

# UHI WORKSHOP

## HOT TOPICS / COOL SOLUTIONS

### *“Mythbusting on Heat”*

Discussions will focus on finding opportunities for Tucson to develop innovative solutions to mitigate the Urban Heat Island (UHI) effect and effectively communicate about and respond to extreme heat events.

**Tuesday, October 31, 2023**  
**9:00 AM - 12:30 PM**

Registration:



<https://tinyurl.com/UHI-Workshop>

Location: Virtual or In-Person

**Environment and Natural  
Resources 2 Building  
1064 E Lowell St,  
Tucson, AZ 85719  
Room N595**

Contact:

**Irene Ogata, Tucson Water,  
Conservation & Stormwater  
Resource Division  
irene.ogata@tucsonaz.gov  
520-837-6960**

## Our Speakers:



**MIKE CRIMMINS**  
*Professor & Extension Specialist -  
Climate Science, U of A*



**LADD KEITH**  
*Asst. Prof. of Planning & Sustainable  
Built Environments, CAPLA, U of A*



**TOM DANG**  
*Science and Operations Officer,  
National Weather Service - Tucson*



**KRISTI CURRANS**  
*Associate Professor, Urban  
Planning, CAPLA, U of A*



**JOSH BEHOUNEK**  
*Business Development Manager,  
Davey Resource Group*



**MARK NORTON**  
*Director, Arizona Division of  
Occupational Safety & Health*

## About the program

*The City of Tucson's Landscape Advisory Committee (LAC) invite you to the 14th Urban Heat Island (UHI) Workshop. This year the workshop is in collaboration with University of Arizona CLIMAS.*





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## Agenda:

9:00 AM - Welcome

9:15 AM - Mike Crimmins

9:45 AM - Ladd Keith

10:15 AM - Tom Dang

10:45 AM - **\*\*Break\*\***

11:00 AM - Kristi Currans

11:30 AM - Josh Behounek

12:00 PM - Mark Norton

12:30 PM - Close

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**MIKE CRIMMINS**

*Professor & Extension Specialist -  
Climate Science, U of A*

Mike Crimmins is on the faculty of the Department of Environmental Science at the University of Arizona and is an Extension Specialist in Climate Science for Arizona Cooperative Extension. He has been in this role for 19 years working with ranchers, farmers and natural resource managers across Arizona to integrate climate information in their planning and decision making and assisting them in developing strategies to adapt to a changing climate.



**LADD KEITH**

*Asst. Prof. of Planning & Sustainable  
Built Environments, CAPLA, U of A*

Ladd Keith, Ph.D., is an assistant professor in the School of Landscape Architecture and Planning and a faculty research associate at the Udall Center for Studies in Public Policy at the University of Arizona. An urban planner by training, he has over a decade of experience planning for climate change with diverse stakeholders in cities across the U.S. His research explores heat planning, policy, and governance to help communities increase their heat resilience. He is currently the UA lead of the Southwest Urban Corridor Integrated Field Laboratory (SW-IFL) funded by the U.S. Department of Energy, the heat research lead of the Climate Assessment for the Southwest (CLIMAS) funded by the U.S. National Oceanic and Atmospheric Administration, co-investigator of the Building Resilience Against Climate Effects (BRACE) funded by the U.S. Centers for Disease Control and Prevention, and co-investigator of the Southwest Center on Resilience for Climate Change and Health (SCORCH) funded by the U.S. National Institutes of Health. He also founded and led the Sustainable Built Environments undergraduate degree program offered in person, fully online, and globally in Peru and Ecuador. He has a Ph.D. in Arid Lands Resource Sciences and an M.S. in Planning from the University of Arizona.



**TOM DANG**

*Science and Operations Officer,  
National Weather Service - Tucson*

Tom Dang is the Science and Operations Officer of the National Weather Service in Tucson, and has served in that capacity since 2020. Tom's training is in operational meteorology, having served in that capacity with the National Weather Service field offices in Alaska, California, and Washington before coming to Tucson. Tom earned his bachelor's degree in Atmospheric Science and Meteorology from the University of Kansas, and was born and raised in Kansas.

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## Our Speakers:



**KRISTI CURRANS**

*Associate Professor, Urban Planning, CAPLA, U of A*

Kristina Currans, PhD, is an Associate Professor of Urban Planning with a doctorate in Civil Engineering (transportation focus). She studies the intersection between transportation and land use development, spanning between the transportation planning and engineering disciplines. Currans' research and teaching emphasizes the rethinking and redeveloping of new data and methods for applications in practice to help communities plan for the places they want. Kristina is also the UArizona executive committee member representative for the National Institute of Transportation and Communities (NITC), a USDOT-sponsored National University Transportation Center.



**JOSH BEHOUNEK**

*Business Development Manager, Davey Resource Group*

Hi my name is Josh Behounek and my technical title is Business Development Manager for the Davey Resource Group's Environmental Consulting division, although sometimes I prefer Theoretical Arborist. I've worked for Davey for over 20 years and currently focus on providing innovative and technical solutions for communities, nonprofits, commercial clients, and state agencies throughout the US & Internationally to proactively and sustainably manage their trees and other natural resources. I've worked as a traveling inventory arborist, climbing arborist, Adjunct Professor, and have held numerous volunteer positions in local, regional, state and national non-profit organizations.

I graduated from Southern Illinois University at Carbondale with a Bachelor's in Forestry Resource Management am a Certified Arborist Municipal Specialist with the Tree Risk Assessment Qualification, a graduate of the Society of Municipal Arborist's Municipal Forester Institute, and have hugged dozens of national champion trees.



**MARK NORTON**

*Director, Arizona Division of Occupational Safety & Health*

Mark has worked safety & health this from all angles over the course of a career spanning more than 40-years. While serving in the U.S. Coast Guard as a Preventive Medicine Specialist / Flight Rescue Medic, he sustained a career ending injury and transitioned back into civilian life in the late 80's, where he started work with the Arizona Division of Occupational Safety & Health (state OSHA), as a safety compliance officer. Within ADOSH he rose to the level of Assistant Director. Mark departed ADOSH after 24 years to take on a leadership role at the Central Arizona Project, until retiring from government service in 2012. Upon retiring he was asked to join the staff at the University of California's, OSHA Training Institute (UCSD-OTI), in San Diego, CA., teaching the full series of OSHA classes in both construction and general industry, Incident Investigation, Fall Protection, Safety Leadership and more. Mark traveled the country as a successful consultant /speaker assisting employers in all types of industries, over the last decade and has currently put that and his UCSD duties on hold, due in part, to restrictions from the pandemic. In November of 2021 Mark returned to Arizona's state OSHA program and serves currently as the Director for the Agency.

Mark holds a BS in Business Management and MA in Organizational Management and has published two books on the topic of safety and health management. Mark's work in the safety & health field has been recognized with such honors as the 2008 National VPPPA Chairman's Award, the 2009 ASSE Southern Arizona Chapter "Safety Professional of the Year" and the Coast Guard Achievement Medal for his work in Occupational Safety & Health. When he can find spare time, Mr. Norton enjoys camping, hunting & fishing, in addition to traveling with his wife Kassie, and spending time with his children and grandchildren.

