



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

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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, 10<sup>th</sup> 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.

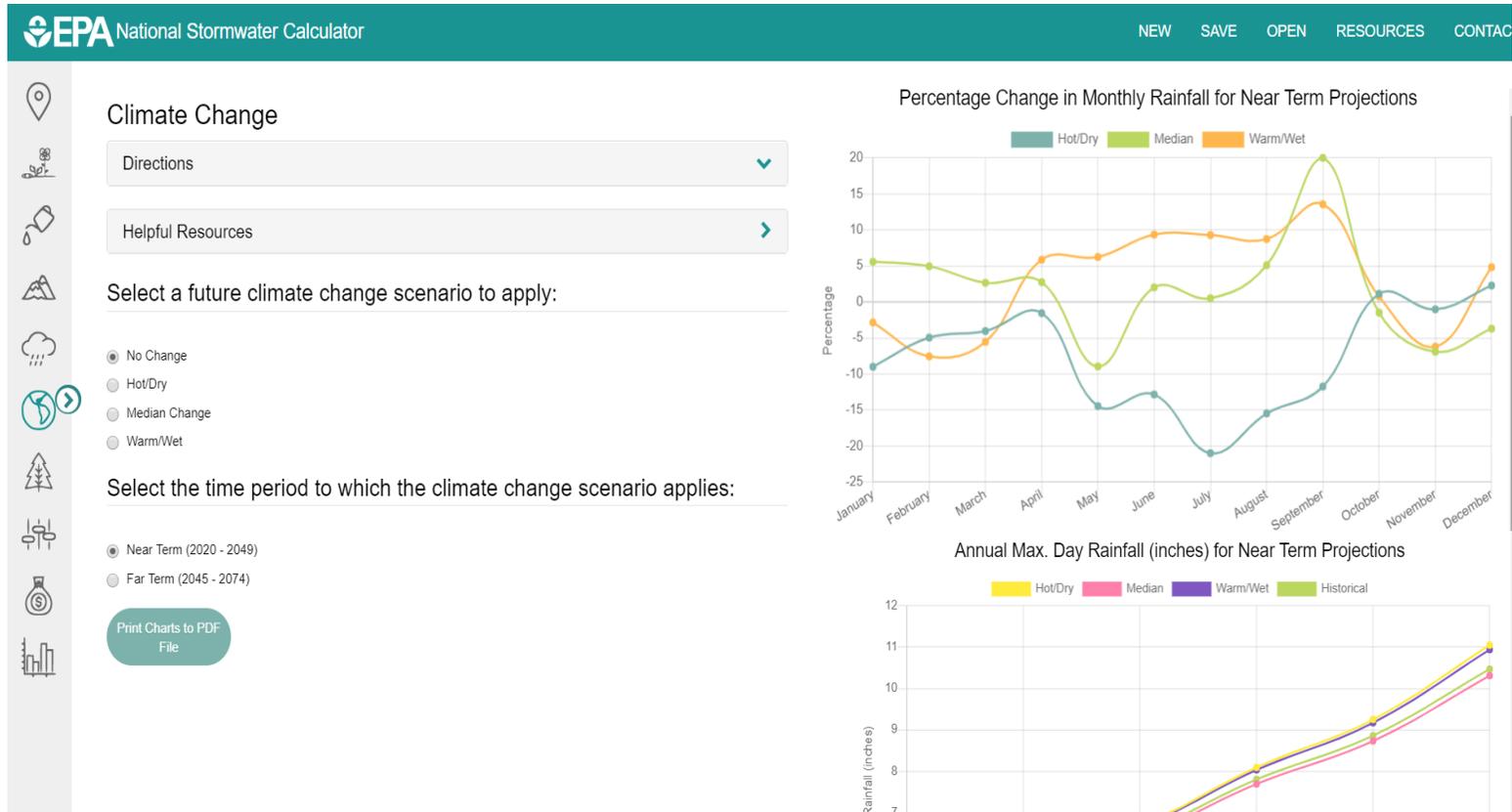
The screenshot displays the EPA National Stormwater Calculator interface. The top navigation bar includes the EPA logo, the text "National Stormwater Calculator", and buttons for "NEW", "SAVE", and "OPEN". A vertical sidebar on the left contains various icons for different data sources and tools. The main map area shows a geographic view of Annapolis, Maryland, with a green location pin and an orange weather icon. A data panel is overlaid on the map, titled "Precipitation/Evaporation". It includes a "Directions" dropdown menu, a "Rain Gage" dropdown menu set to "ANNAPOLIS POLICE BRKS", and a "Weather Station" dropdown menu also set to "ANNAPOLIS POLICE BRKS". Below these, the "Rainfall and Evaporation Information" section displays: "Record Start Date: 1970/01/01", "Record End Date: 2005/12/31", and "Annual Rainfall: 46". A "Download rainfall/evaporation data" link and a "Help" link are also visible. The map background shows streets, water bodies, and various landmarks like the Naval Academy and US Naval Academy Golf Club.

