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Presents

A Pre-Conference Workshop

Technology for a Connected Triangle+
Designing the Use Cases

Welcome to the Triangle Region of N.C.



SMART CITIES
CONNECT
SPRING CONFERENCE & EXPO

Connected Triangle+ Workshop

Thank You to Our Sponsor



Bryan Johns, Senior Consultant

Laurie Okun, Business Solutions Connector/Strategic Accounts

Casey Overman, Data Architecture and ML Analytics

Greg Blair, Visual Analytics



Raleigh



Connected Triangle+

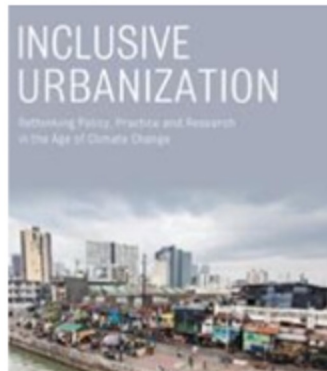
- Precursor: IDC Award-Winning Stormwater Data Sharing Project (2020)
- Established Project Charter, Regional MOU, Data Rights Agreement, Data Architecture Agreement (All Opt-in)
- Current Effort: Regional convening with CIOs & stakeholders since Nov 2023
- Exploring data sharing models and use cases
- Inputs for Today's Workshop:
 - Strategic Plans from all communities in Durham, Orange, and Wake Counties
 - Advising from committee of regional Sustainability Leaders
 - Inputs from Triangle+ group on sustainability-related data already being collected, and "wishlist" data

Urban Microscale Weather and Climate Modeling for City / Regional Intelligence Supporting Sustainability

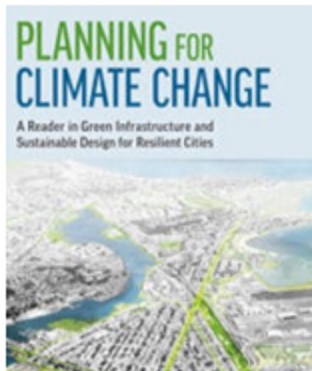
Mike Robinson

*Senior Principal Engineer
The MITRE Corporation*

Challenges Motivating our Effort



Shrestha, et al. 2015



Hamlin Infield, Abunnasr, Ryan 2019

This “climate change/urban development intersection” and its associated vulnerabilities in cities **are not readily understood at needed spatial scales (“meters, not kilometers”)** – as these vulnerabilities may vary hour by hour, day by day, day after day.....

FOCUS

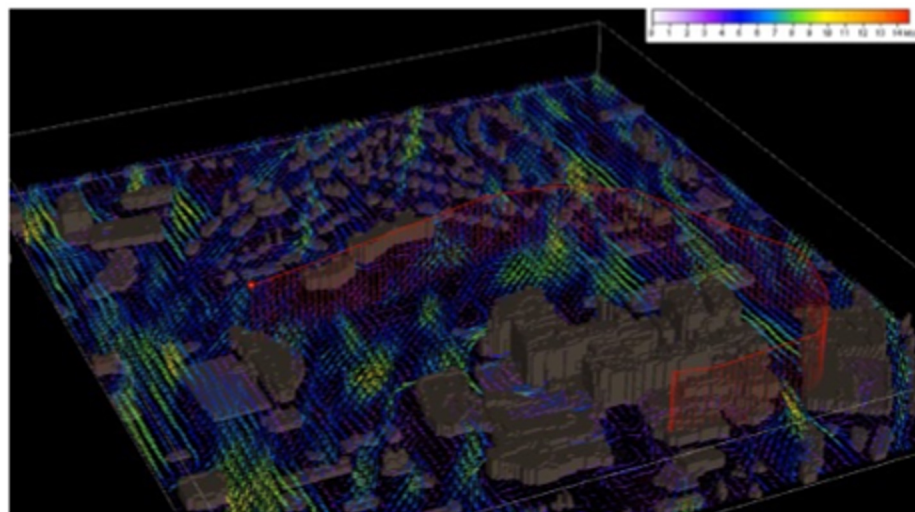
- **WITHIN** and **THROUGHOUT** cities, can we help stakeholders and citizens assess climate and environmental impacts on:
 - Public health?
 - (Building) energy needs?
 - Urban aviation transportation?
- Can we determine this for both current and future climate and urban landscape?
- Can we provide data-driven results, at meter(s) scale, that mitigate societal impacts?
- Can we provide this data, day after day, to be integrated with city / regional plans, strategies, data, and services for climate action, sustainability, and equity / environmental justice

Enabling Technology: Urban-Suburban, Fast-time Microscale Weather Model

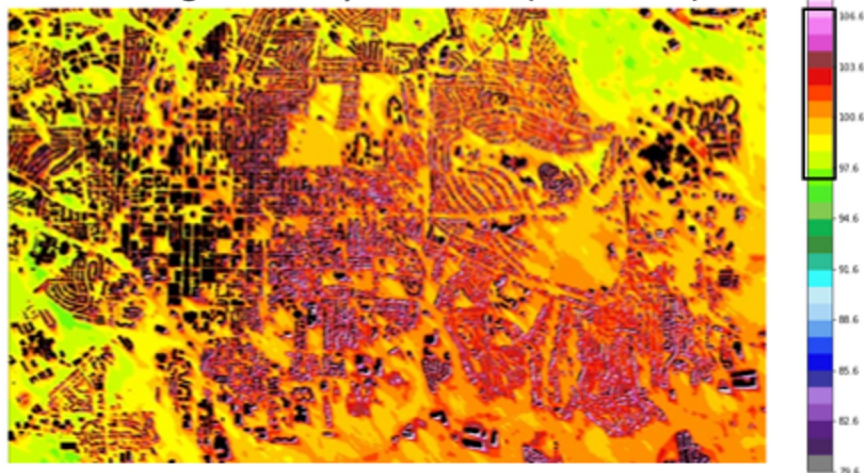
Extensively Validated

Publications: Schalkwijk et al. *BAMS* 2012
Schalkwijk et al. *MWR* 2015
Schalkwijk et al. *BAMS* 2015
Schalkwijk et al. *BLM* 2016
Robinson et al. *AIAA* 2020
Bieringer et al. *Atmos* 2021
Pettegrew et al. *AMS Conf* 2023

- Application of Aeris Rapid Microscale Weather Forecasting System
 - Joint Outdoor-indoor Urban Large Eddy Simulation (JOULES) model
 - Full physics atmospheric model
 - Meter scale spatial resolutions
 - Implemented to run on GPU – very fast (faster than real-time calculations)



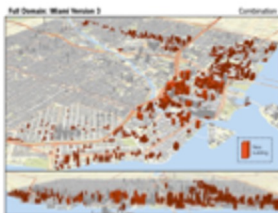
Raleigh NC – July Afternoon (NW Winds)



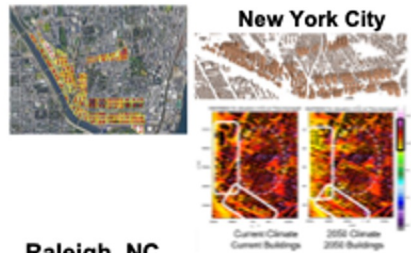
Sample Micro-Weather and Heat Stress Applications – Tested with Cities