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**Environment and Natural Resources 2 Building  
1064 E Lowell St,  
Tucson, AZ 85719  
Room N595**

## Directions:

From Sixth Street heading west (towards Downtown), turn right into the Sixth Street Garage ramp 1 1/2 blocks past Highland Avenue.

From Sixth Street heading east (away from Downtown), turn left at Park Avenue (Jett's Wildcat, UA Liquors), turn right at first street (Lowell Street) and the garage entrance will be on the right.

Room is on the 5th Floor of the ENR2 building and is near the north east corner as a standalone classroom outside of the main building in the atrium area.



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# **Assessing Cool Corridor Heat Resilience Strategies for Human-Scale Transportation**

**Kristina Currans, University of Arizona (co-PI)**

**Ladd Keith, University of Arizona (PI)**  
**Nicole Iroz-Elardo, Willamette University**



**THE UNIVERSITY  
OF ARIZONA**



# Meet the Team



**Ladd Keith**

Assistant Professor,  
Urban Planning  
and Sustainable Built Environments  
University of Arizona



**Kristina Currans**

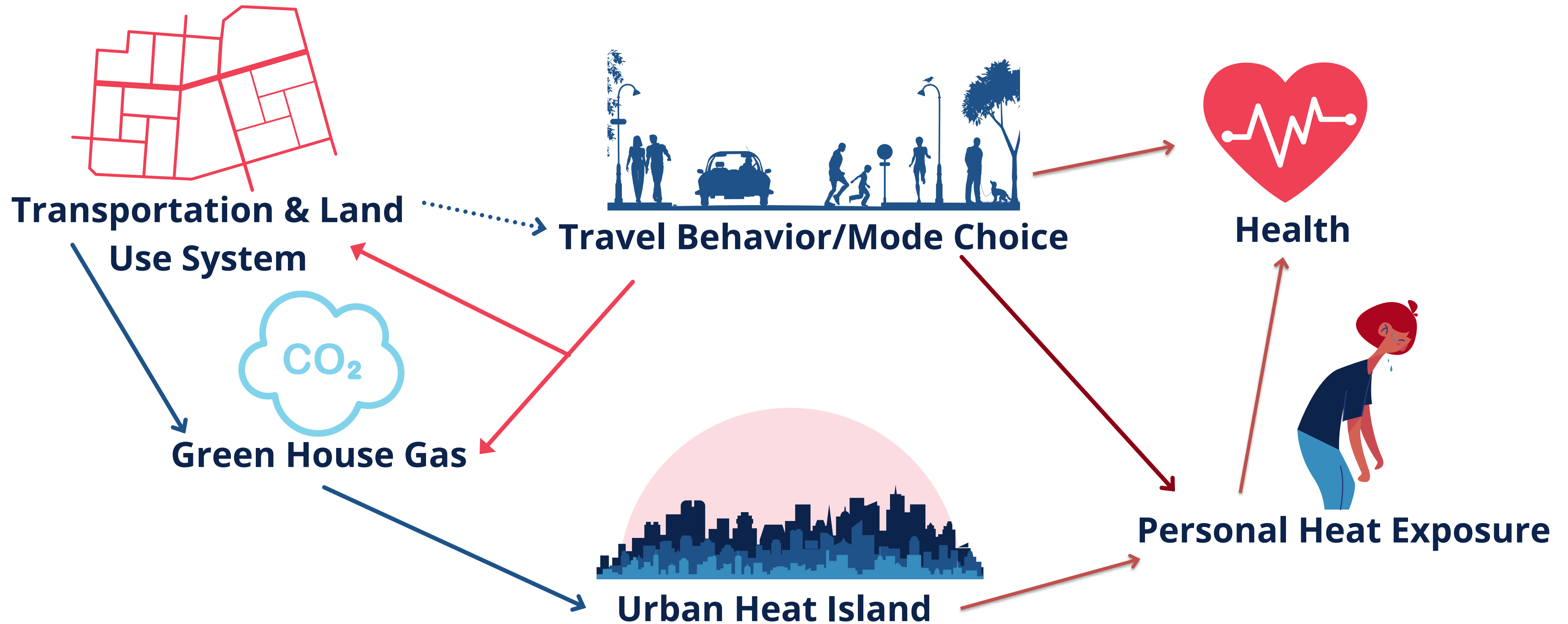
Associate Professor  
Urban Planning  
University of Arizona



**Nicole Iroz-Elardo\***

Assistant Professor,  
Public Health, Ethics, Advocacy,  
and Leadership  
Willamette University

