Extreme Weather Research Overview & Coordination: On-going Research Projects

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U.S. Environmental Protection Agency (EPA)
Office of Research and Development (ORD)

Chesapeake Bay Program (CBP):
Modeling Workgroup and Climate Resilience Workgroup
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Coordinating Research Efforts on Urban Stormwater Planning and Extreme Weather

- Both CBP and ORD currently conducting research on intensity duration frequency (IDF) curves for urban stormwater planning needs
  - ORD researchers: Tom Johnson, Tanya Spero, Anna Jalowska, Colleen Barr, and Jason Bernagros
    - National Stormwater Calculator (SWC) historical and extreme weather updates
    - Using dynamically modeled meteorology and climate to generate future IDF curves
    - IDF Curves for Precipitation and Runoff under Future Climate: Efficient Statistical Generation Approach

- Sharing potential overlapping research efforts from ORD with the CBP

National Screening of Potential Future Precipitation Effects on Stormwater Runoff and BMP Sizing

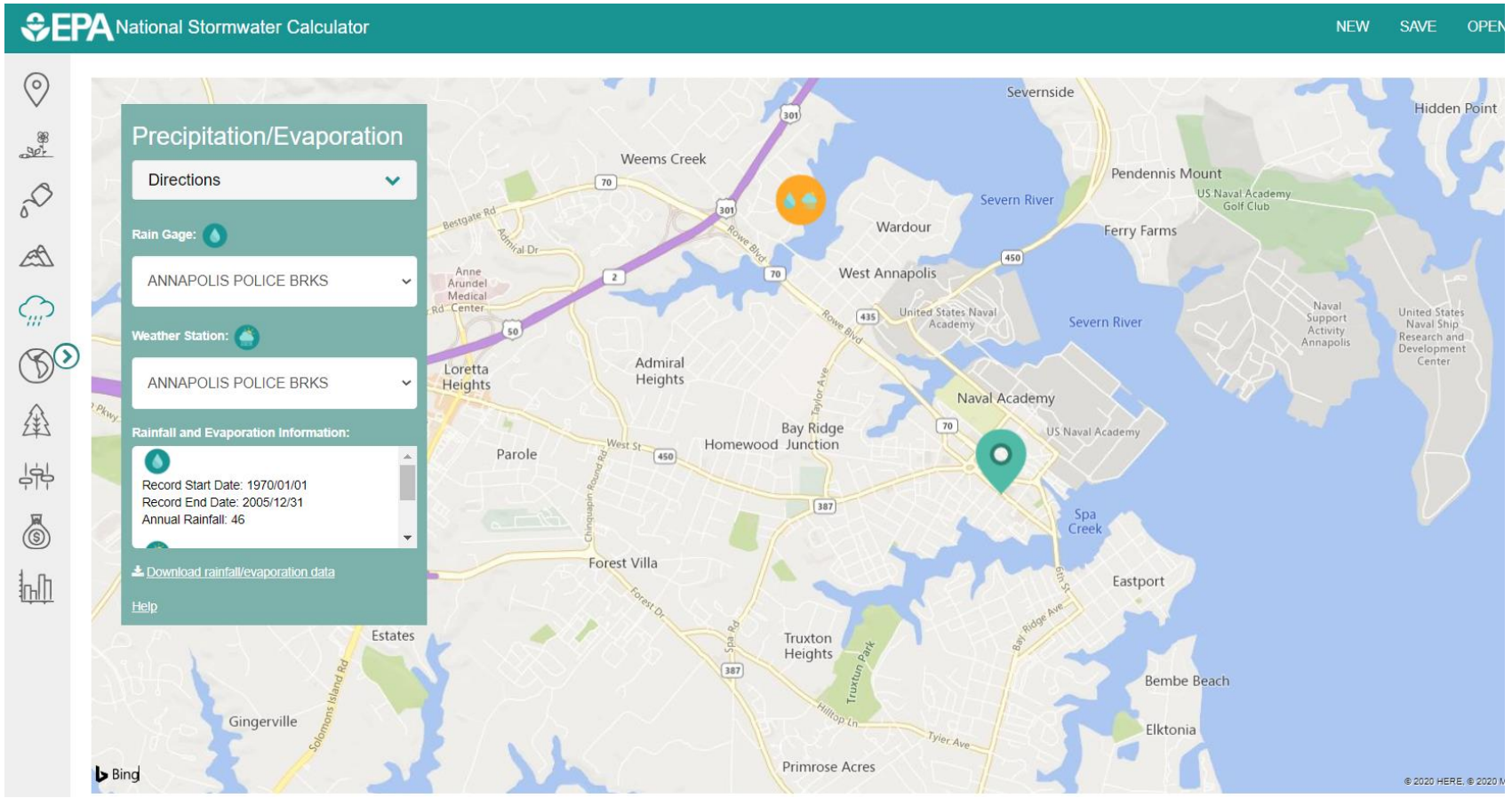
- Based on design storms – statistical approach to update NOAA Atlas 14 precip IDF curves to represent projected future changes
  - Use modeled changes in the cumulative distribution of storm events to adjust the extreme value fit used in Atlas 14 (equidistant quantile mapping approach)
  - Climate scenarios selected from LOCA downscaled GCM output
  - Mid-century; high/low emissions; median, 10th and 90th percentile GCM