“What-If” Urban Scenarios Today vs Future Impacts

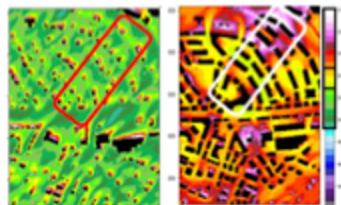
Miami, FL



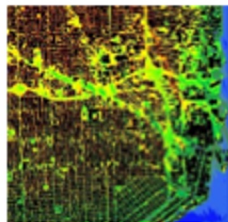
New York City



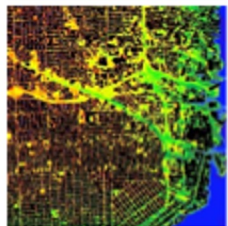
Raleigh, NC



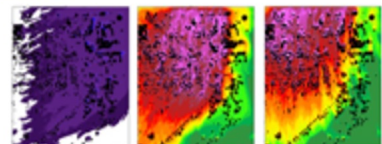
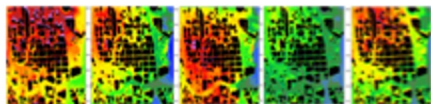
Comprehensive, Hyperlocal Heat Stress Awareness, Alerting



13 Jul 2022



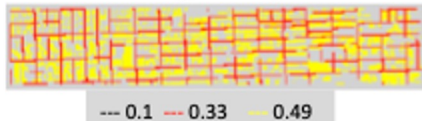
19 Aug 2022



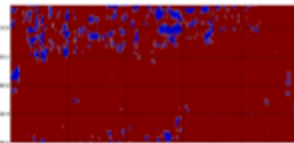
Modeling Heat Mitigations given Increased Albedo, Tree Canopy



Varied Reflectance, Streets and Building Rooftops



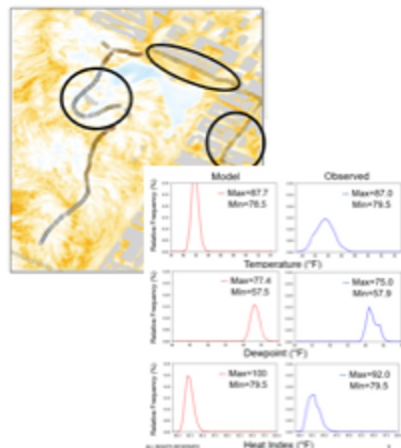
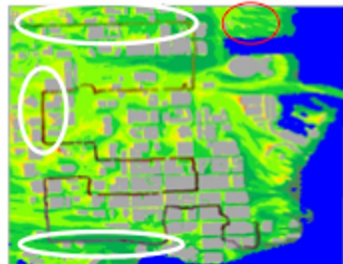
Reduced Heating, Temp under Tree Canopies



Reduced Heat Index, Trees + Mitigations



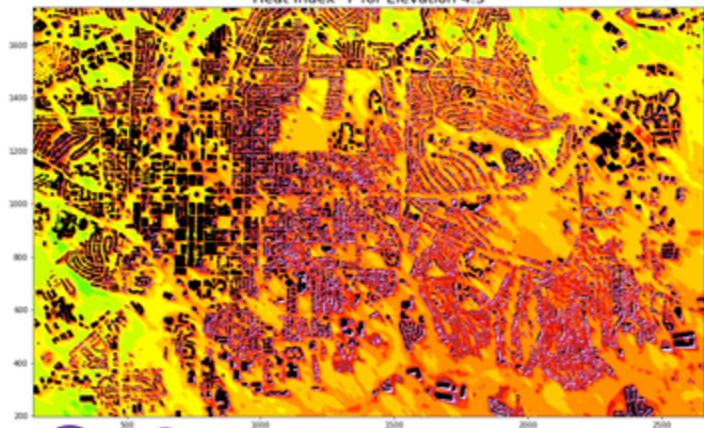
Microscale Weather Model Validation



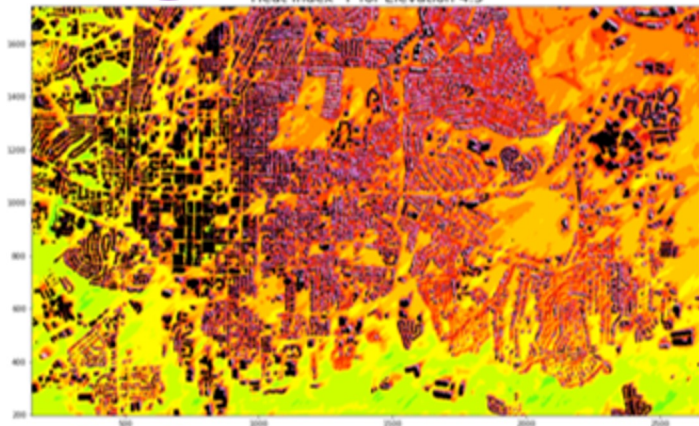
Micro-Weather and Climate Simulations – Raleigh, NC (3-m)



RDU/ Full Domain/ 18UTC/ NW15
Build: 2020 V0 & Climate: 2020
Heat Index *F for Elevation 4.5



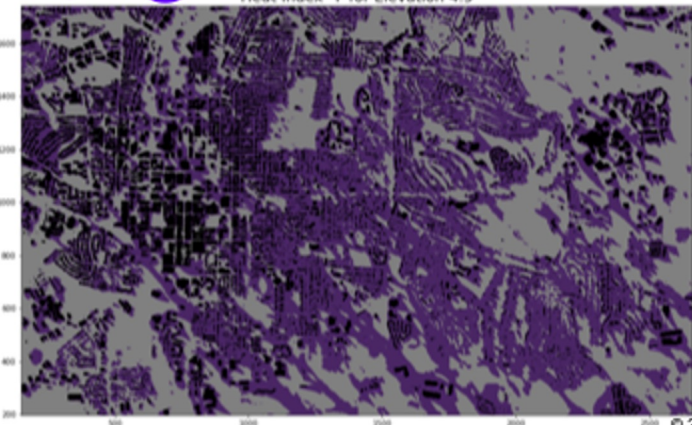
RDU/ Full Domain/ 18UTC/ SW15
Build: 2020 V0 & Climate: 2020
Heat Index *F for Elevation 4.5



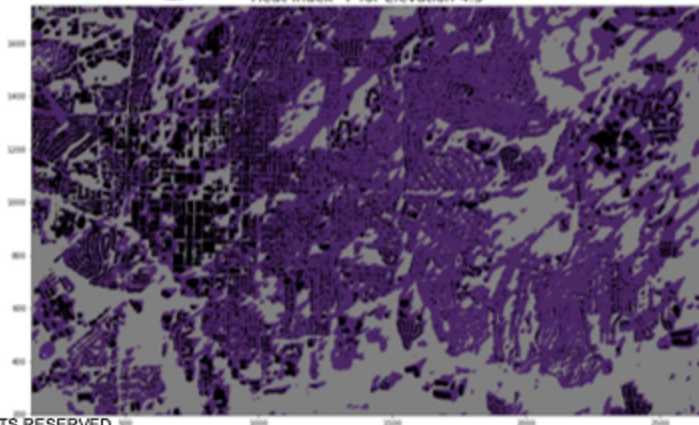
Heat
Index



RDU/ Full Domain/ 12UTC/ NW15
Build: 2020 V0 & Climate: 2020
Heat Index *F for Elevation 4.5