# Transportation Both Influences Heat & is Influenced by Heat





# Tucson Cool Pavement Project

## Pilot of Cool Pavement

- 1.5 mile
- TiO<sub>2</sub> embedded via asphalt rejuvenator

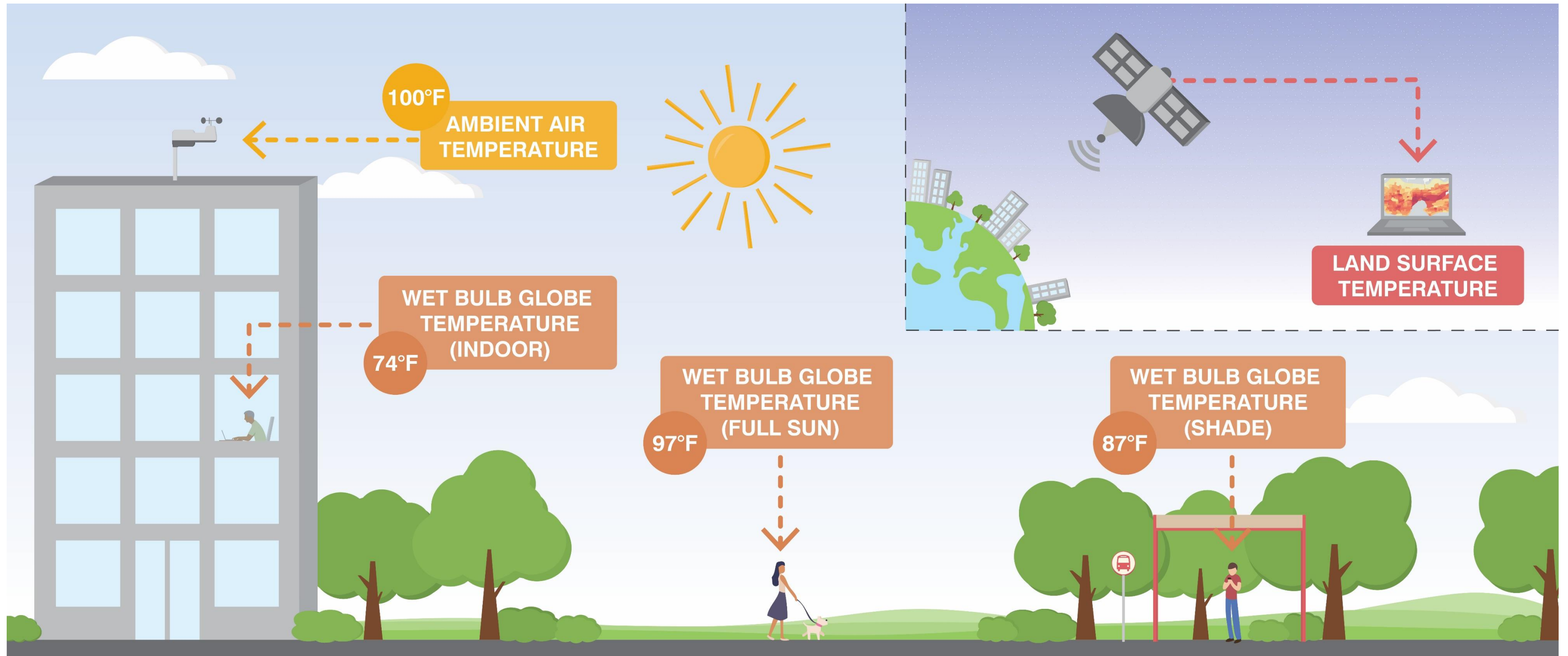
## Partnerships

- City of Tucson
- University of Arizona
- NITC





# What Scale & How Do we Measure?





# What Scale do we Measure?

**Urban Heat Island**  
Regional

**Microclimate**  
Corridor  
Pedestrian Level





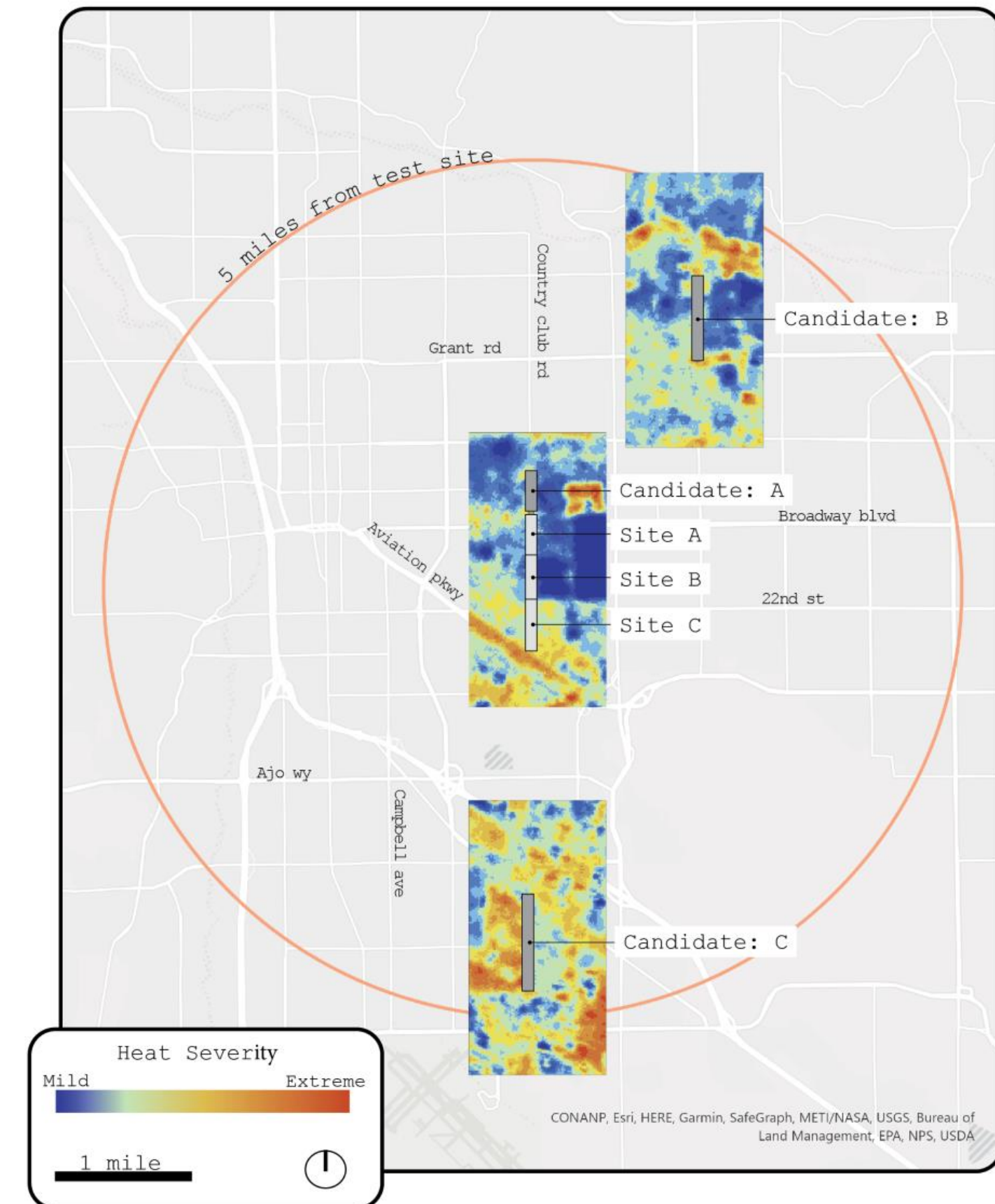
# Tucson Cool Pavement Project- Sites

## Before/After, Case/Control Nine Sites

- 6 test sites
- 3 control sites

## Used GIS to map and match test sites to control sites

- 7 land cover types:
  - Water, Trees/Shrubs, Irrigated Land, Desert, Barren/Bedrock, Impervious, Structures
- Street design
- Street Orientation