- Use SWMM5 to convert rainfall to runoff and simulate BMP performance

- Scenarios identify range of futures to which adaptation may be needed

SWC Weather Data Updates

- Currently rely on EPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) historical weather.
- Data goes back approximately 30 years from 2006/2009.
- Provides hourly rainfall and daily potential evaporation.



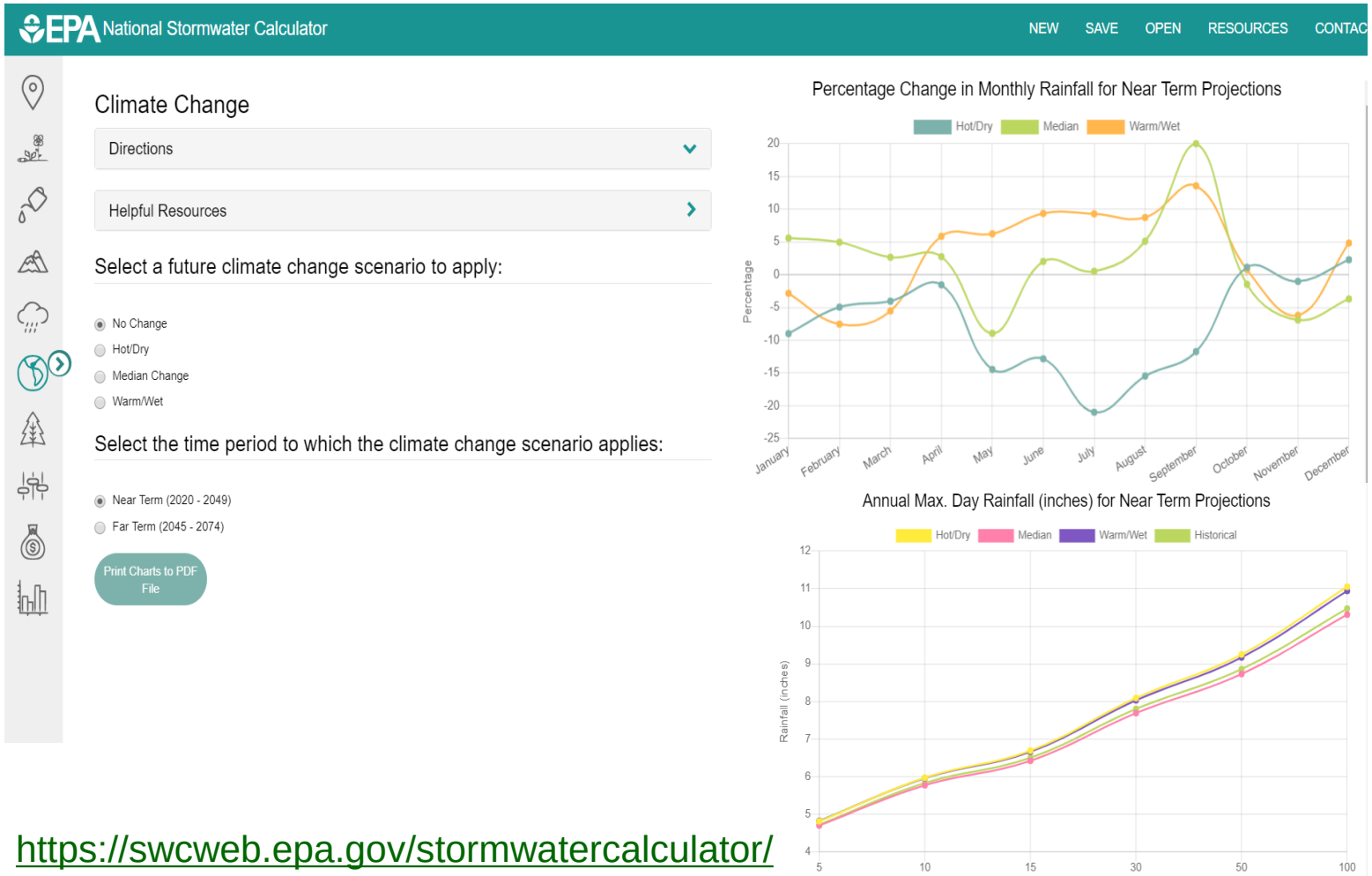
SWC Weather Data Updates

- Actively researching and updating historical weather data using NOAA's Integrated Surface Database (ISD) and Hourly Precipitation Dataset:
  - Data going back 20 years to as recent as 1 week old
  - Focusing on station data from principal airports and National Weather Service (NWS) Cooperative Observer Program (COOP)
  - Allow users of the SWC to have easy access to recent historical weather data, that will be annually updated by EPA