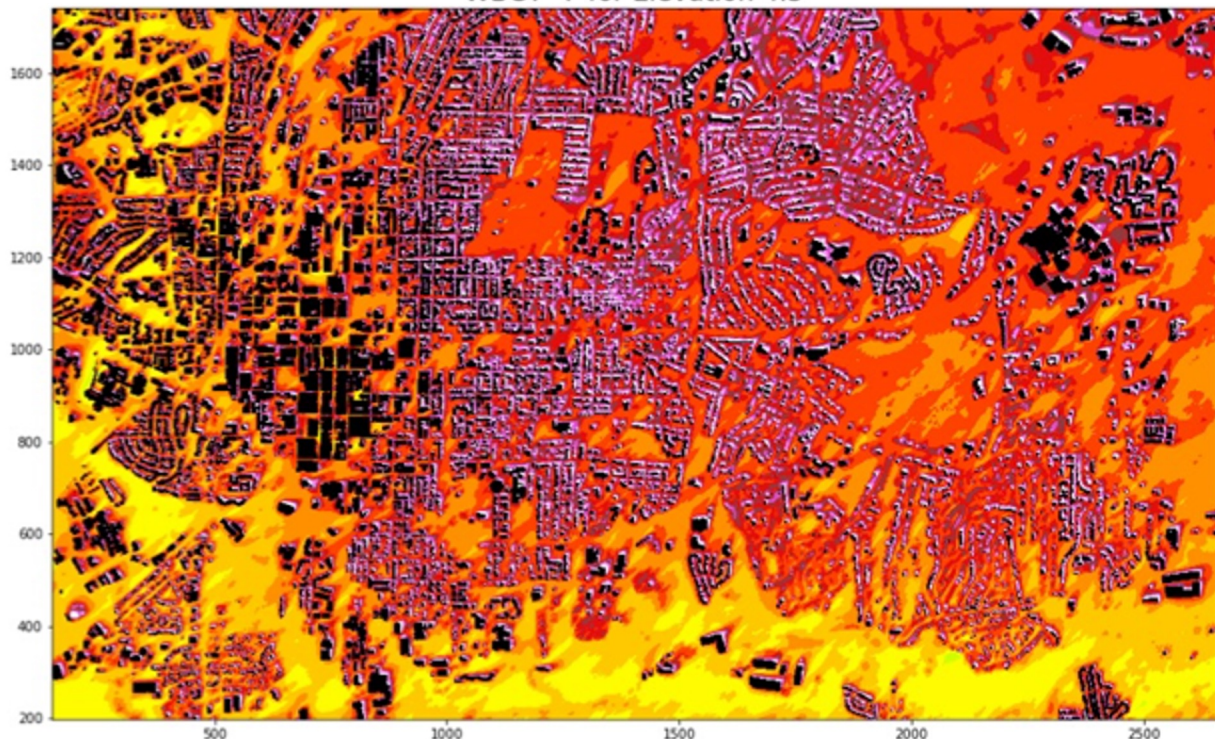
RDU/ Full Domain/ 12UTC/ SW15
Build: 2020 V0 & Climate: 2020
Heat Index *F for Elevation 4.5



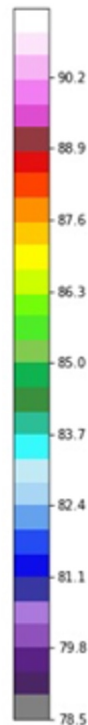
Micro-Weather and Climate Simulations – Raleigh, NC (3-m)



RDU/ Full Domain/ 18UTC/ SW15
Build: 2020 V0 & Climate: 2020
WBGT °F for Elevation 4.5



Wet Bulb Globe Temperature



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Article | Published: 20 April 2023

Increased heat risk in wet climate induced by urban humid heat

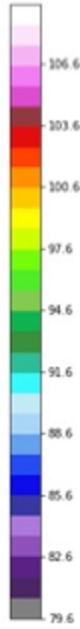
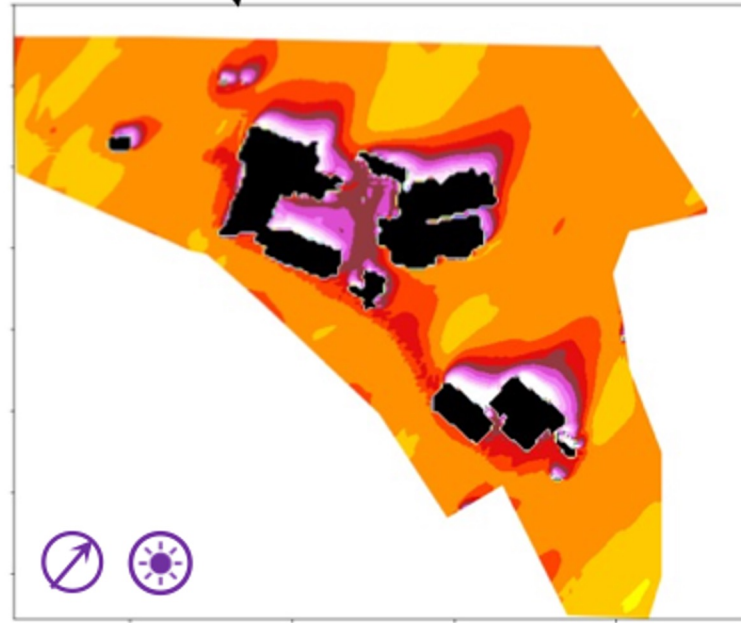
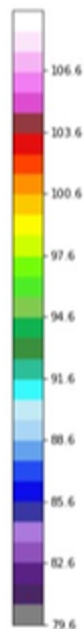
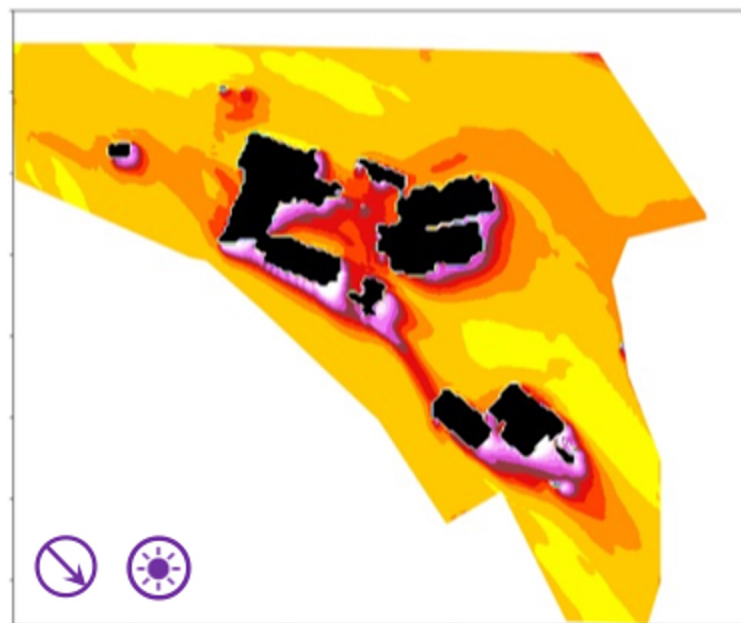
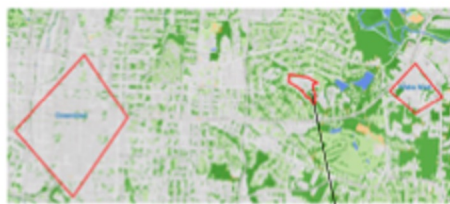
[Xen Zhang](#), [Cheng Cao](#), [Haochen Chu](#), [Lei Zhao](#), [Jiayu Zhao](#) & [Kuhul Lee](#)

Nature **417**, 738–742 (2023) | [View this article](#)

