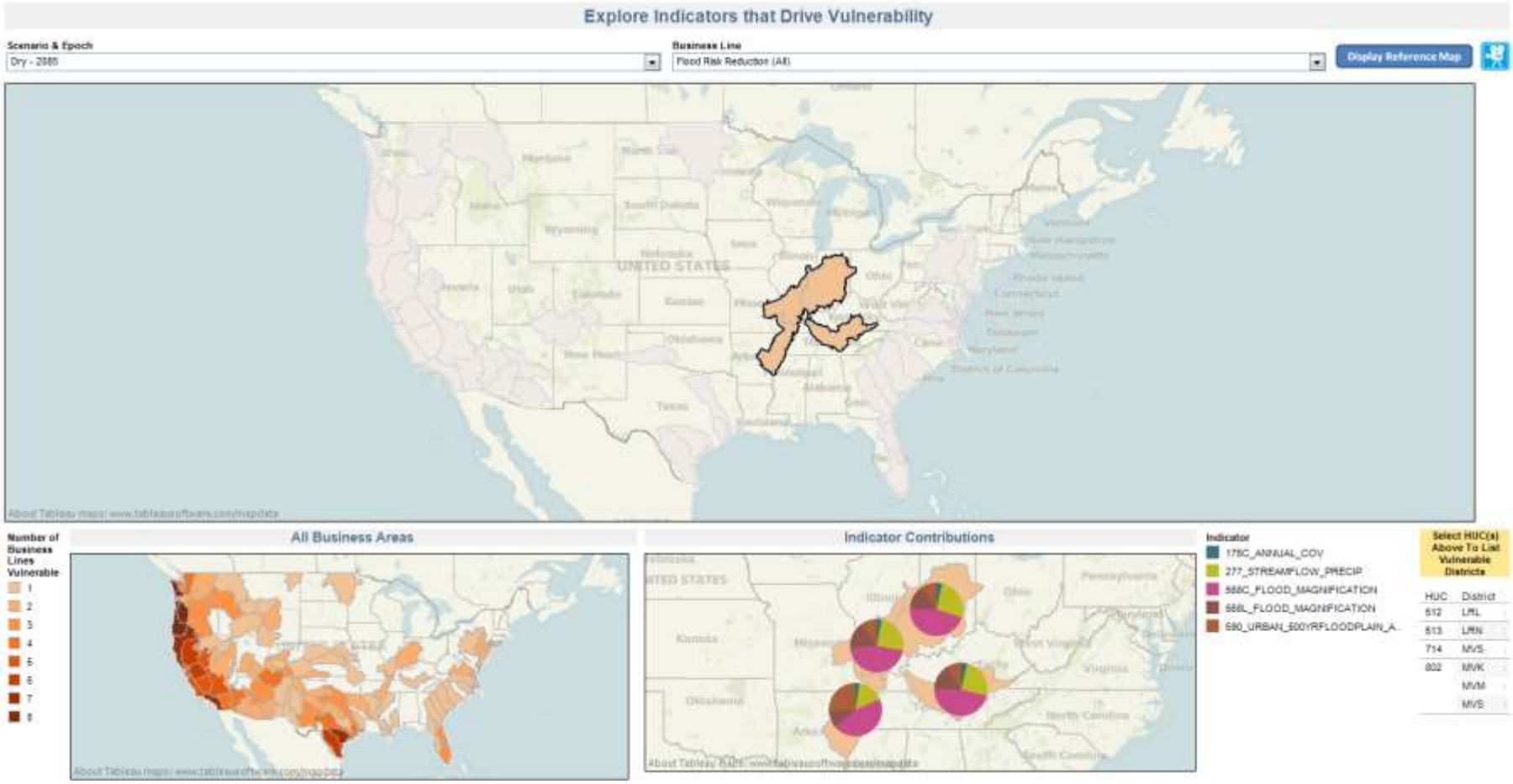
Vulnerability Score – Comparison of 20% Most Vulnerable