- Expect to conduct user testing in 2020 and finalize historical weather update research in 2021

Updates to Extreme Weather in the SWC

- Currently rely on extreme weather data from Climate Resilience Evaluation and Awareness Tool (CREAT) 2.0 from 2013
- CREAT 2.0 climate change scenario is applied to the user selected BASINS weather station (percent change in rainfall and temperature)
- Extreme 24-hour design storms (5 to 100-year storm) computed from CREAT 2.0



https://swcweb.epa.gov/stormwatercalculator/

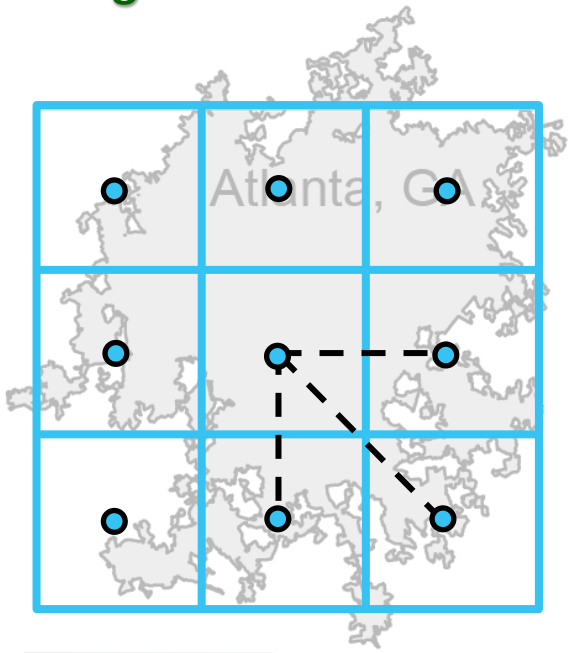
Updates to Extreme Weather in the SWC

- Researching best recent and available technical options/approaches for updating existing and projected IDF curves data for use within the SWC and SWMM
- Updated extreme weather data in the SWC will be applied to the annually updated historical weather data
- Expecting to conduct user testing of the extreme weather update for the SWC in 2021