Micro-Weather and Climate Simulations

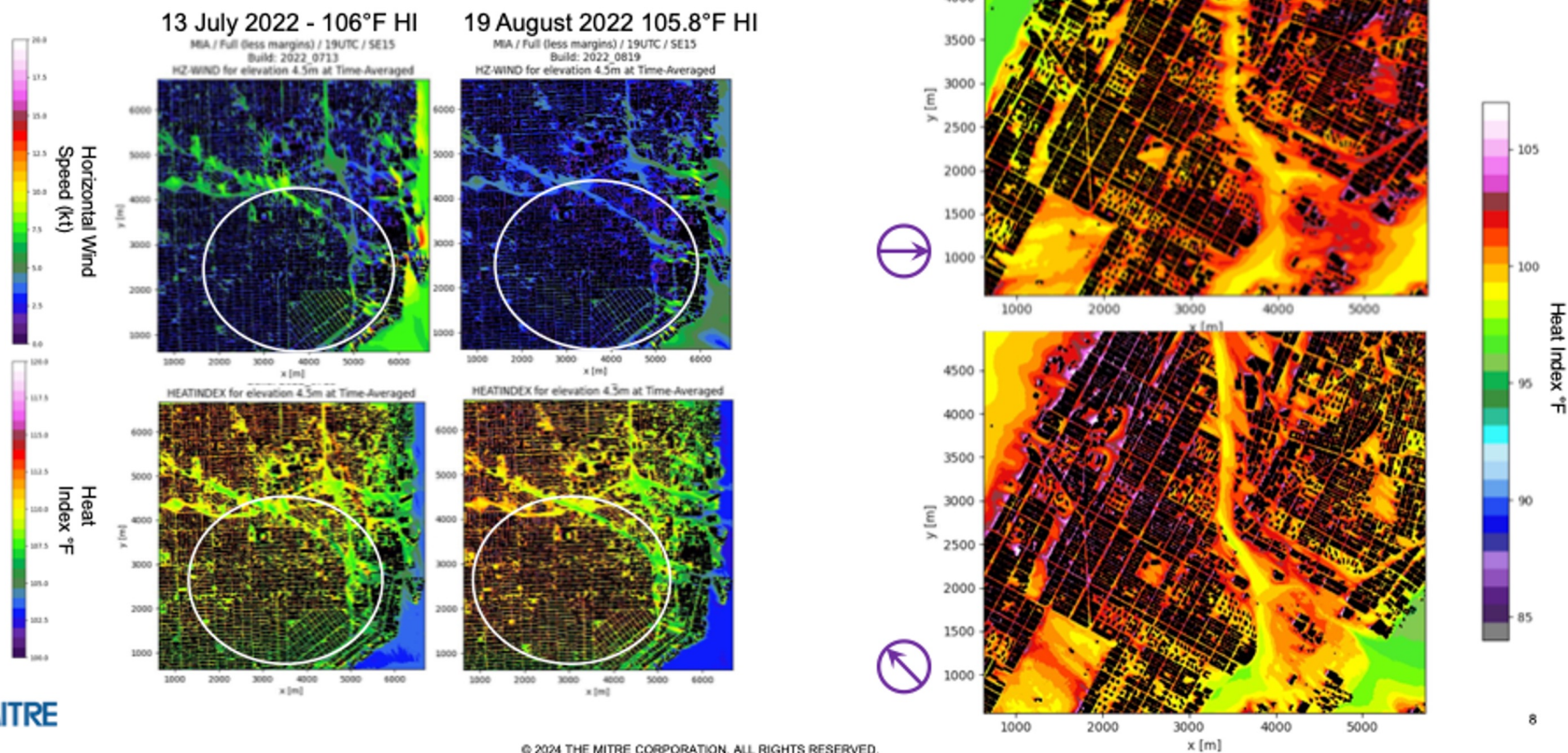
Enloe School, Raleigh, NC

(3-m Resolution)



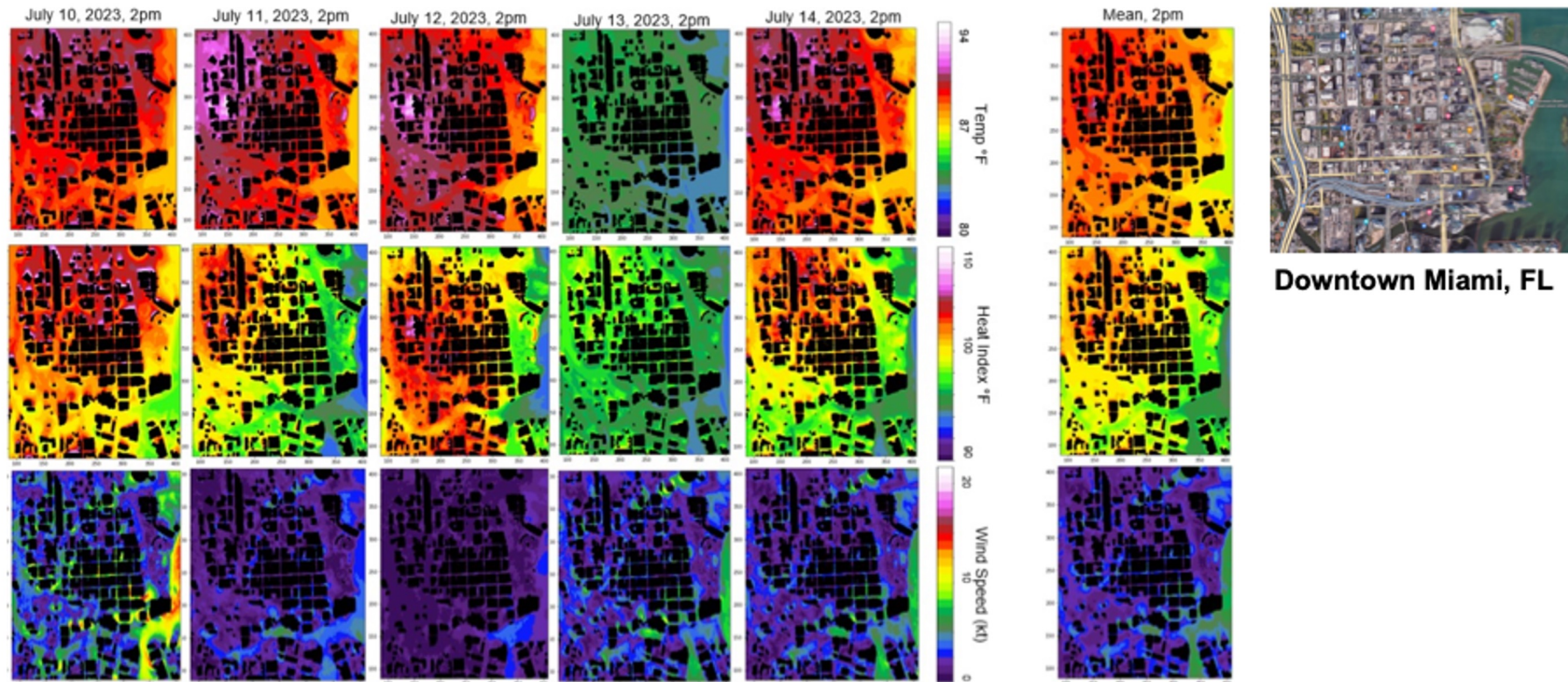
Microscale Model for Hyperlocal Heat Stress Awareness and Urban Heat Island Monitoring through Daily Heat Simulations

Footprints of Hyperlocal Heat May Vary Significantly, Day-to-Day



Microscale Model for Hyperlocal Heat Stress Awareness and Urban Heat Island Monitoring through Daily Heat Simulations

Continuous Microscale Modeling of Daily / Hourly Heat Conditions Across City – Urban Heat Island Across a Week