# Personal Heat Exposure Measurement

## Ambient Air

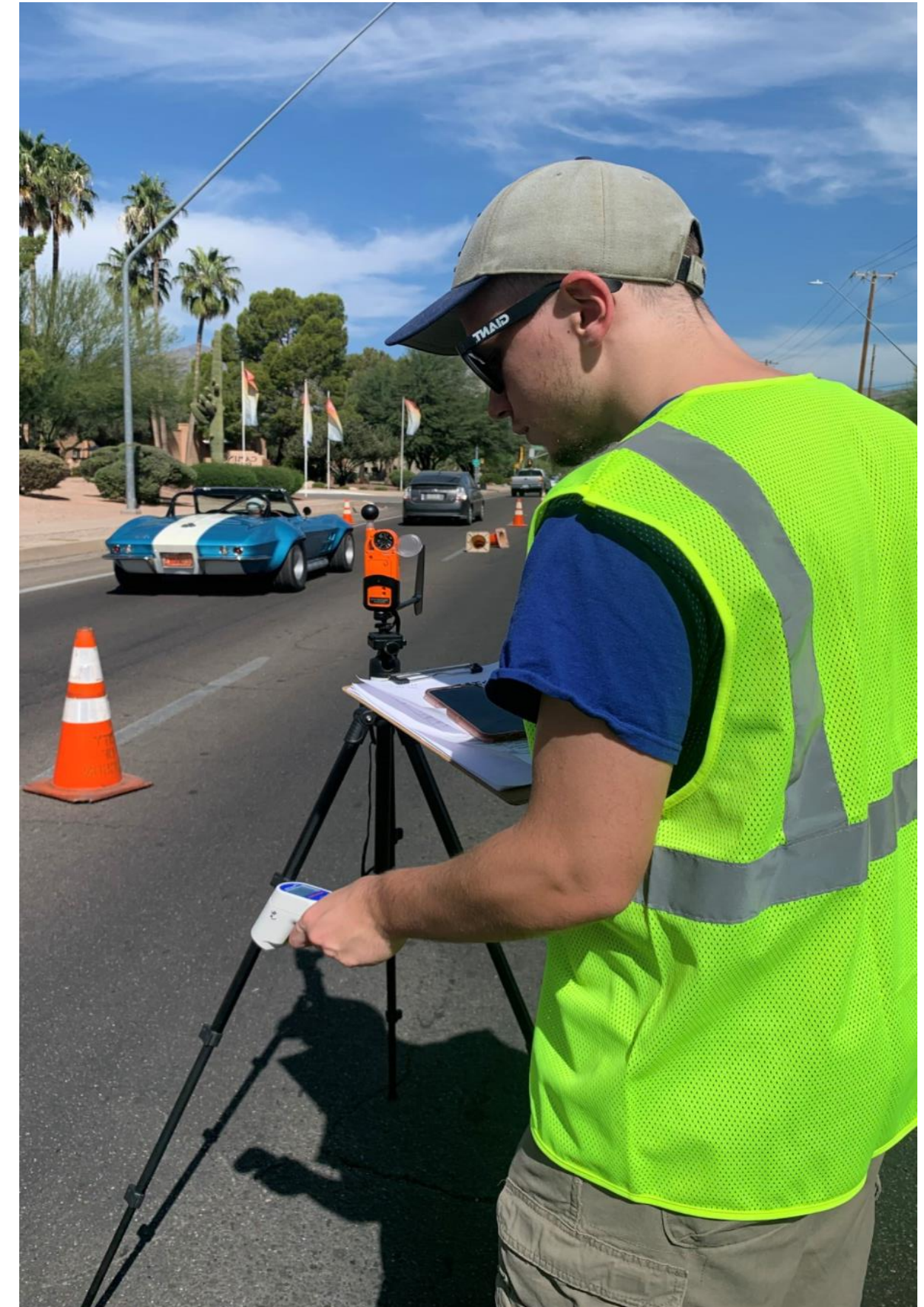
- A general level of heat
- Measured by standard thermometer
- Analogous to the weather station readings

## Thermal Comfort

- Wet Bulb Globe Temperature (WBGT) Index
- Measured comfort of humans at pedestrian level
- WBGT expands the concept of ambient air temperature to incorporate humidity, wind, and solar radiant heat.

## Surface Temperatures

- Sidewalks, gravel, vegetation, etc.
- Sun and Shade





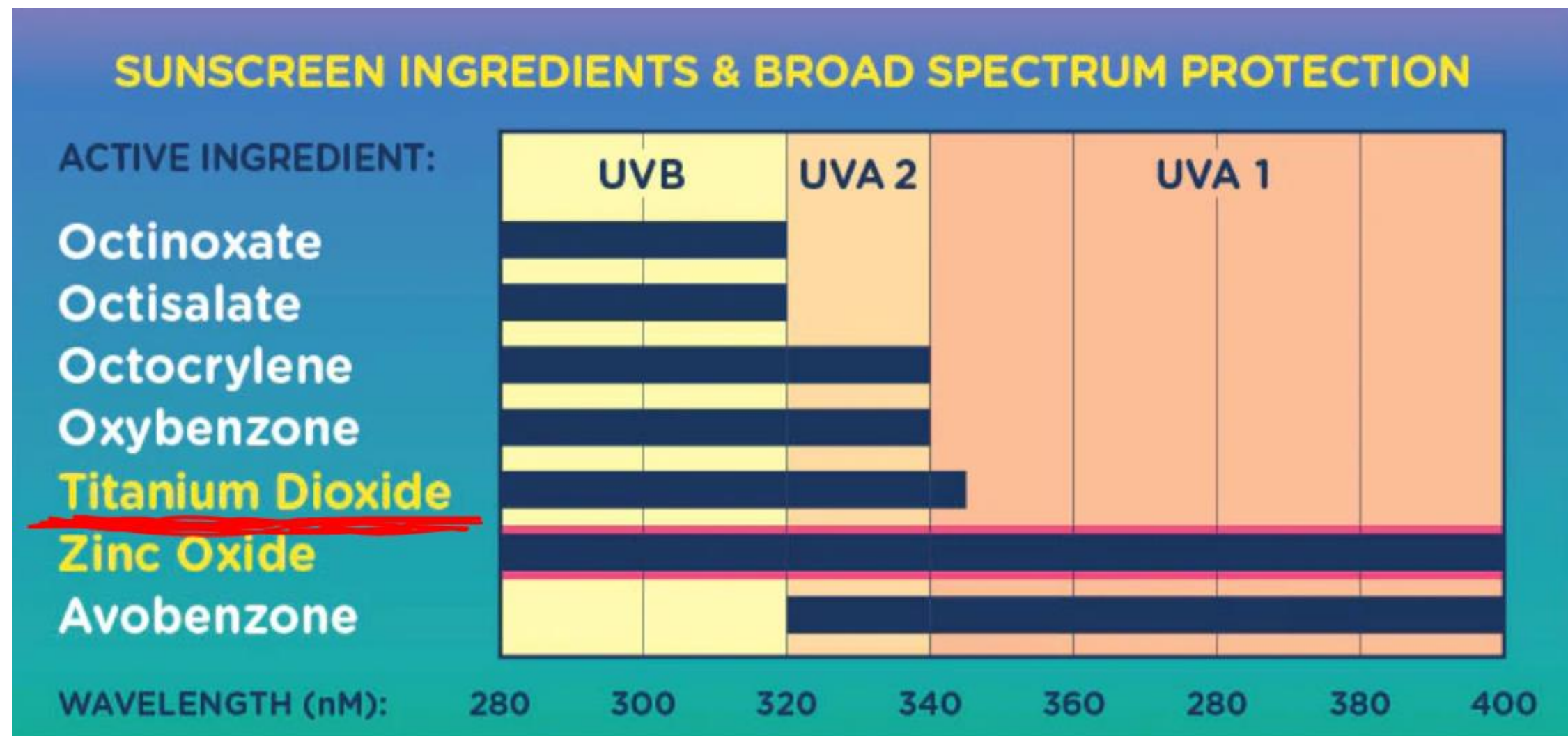
# Measuring Impact of UV

## Titanium Dioxide

- Reflectivity
- Sunscreen, current pavement striping, paint, protective clothing, and more!
- Safe, fairly cheap