# 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

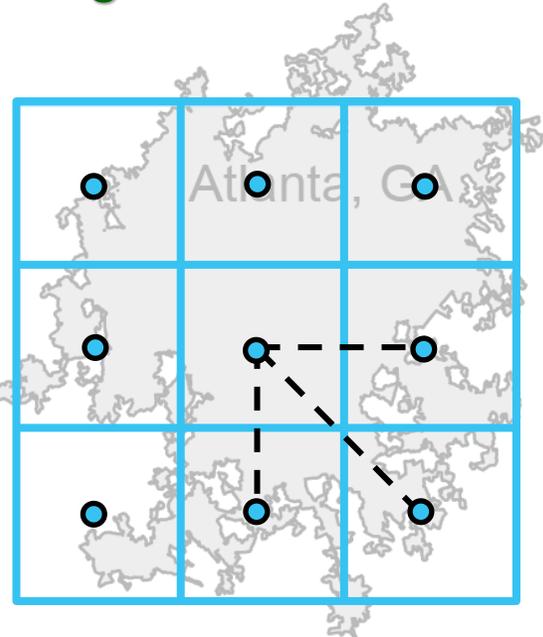
## - a Proof of Concept

### MODEL RESOLUTION

#### OBSERVED DATA

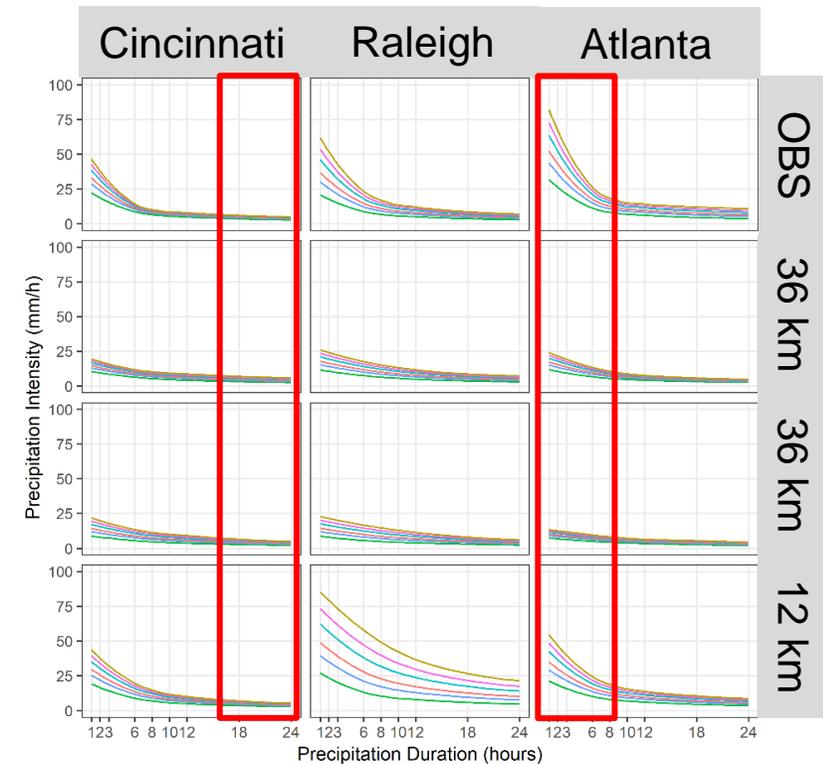
- Extensive analysis of NOAA Atlas14 methodology and NCEI datasets
- Reproduced NOAA Atlas14 methodology and adapted it to gridded/modeled data

- 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.