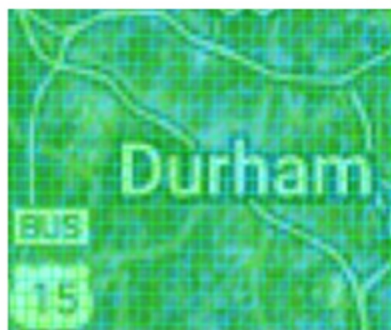
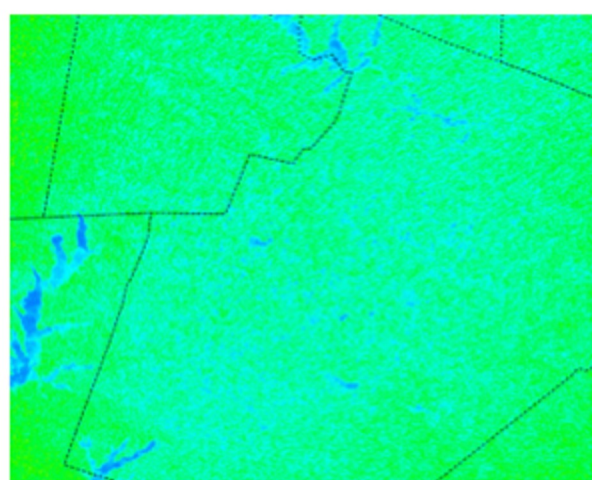
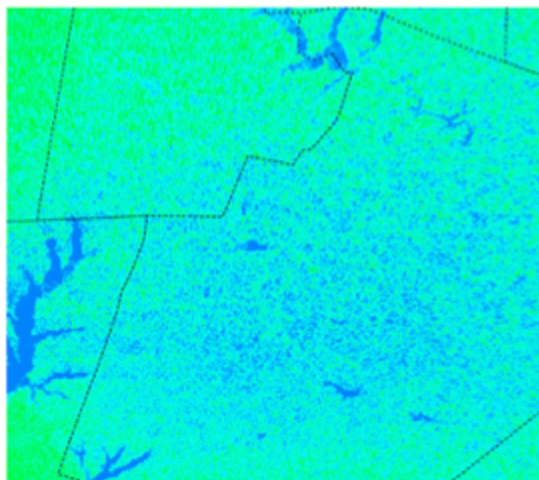
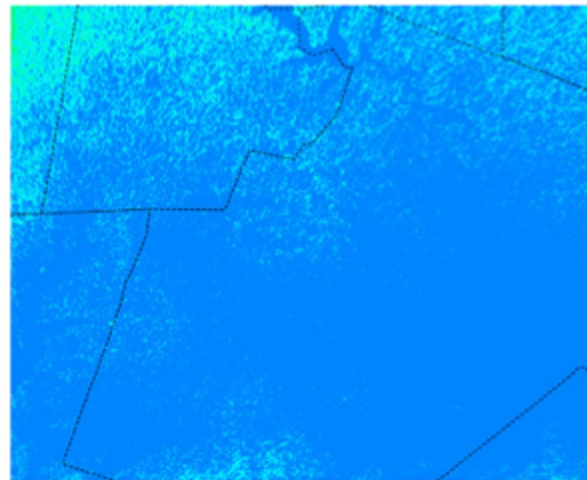
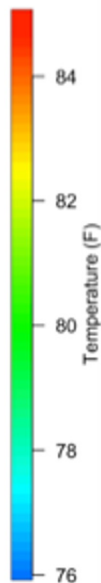
REGIONAL, CONTINUED Hyperlocal Weather Simulations

Multi-Counties and Cities: 50-meter Resolution

28 April 2024 – 3 PM

29 April 2024 – 3 PM

30 April 2024 – 3 PM



AERIS



ENGINEERING SERVICES

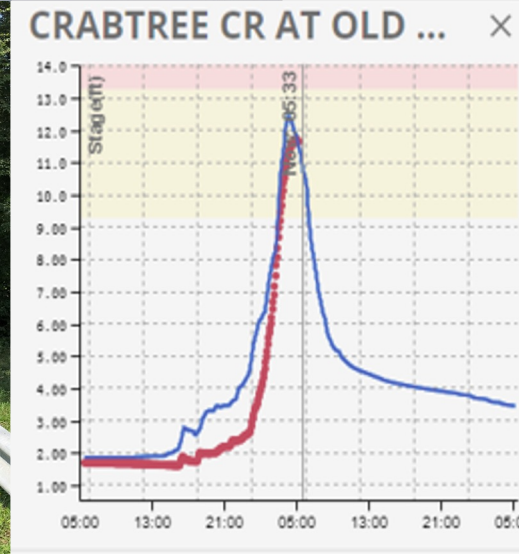
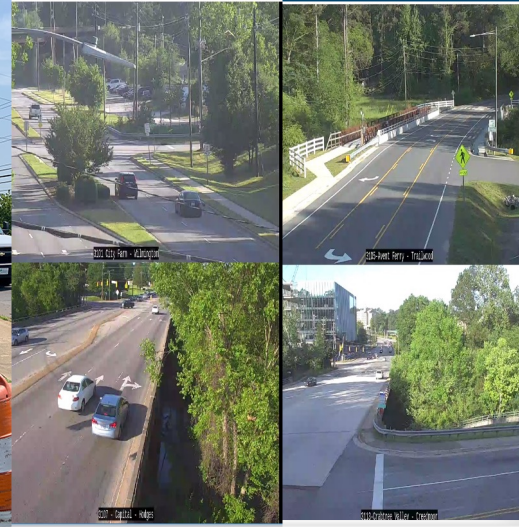
Flood Early Warning System and Active Flood Management

City of Raleigh, North Carolina

Presentation for the
Smart Cities Workshop
May 7, 2024



Raleigh





Goals and Benefits of FEWS

Improved Public Safety and Awareness through:

- Flood Monitoring (Software, Gauges, Sensors, Cameras)
- Flood Predictions
- Advanced Warning
- Alerts and Notifications

Improved System Planning and Flood Resilience through:

- Historical Flood and Rainfall Data
- Flood and Rainfall Event Reports
- “What if” Scenarios
- Active Flood Control