## Measurement

- Hourly, measure sky/ground
- Each sidewalk and centerline
- 3 times each, then average





# Tucson Cool Pavement Project- Times

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**Before:** October 2021

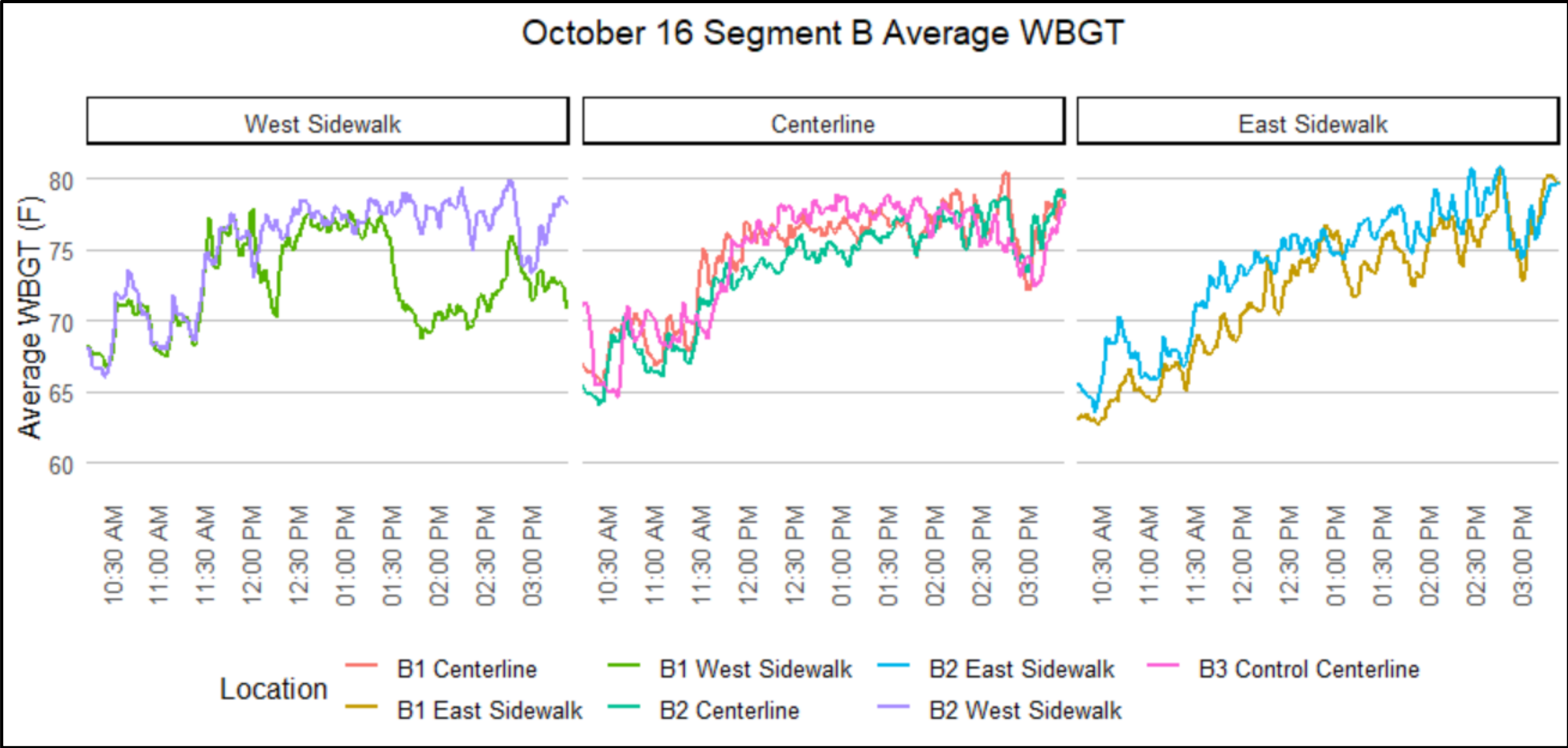
**After:** April 2022

- 3 days for each segment
- 2 treatments + 1 control
- 10AM-4PM





# Tucson Cool Pavement Project- Baseline WBGT





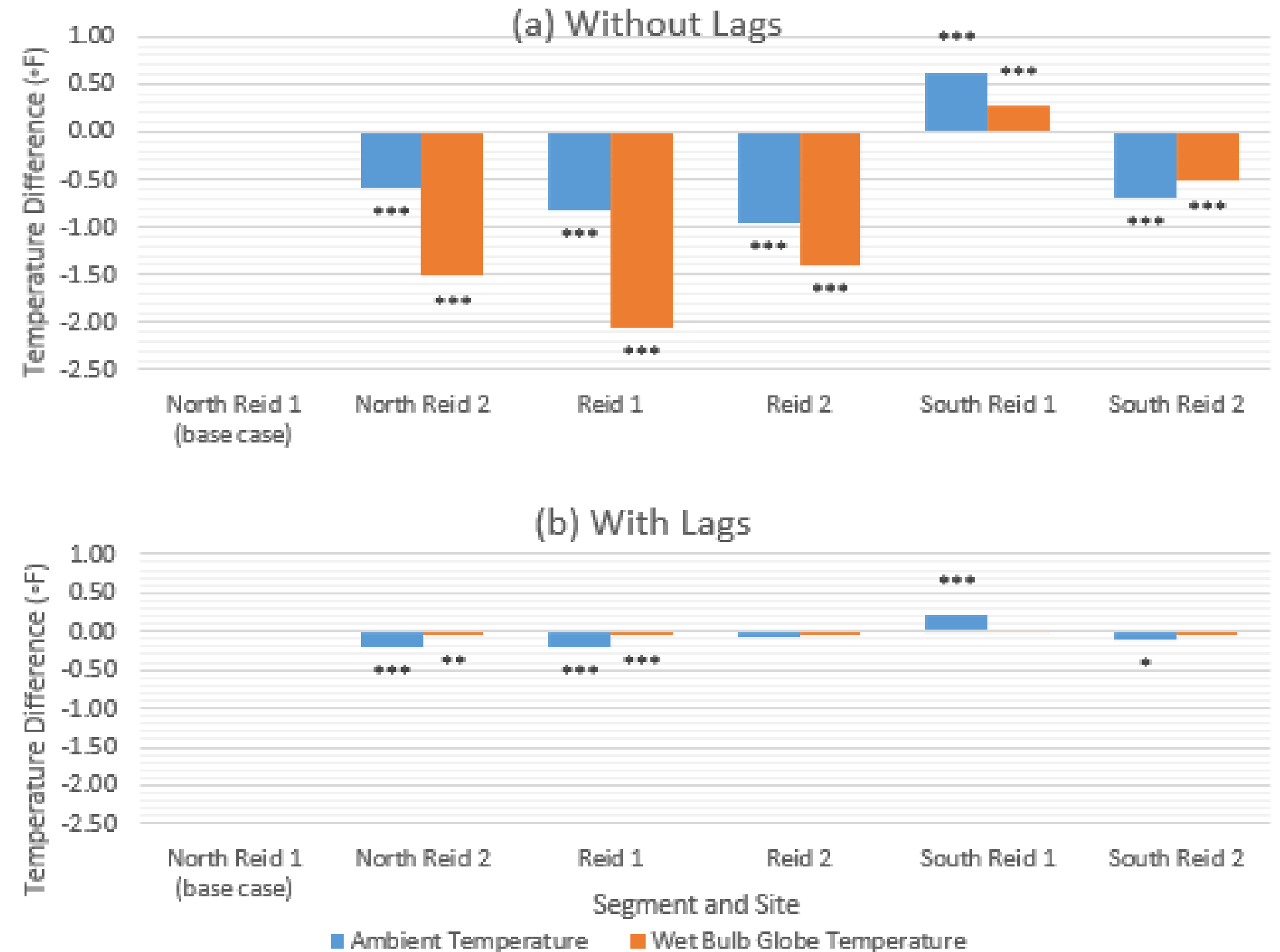
# Summary of Findings

Focusing on Before/After,  
Treatment Only

Controlling for temporal  
autocorrelation

Centerline Analysis

|                                  | Ambient (°F) | WBGT (°F)       |
|----------------------------------|--------------|-----------------|
| Autocorrelation<br>one-min. lags | 1            | 3               |
| Shade                            | -0.3         | -0.08           |
| Wind                             | -1.0         | -0.04           |
| After (vs. Before)               | -0.3         | <i>Not sig.</i> |



Notes: \*\*\*: p-value < 0.001; \*\*: p-value < 0.01; \*: p-value

Figure 11 Temperature differences (°F) for ambient air temperature and wet bulb globe temperature by segment and site (a) without and (b) with temporal lags



# Summary of Findings

**Experimental UVB/UV Index**

**UVIndex – reflection higher on concrete (sidewalk) than asphalt (road)**

|          | Highest Range of Measurement | Proportion Reflected (average) |
|----------|------------------------------|--------------------------------|
| UV Index | 7.7-8.1 “Very High”          | 4%                             |
| UVB      | 0.22-0.26 mW/cm^2            | 3%                             |