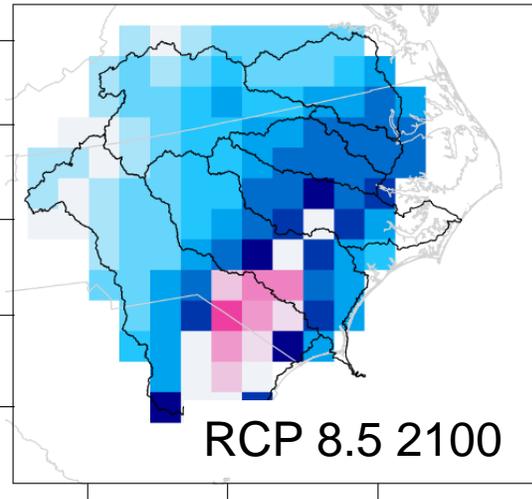
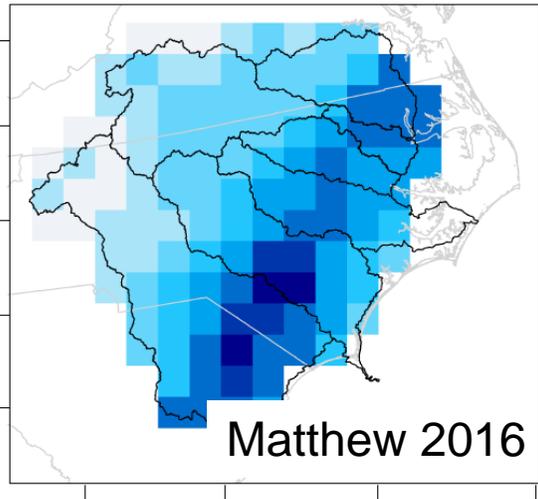
#### METHODOLOGY