Flood Risk Business Line



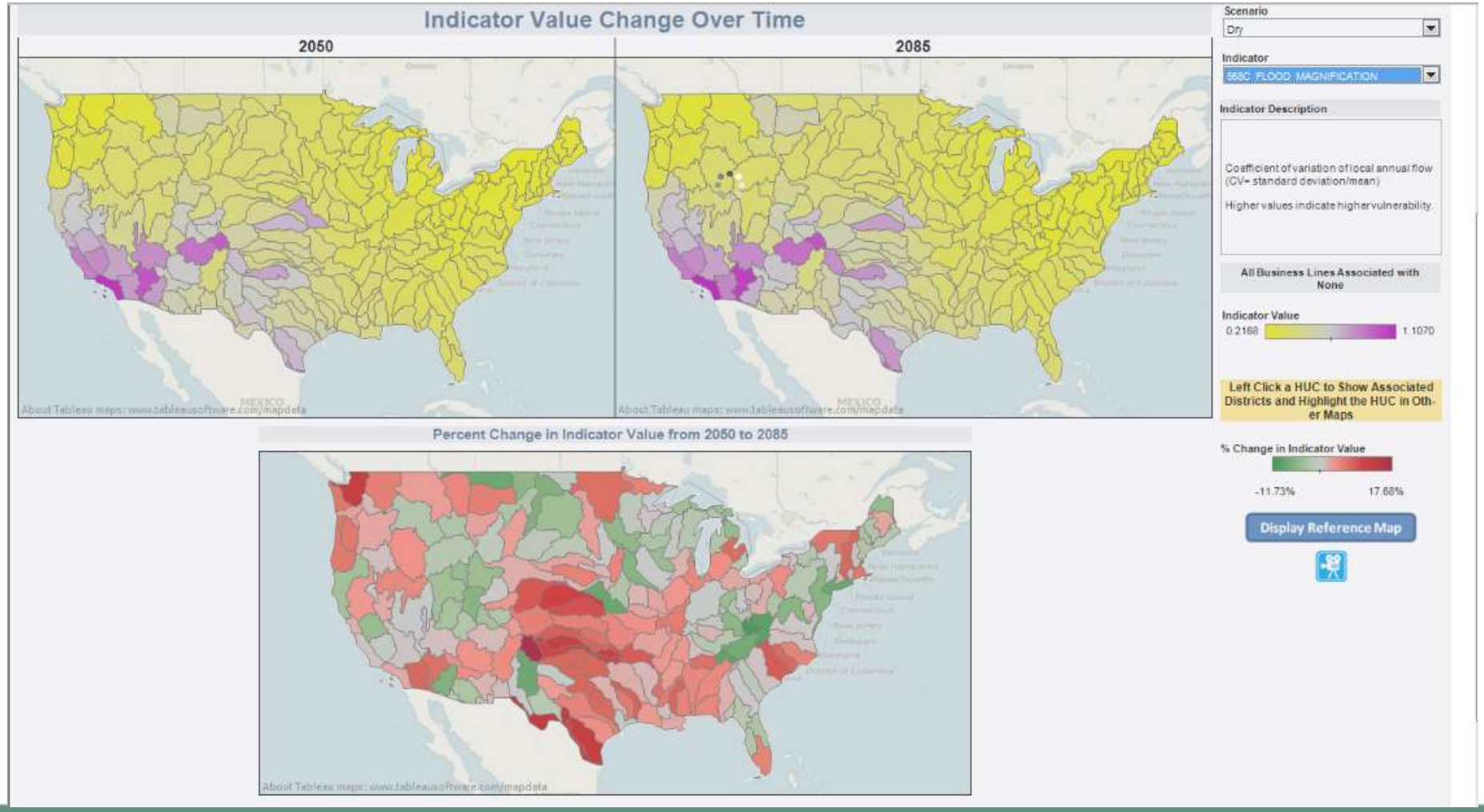
Vulnerability Details Map

2085, Dry Scenario, Flood Risk Reduction Business Line



Single Vulnerability Indicator

Dry Scenario, Flood Risk Reduction Business Line



So What?