Raleigh

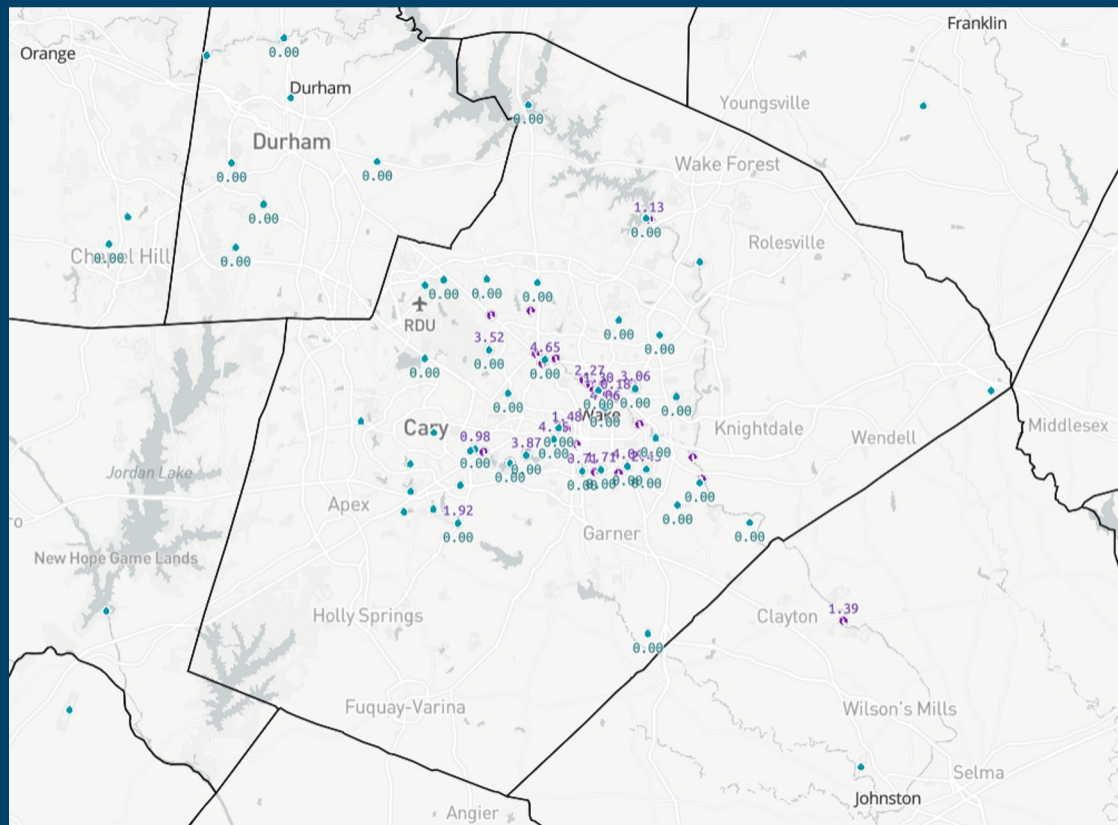
FEWS Stream and Rain Gauge Network

Current Network

- 18 Stream Gauges
 - 18 USGS (16 Raleigh)
- 55 Rain Gauges
 - 35 USGS (22 Raleigh)
 - 8 Cary
 - 7 Raleigh Water
 - 5 NWS

Alert 2 System (Raleigh)

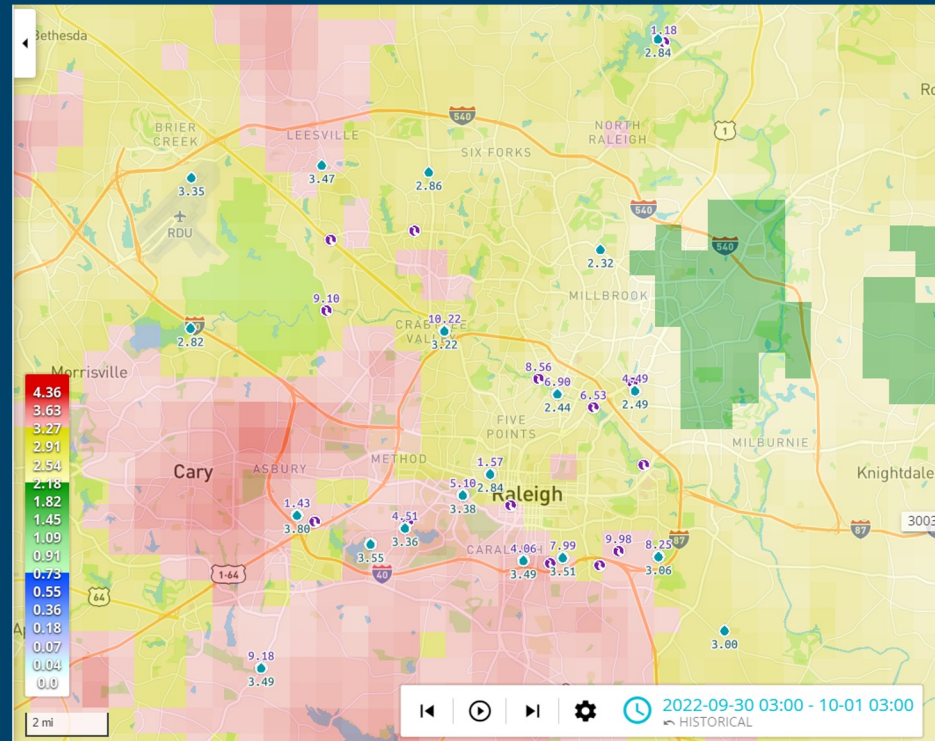
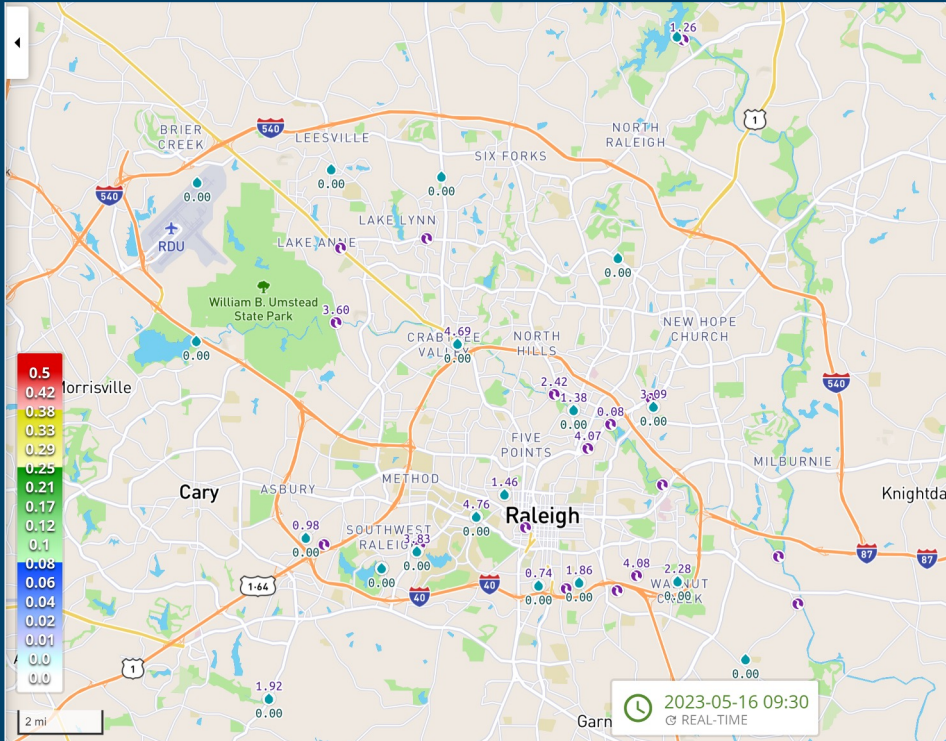
- Radio Frequency Reporting w/ 5-minute updates.





Flood Early Warning System (FEWS) Software

Gauge Adjusted Radar Rainfall (GARR) and forecasts





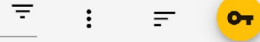
Flood Early Warning System (FEWS) Software