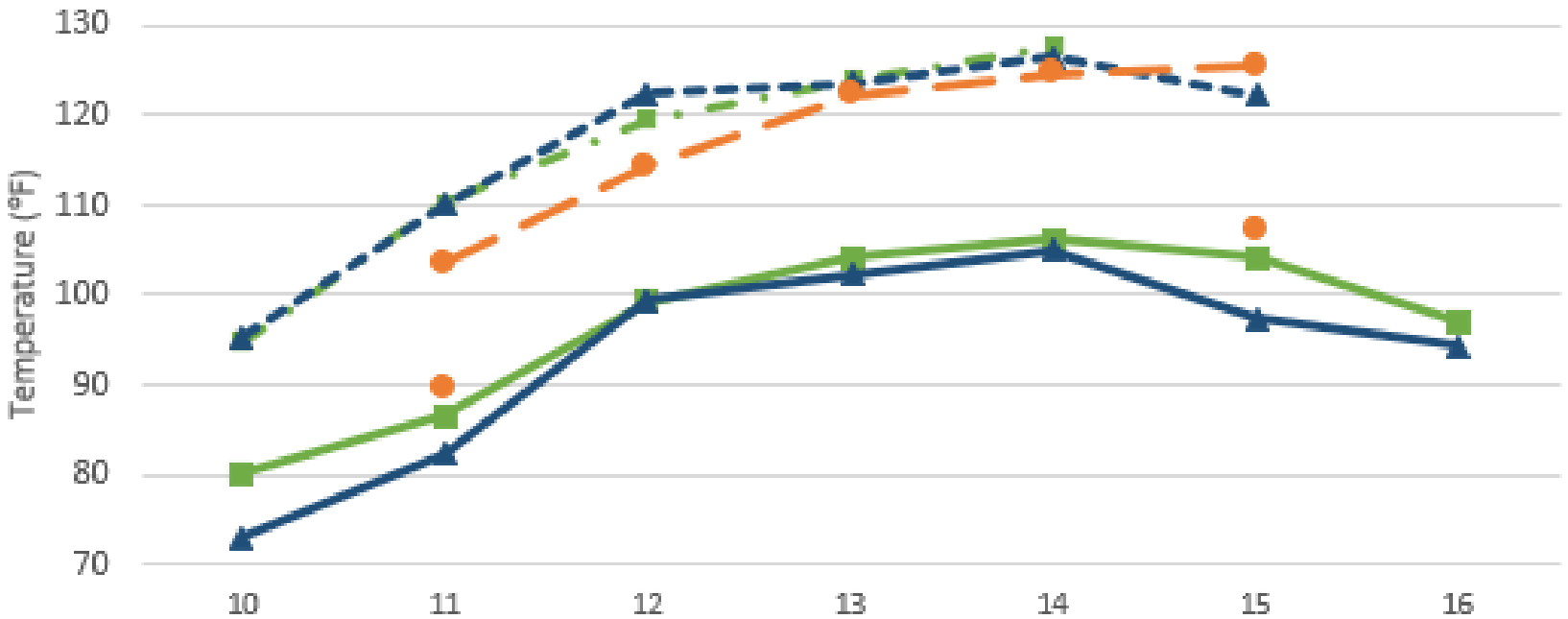
# Summary of Findings

## Surface Temperatures

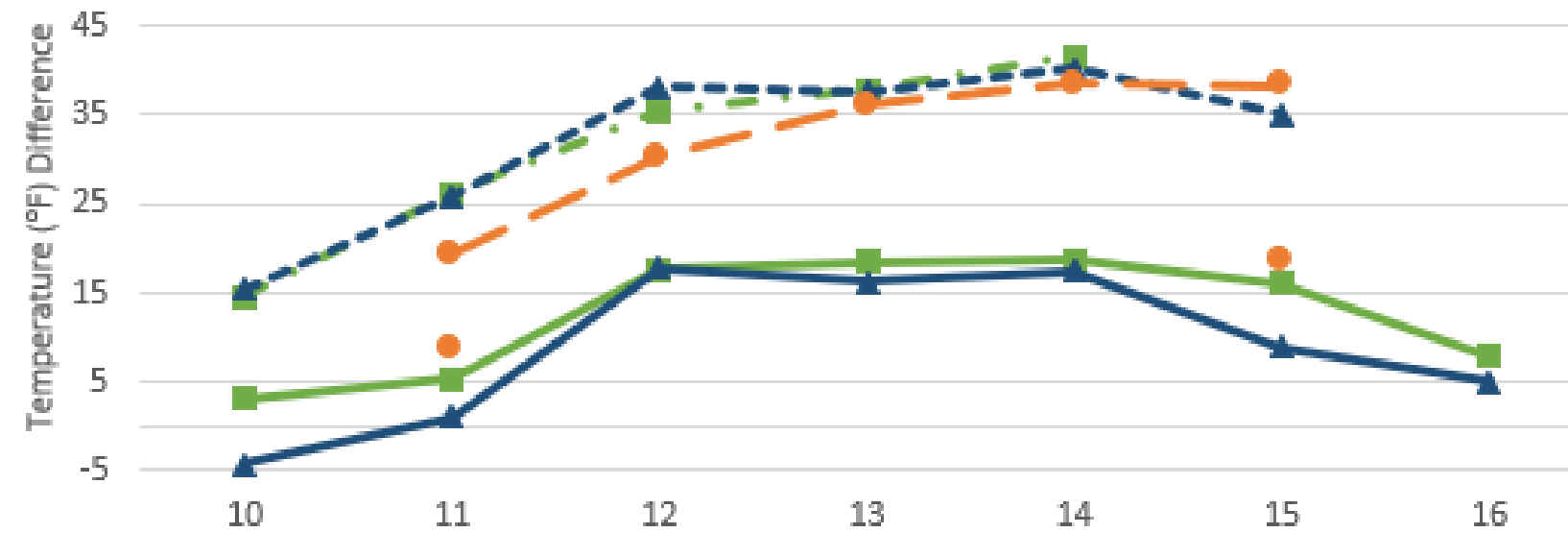