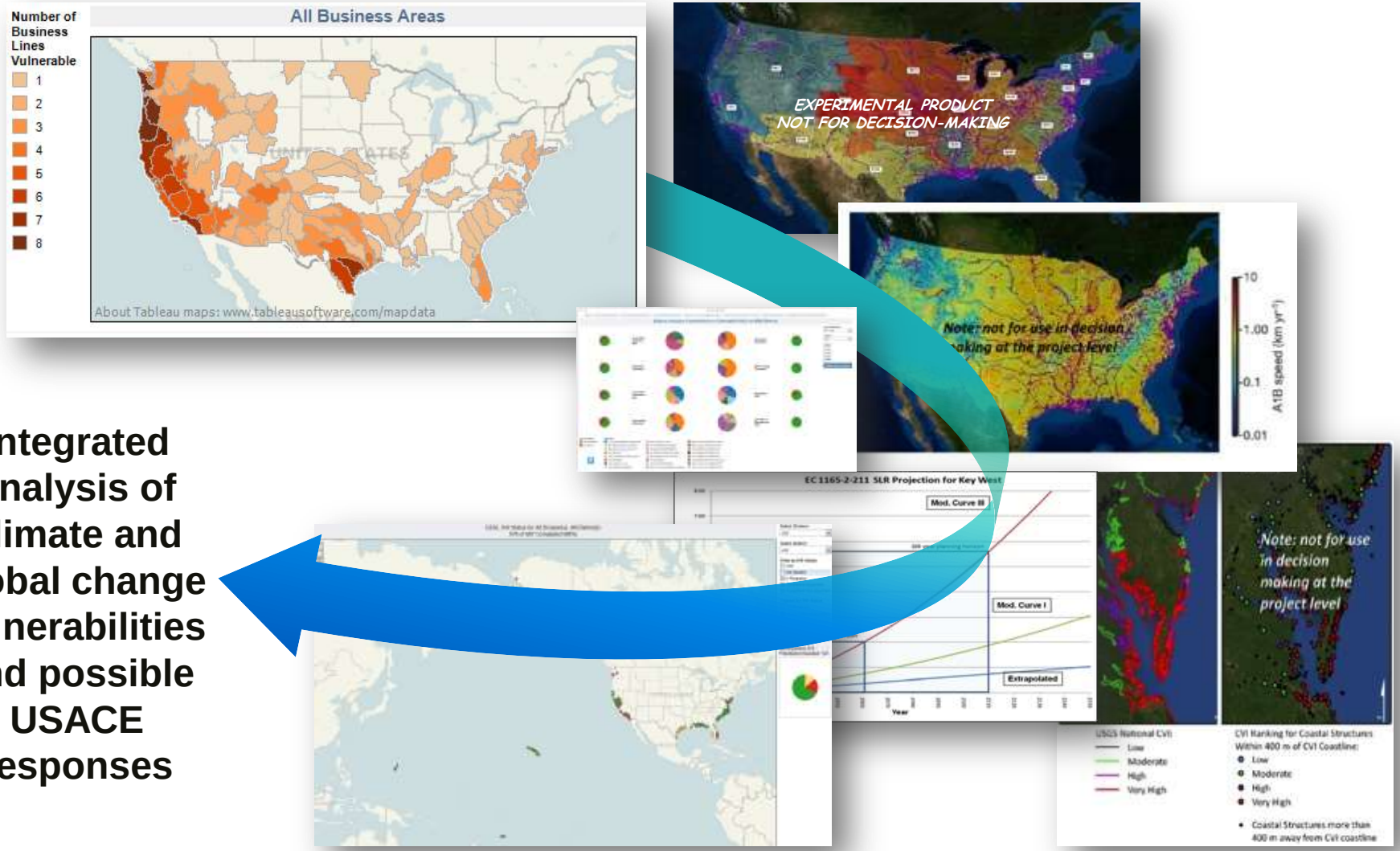
- What do these tools allow us to do?
  - Explore the vulnerability of a given business line or HUC at a screening level
  - Develop a relative sense of particular vulnerabilities to climate change, relative to other regions or business lines
  - Obtain an indication of the trend in climate vulnerability over time for the specific indicators and as grouped in business lines

- Assessments using these tools will help identify and characterize specific climate threats and particular sensitivities or vulnerabilities, at least in a relative sense, across regions or business lines

- The screening-level analysis helps to narrow the scope of additional more detailed analyses required for considering adaptation measures

Background slides

Where Are We Headed?