PIDF Curves From Gridded Data - a Proof of Concept

OBSERVED DATA

- Extensive analysis of NOAA Atlas14 methodology and NCEI datasets
- Reproduced NOAA Atlas14 methodology and adapted it to gridded/modeled data

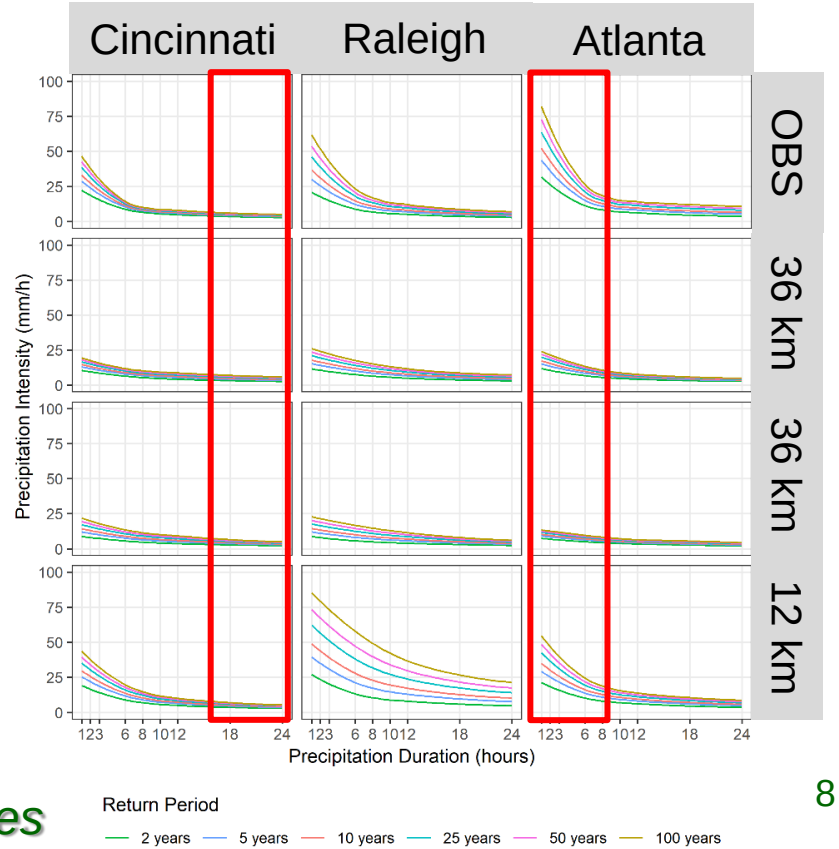


METHODOLOGY

Best results with data aggregated using the Inverse Distance Weighting (IDW) method (RFA and other methods tested)