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



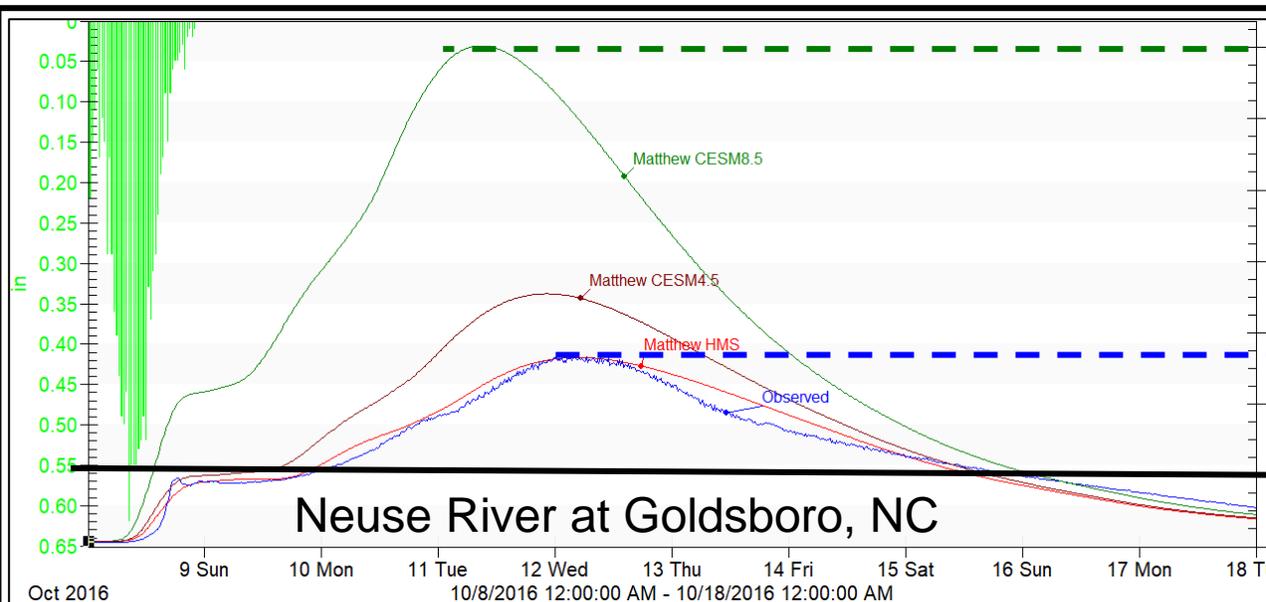
0 12 36 km

# 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*



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

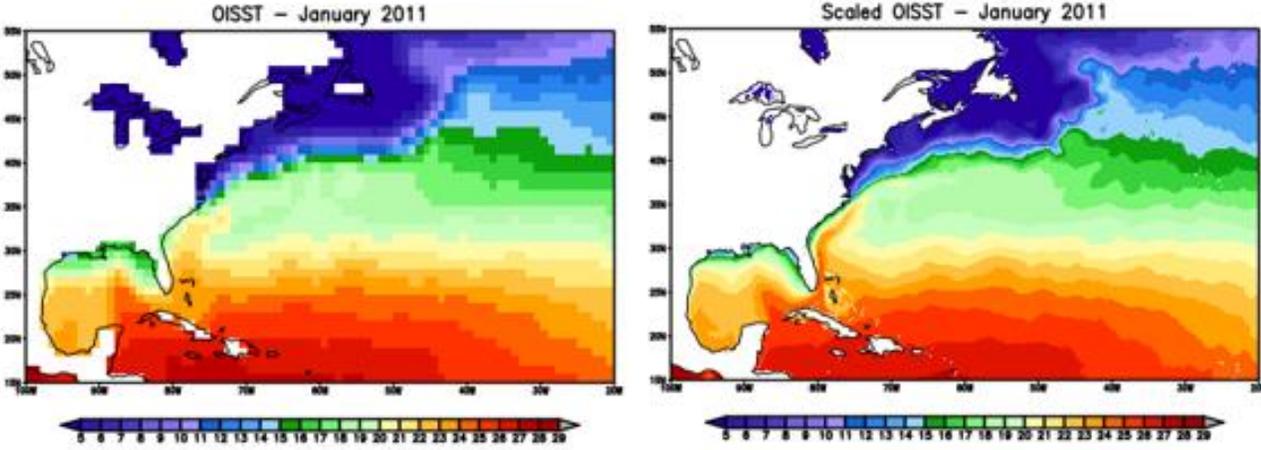
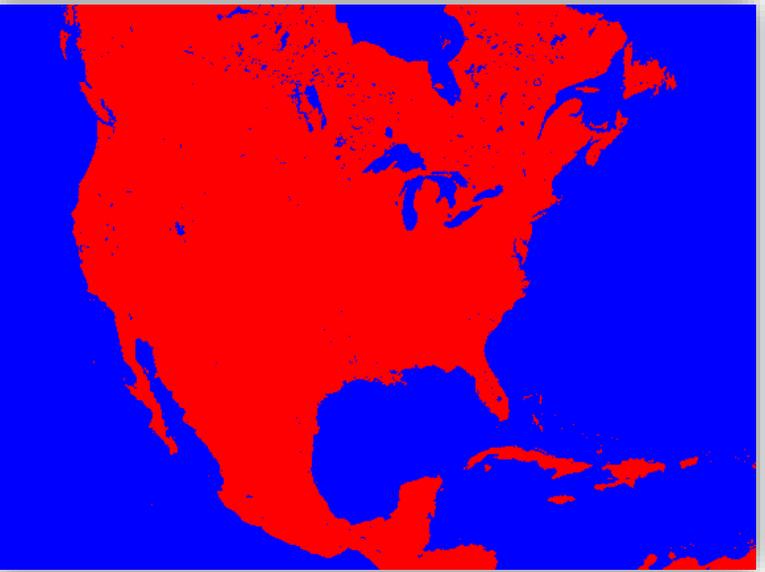


Figure credit Jared Bowden



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

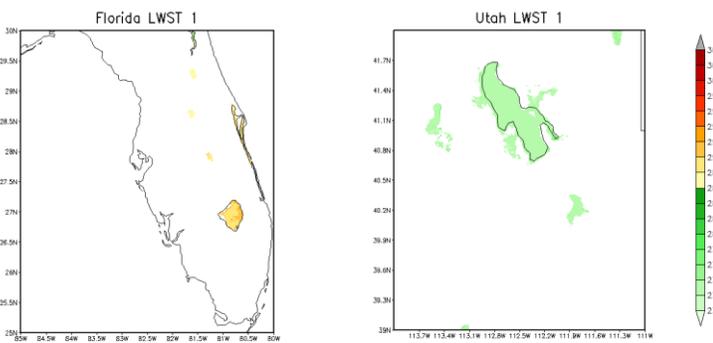


Figure credit Jared Bowden

## 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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