Integrated analysis of climate and global change vulnerabilities and possible USACE responses

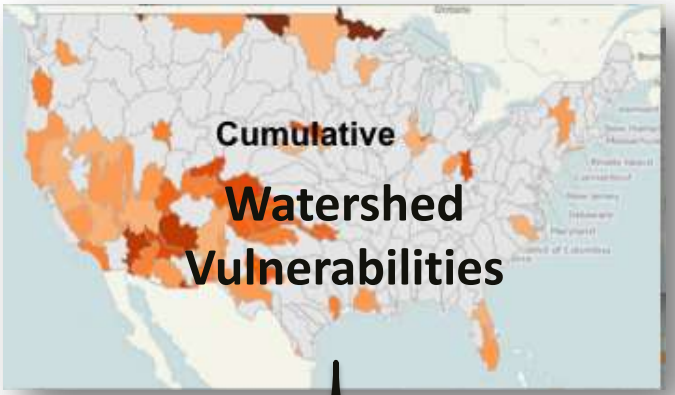
Vulnerability Assessments are a Piece of the Adaptation Puzzle

- Begin with a comprehensive look at missions and operations
  - To identify a set of decisions at the scale of the assessment which could be sensitive to specific climate threats
  - To produce, gather, and select climate change information relevant to those decisions
  - To develop policy and guidance that supports mainstreaming and implementation of climate change adaptation measures
- Identify risks to the federal water resources investment so that actions to improve resilience and decrease vulnerabilities can be targeted
  - Tiered approach to find thresholds and tipping points
  - Climate and hydrologic extremes, increased frequency of events, and cumulative climate effects are important factors
- Communicate user needs guide and shape science
- Collaboration is key

20

Current Status – Phase II (FY12-14)

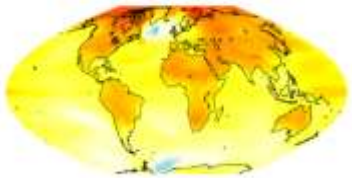
Two 30-yr epochs of analysis centered on 2050 and 2085



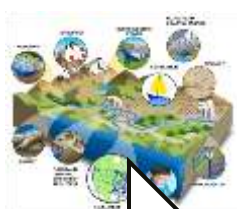
Wet (10% exceedance) and dry (90% exceedance) for each HUC

100 combinations of models and scenarios

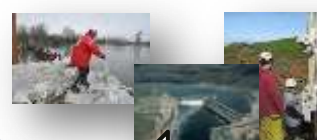
Projected Future Climate Information
Improvement in Climate Science Information



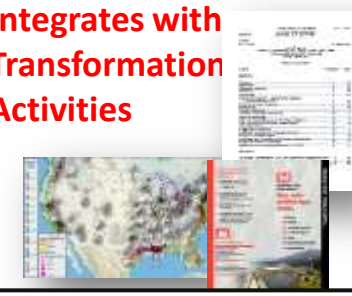
Future Watershed Response Functions
Updated Evaluation of Watershed Response in each HUC



What are Business Lines/Functional Areas Sensitive To
Improvement in Sensitivity (USACE)



Aggregating Data Between/Across Business Lines
Integrates with Transformation Activities



Impacts

Perform Screening-Level Vulnerability Assessments

Sensitivities

USACE CLIMATE CHANGE ADAPTATION STEERING COMMITTEE
Draft only, not for distribution
21

What's at Risk? What Are the Threats? How To Indicate Them?

Review of Literature
Literature sources from 1998-present related to environmental indicators and climate change were reviewed.

Identification of Indicators
A list of indicators identified in the literature was compiled.

593

Determination of Exposure & Sensitivity Factors
Exposure and Sensitivity factors determined for each USACE management area.

Selection of Indicators for Key Management Areas
Indicators selected based on relevance to E and S factors for each of USACE's eight management areas.

74

Determination of Data Availability
Indicators were evaluated to determine whether they had readily available and complete national-scale data sets.

Resultant Indicator Selection by Business Line
Indicators determined to have adequate data were selected for USACE's management areas*.

Flood Risk	Navigation
Ecosys. Restoration	Hydropower
Recreation	Regulatory
Emergency Mgmt	Water Supply

*A single indicator could be selected for more than one management area.