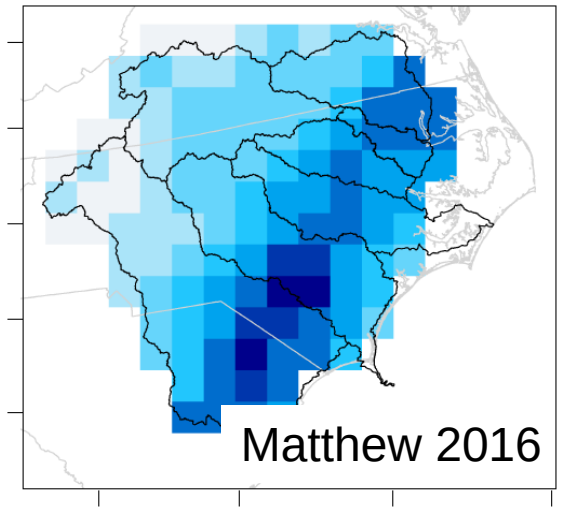
MODEL RESOLUTION

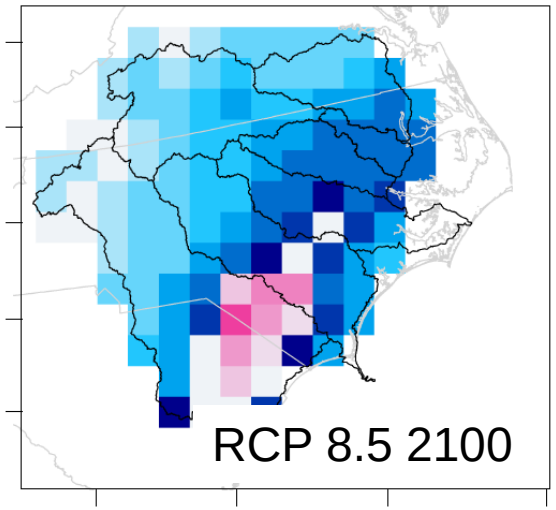
- 36km grid spacing is not sufficient to reproduce sub daily data but can be used for daily extreme precipitation.
- 12km grid spacing was able to resolve sub-daily information.



Jalowska & Spero (2019), JGR Atmospheres

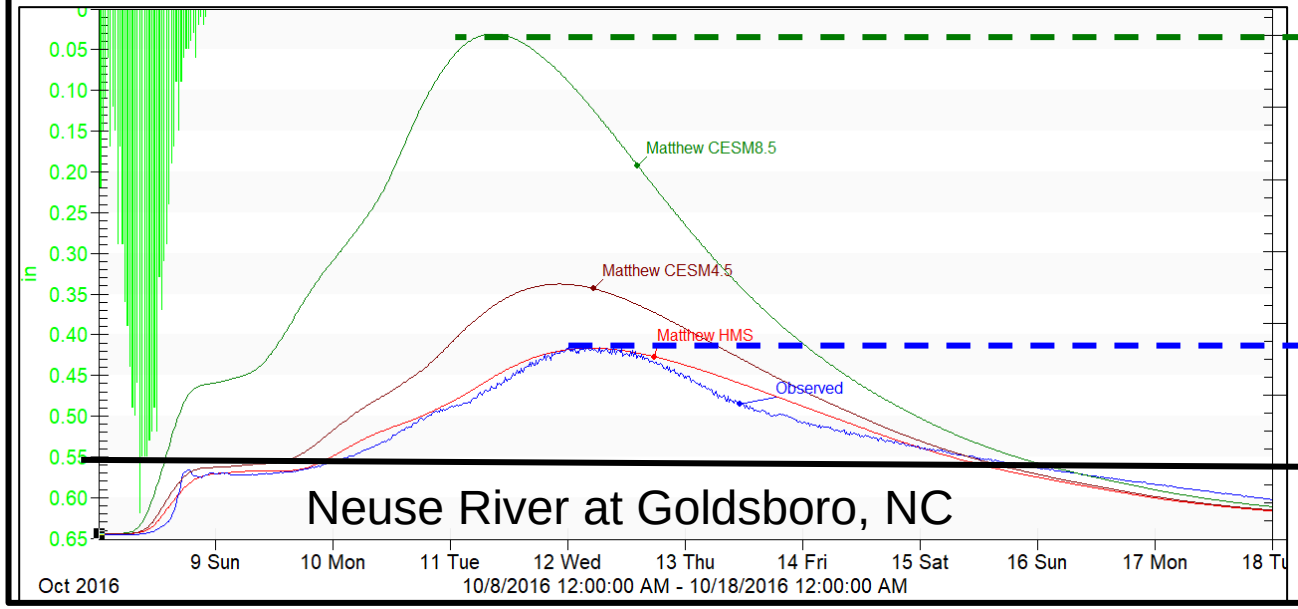
Future Projected Rainfall From Tropical Cyclones