- Collected hourly

## Complications in case/control with micro-climates

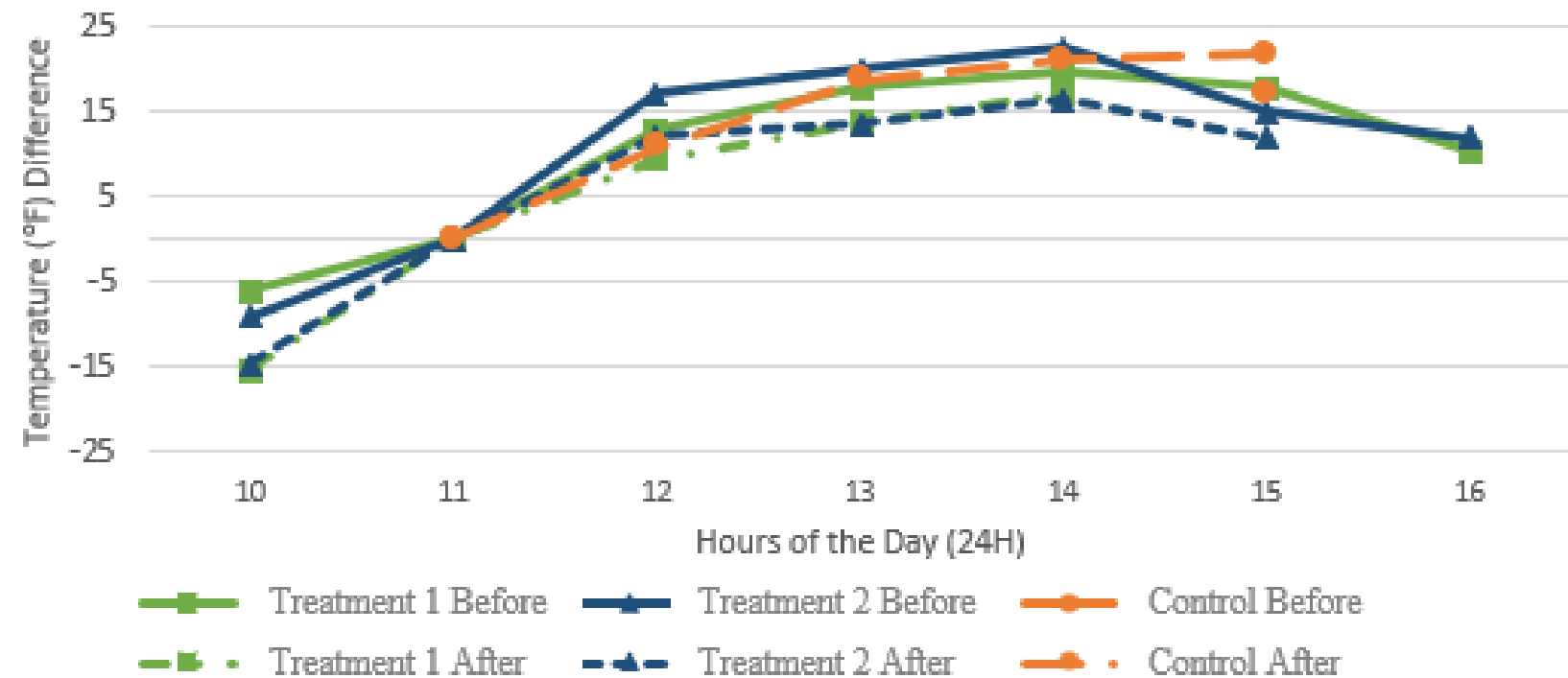
Temperature (°F)