29

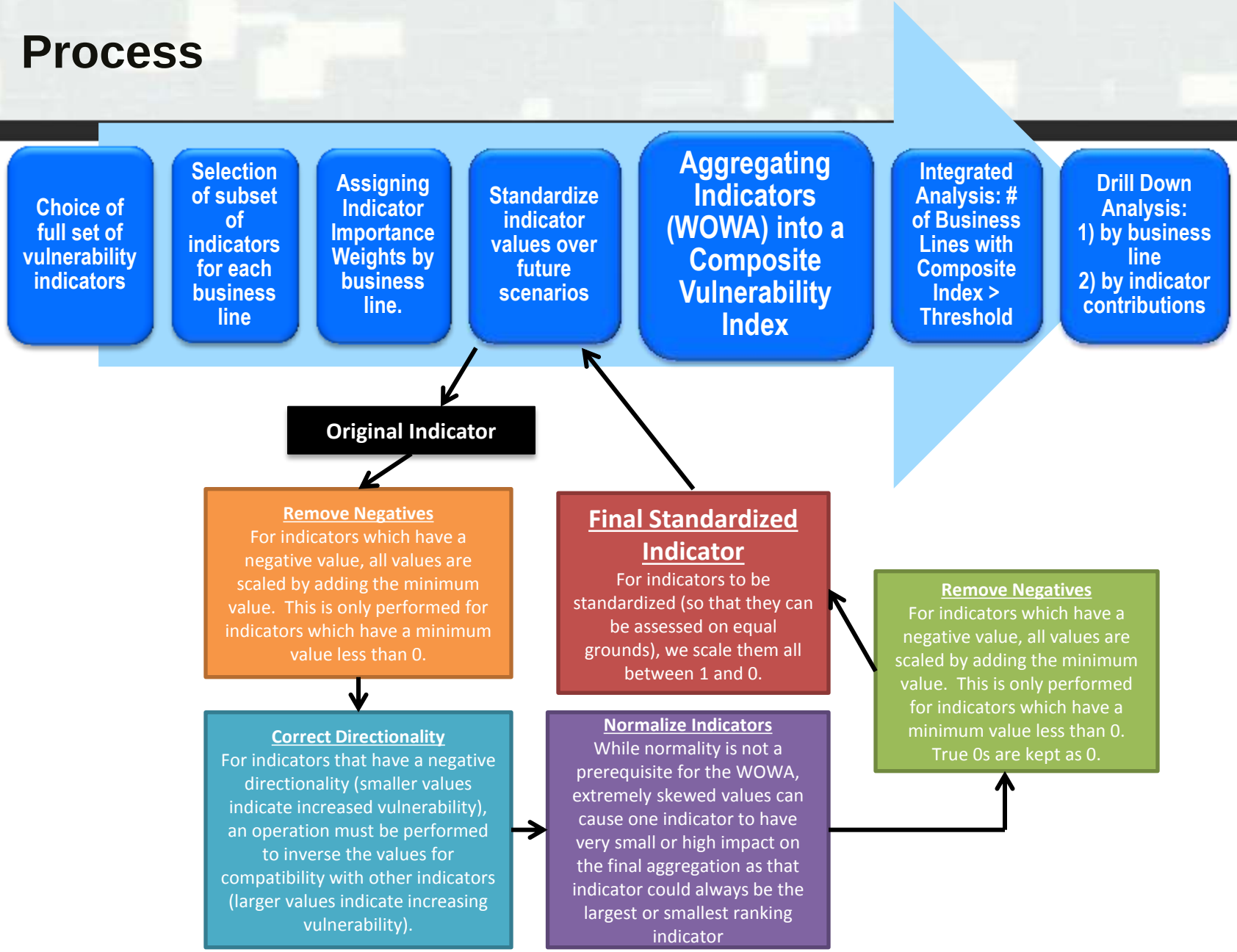
Hydropower	
Sensitivity Factors	**Exposure Factors**
Reliable production of electricity Quantity of power	Peak Q and sediment Minimum rate of Q and sediment Flow duration Timing of Q and sediment Change in above factors (peak, minimum rate, and timing of Q and sediment, and flow duration) Delta frequency

List of ALL Available Indicators for Business Line: Hydropower (Selected)

95_DROUGHT
156_SEDIMENT
175C_ANNUAL_COV
221C_MONTHLY_COV
277_STREAMFLOW_PRECIP
568C_FLOOD_MAGNIFICATION
568L_FLOOD_MAGNIFICATION
700C_LOW_FLOW_REDUCTION

Draft only, not for dissemination

Process



Draft only, not for dissemination

23

Next Steps

- Make tool suite available with the initial default settings across the country to obtain consistent and comparable baseline
- Work with BL/FA/MSC teams to evaluate use of different, more, or fewer indicators, effects of different weighting and tradeoff schemes, and interpretation of results
- Continue automation/visualization process
- Submit and publish journal papers on method to lay groundwork for scientific and legal credibility
- Work with PDTs to consider how climate vulnerability screening information is being used