Predicted heights and lead-times for potential flooding

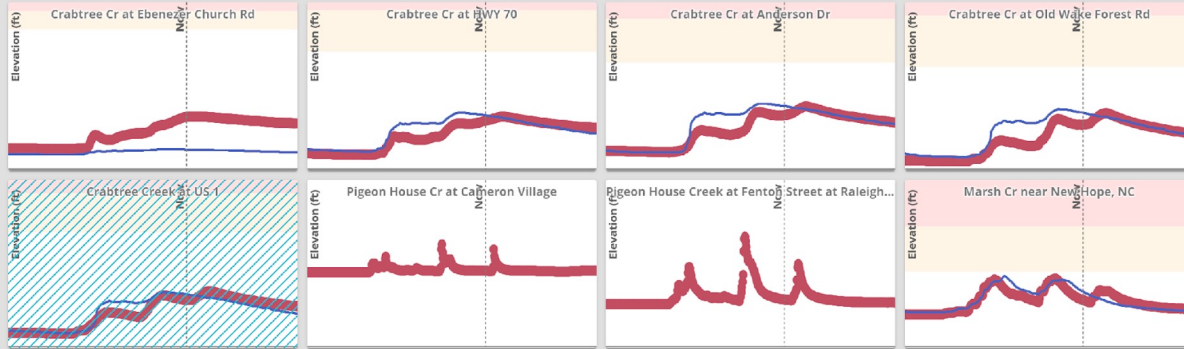
2023/04/30 21:00 ▾

Filter

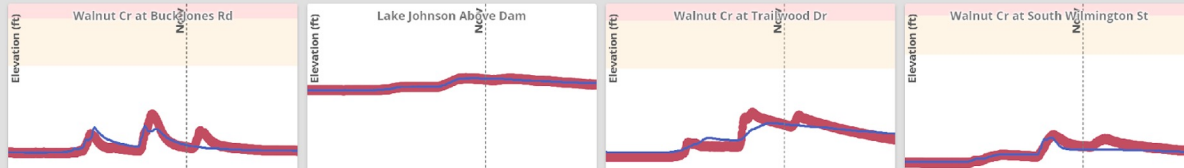
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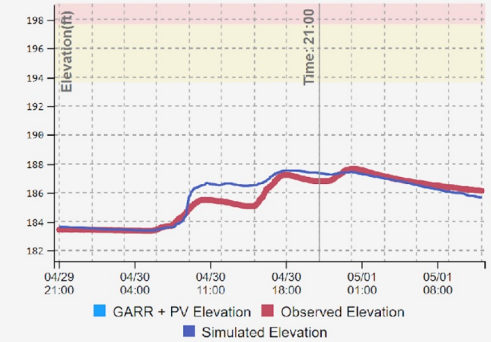
Crabtree Creek



Walnut Creek



Crabtree Creek at US 1



Limit forecast(s) to chosen time

Basin	Crabtree Creek
ID	02087324
Group	USGS
Status	Normal Level



Flood Early Warning System (FEWS) Software

Alerts

(Current - Staff / Future - Public)

What if Scenarios

RULES MANAGER

All Items | Search list

TYPES

- Complex
- DDF
- Forecast
- GARR
- Gauges
- Inundation
- PreView
- WatchPoints

IMPORTANCE

- Critical
- Moderate
- Low impact

Rule | Notifications

Title: Anderson Drive - Action

Suggestion: succinct explanation of what happens when this rule is triggered

Description: (SOP) Point: Crabtree Creek at Anderson Drive

Suggestion: include specific services, structures, and locations that are likely to be impacted

Importance: **LOW IMPACT** | MODERATE | CRITICAL

Type - subtype (locked): WatchPoints - Value

Whether a watchpoint's data crosses a threshold.

TOTAL: 32 | SELECTED: 1

Active | DELETE | SAVE

WHAT-IF?

Scenario Info

Title: Full Run (+20in)

Description: All basins, with an extra 20in over the 72 hours

72 hr Forecast: NDFD QPF (in, 6 hr)

Requested: 2021/09/29 16:59

Adjustment Type: Additive | Amount (inches): 20

Solve time after rainfall: 12 Hours

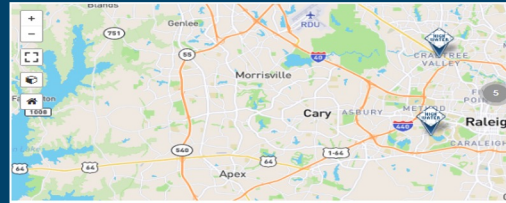
DELETE SCENARIO

































































Map showing watershed with forecast overlay (0.0 to 5.0 inches).



Flood Warning Signs

- 9 sensor/signs systems (roadways)
- 1 sensor only (facility)
- Automated flood warning
- Push notifications (Text/Email)



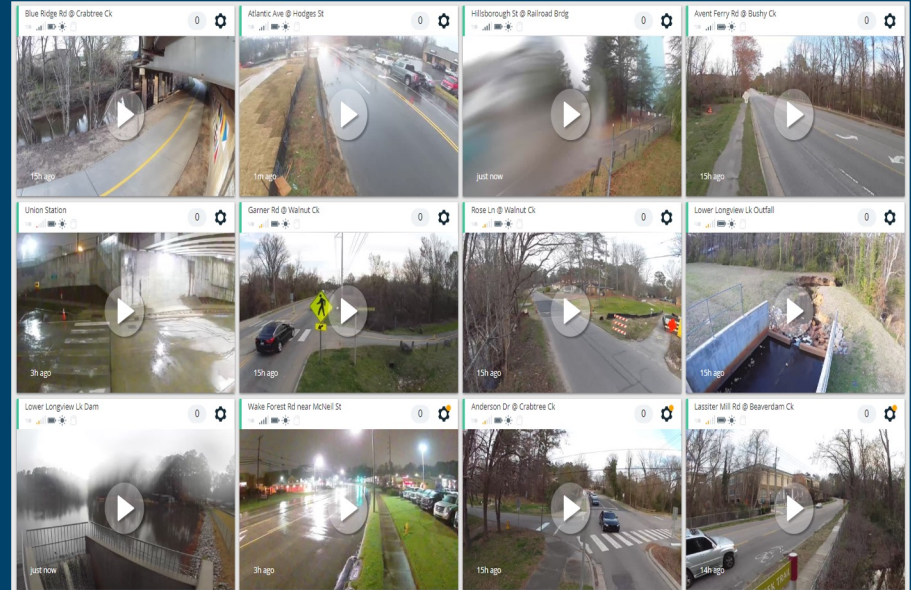
Type	System Name	System Status	Notify Me	Tags	Company Name
<input type="checkbox"/>	 Anderson Dr	(In Maintenance)	  	0	Raleigh NC City of
<input type="checkbox"/>	 Atlantic Ave	  	  	0	Raleigh NC City of
<input type="checkbox"/>	 Avent Ferry Rd	  	  	0	Raleigh NC City of
<input type="checkbox"/>	 Creedmoor Rd	  	  	0	Raleigh NC City of
<input type="checkbox"/>	 Garner Rd	  	  	0	Raleigh NC City of
<input type="checkbox"/>	 Lassiter Mill Rd	  	  	0	Raleigh NC City of
<input type="checkbox"/>	 Rose Ln	  	  	0	Raleigh NC City of
<input type="checkbox"/>	 Southgate Park	  	  	0	Raleigh NC City of - Parks and Recreation
<input type="checkbox"/>	 Union Station	  	  	0	Raleigh NC City of - Union Station
<input type="checkbox"/>	 Wake Forest Rd	(In Maintenance)	  	0	Raleigh NC City of



Cameras Supporting Flood Monitoring

18 Flood / 180 Traffic Cameras

21 Cellular / Solar Flood Cameras





Raleigh

Flood Control through Active Lake Level Management

- Remote control of gate
- Tool for storm preparation
- Cellular or option of NOAA Weather alert activated
- Siren and flashing warning light for safety when valve is opened
- Connected to AC power but also solar capable
- Water level sensor

Lake Johnson Pilot Project





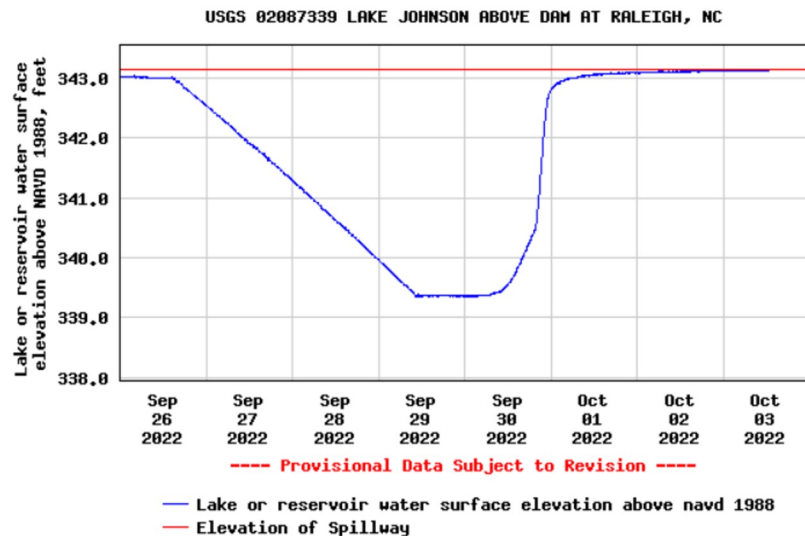
Raleigh

Lowering Lake Johnson (Hurricane Ian)