Temperature (°F) Difference with Airport Ambient



Temperature (°F) Difference with Surface Temperature





# Challenges and Caveats

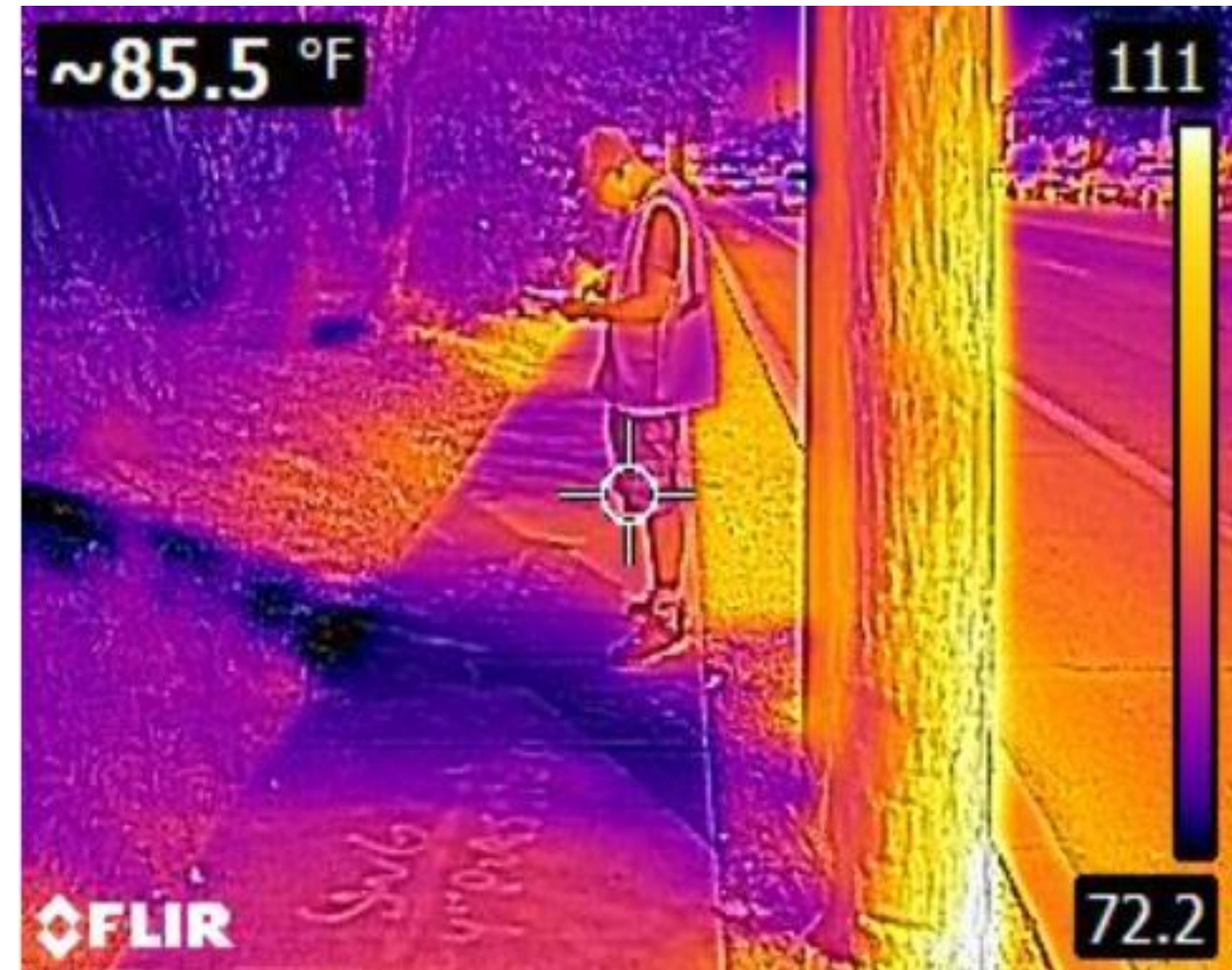
## Observations (vs. Predictive Modeling)

- Data rich, but point-specific
- Manual data collection is time consuming and instrument intensive

## With Micro-Environments, Before-After worked better than Case-Control

## Challenges

- Controlling for spatial- and temporal autocorrelation
- Statistically linking surface temperature (hourly) with Kestrel data (10-sec.)





# What is Next for Cool Corridor Project?

## What are the Conceptual Tradeoffs?

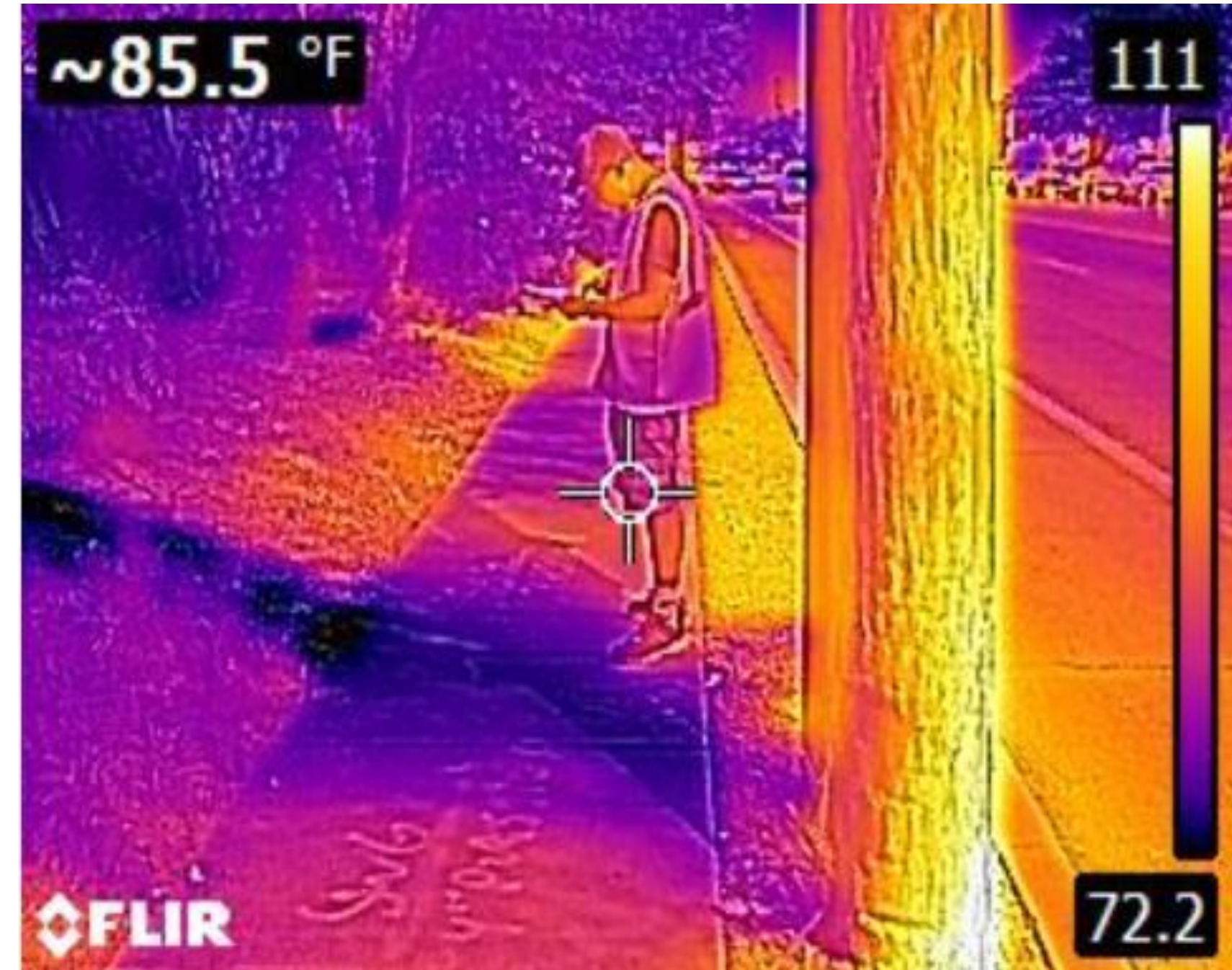
- Greening
- Cool Pavements

## Incorporate Surface Temperature Comparisons

## Compare Centerline with Sidewalk

## Test Micro-Environment Features

## Lessons Learned, DOE Testbed





# Any Questions?

**Kristina M. Currans**, Associate Professor, Urban Planning  
curransk@arizona.edu

This project was funded by the National Institute for Transportation and Communities (NITC; grant number 1483), a USDOT University Transportation Center.

[https://nitc.trec.pdx.edu/research/project/1483/Assessing Cool Corridor Heat Resilience Strategies for Human-Scale Transportation](https://nitc.trec.pdx.edu/research/project/1483/Assessing_Cool_Corridor_Heat_Resilience_Strategies_for_Human-Scale_Transportation)