- Developed 24-, 72- and 96-hour PIDF curves from future projected rainfall data under three scenarios from 36-km domain
- Calculated the change (delta method & designed rainfall approach) in the future PIDF curves and applied it to a gridded observed data for three tropical cyclones over Eastern NC

Jalowska et al., submitted



Neuse River at Goldsboro, NC

CESM8.5 = 3,964 cms
6x MF

Matthew = 1,512 cms
2.3x MF

Major Flood (MF)
= 651 cms

Used generated rainfall data to produce runoff and stream flow from future tropical cyclone in the Neuse River Basin

Jalowska et al., in prep

Next Steps

- 12 km extended North America + Puerto Rico domain for CESM 8.5
- Extended historical period: 1975-2005
- Future: 2025-2100

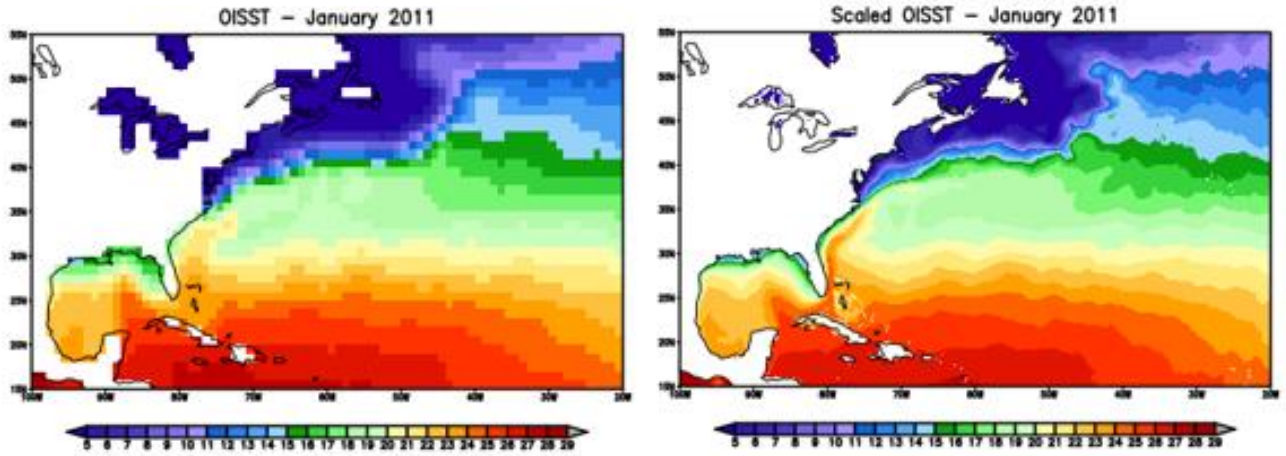


Figure credit Jared Bowden

- Updated sea surface and lake temperatures
- Updated WRF version
- Updated modeling options and newer science

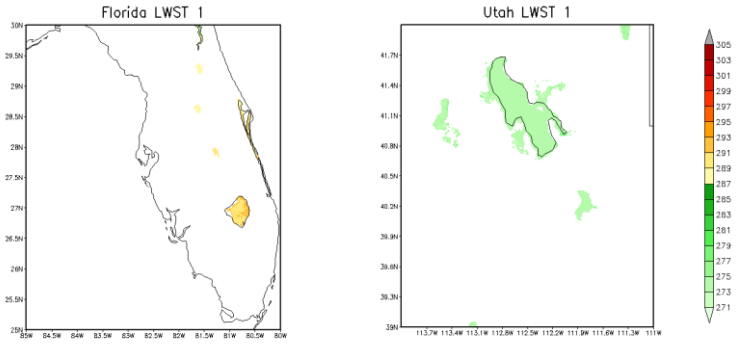


Figure credit Jared Bowden

Discussion: Q & A

- Shared or common research interests?
- Sharing relevant information for on-going research efforts
- Exploring ways to coordinate research efforts on extreme weather and stormwater BMP design and planning data and design tools?

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