Lake Johnson

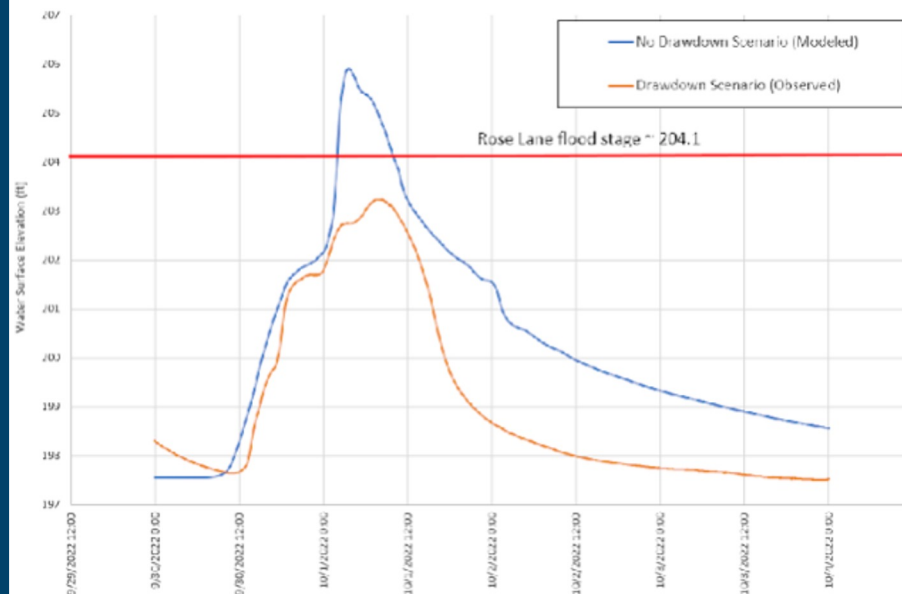
Lake or reservoir water surface elevation above NAVD 1988, feet

Most recent instantaneous value: 343.14 10-03-2022 12:55 EDT



Rose Lane

Rose Lane Stage Comparison (02087358)





Raleigh

Thoughts

- **Can the system be improved?**
 - Yes. (More sensors and data would allow us to: improve the GARR calibration in areas where we do not have many gauges, do stream flow and height predictions in more areas, send alerts and notifications for more locations, and more.)
- **Can the system be expanded?**
 - Yes. (For example, we are in the process of expanding the GARR coverage to all of Wake County and portions of Durham County and Johnston County.)
- **Can we data share with this system?**
 - Yes. (We can pull in gauge and sensor data from most any system with an API.)

Questions / Discussion

Kelly Daniel

Flood Early Warning System Manager

Kelly.Daniel@raleighnc.gov



Breakout Discussions

Desired Outcome:

Identify priority projects to advance regional sustainability goals through more robust data collection and data sharing

Facilitators



Deb Wojcik
RTCC



Cristina Leos
City of Raleigh



Liz Tracy
*Organizational
Psychologist &
Educator*



Rachael Newberry
RIoT

Topic 1: Climate Change (Heat & Weather Patterns)

Climate change and its impact on our communities can be measured in numerous ways— from greenhouse gas emissions, to climate vulnerability assessments, to monitoring weather patterns (as shown in MITRE’s heat and wind model). If we can better capture heat and wind data (for example), what climate change problems can we address in the region?

Topic 2: Stormwater

How might we build on the Flood Early Warning System? What additional communities stand to benefit, where is more robust data needed, and what problems still need to be solved in the stormwater management space? What proactive actions or advanced capabilities might be considered in an expanded FEWS?

Topic 3: Air Quality (Public Health)

Air quality is an increasingly hot topic with profound impacts on public health. What problems can we solve in our region with greater access to air quality data? What measures are most critical?

Topic 4: Electrification (EV Charging)

As our region pursues further electrification, supporting EV proliferation is top of mind. How might we better inform efforts that drive EV adoption and create an EV-friendly region? What outcomes might tracking EV charging locations and usage lead to? Are there other more important data points or challenges to address? For example, how might we first foster government fleet conversion?

Ground Rules

FOCUS AREAS:

- ***Mutually interesting problems for local government to solve and what kinds of data can support***
- Considering multiple stakeholders (beneficiaries) is fair game: ***Internal gov ops, residents/visitors, local business community***
- All voices heard – we'll ask ***Public Sector Leaders*** and ***Sustainability Experts*** to weigh in first

NOT COVERED TODAY:

- Solutions or technology deployments
- Pilot or budget specifications
- Policy discussions
- A ***"PARKING LOT"*** is provided for comments in the above realms - we will make note, but avoid diving deeper

5-MINUTE REFLECTION

CLIMATE CHANGE / STORMWATER / AIR QUALITY / ELECTRIFICATION

Brainstorm:

- What problem(s) would you like to see solved in your community?
- If only we knew _____, we would be better equipped to take action on this problem.
- Existing initiatives you're aware of?

What's Next?

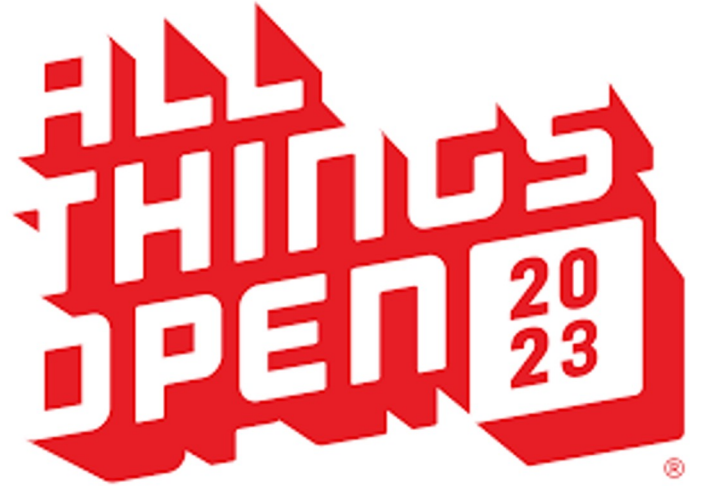
Beyond Today's Workshop:

Information and input gathered will be reviewed and considered by the Connected Triangle+ Partners for next stages, funding, and the possible development of pilot projects across our region.

CONNECTED TRIANGLE+ SUMMIT

In Partnership With

SAVE THE DATE!
OCTOBER 29th



Self-Select to Your Desired Breakout Discussion:



Deb Wojcik

1
Climate Change
(Heat & Weather
Patterns)



Rachael Newberry

3
Air Quality
(Public Health)



Cristina Leos

2
Stormwater



Liz Tracy

4
Electrification
(EV Charging)

KEY QUESTIONS

What are the main problems to solve in our region?

What data do we need to support solving these problems?

If we could solve one thing (related to this topic), what would have the greatest impact on quality of life for residents? On internal government operations?