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

NITC
NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

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

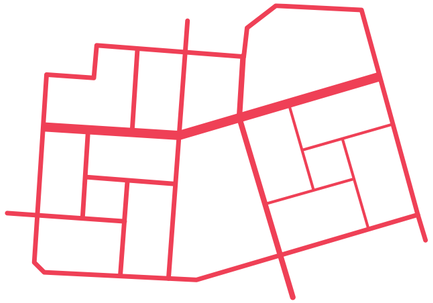
Nicole Iroz-Elardo*

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

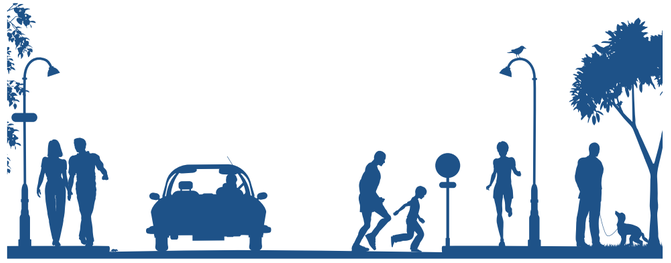
Students: Ash Avila, Lauren Heath, Ethan Wissler, Andrew Birkelbach, and Brenden Little.

** Majority of these slides were developed by Prof. Iroz-Elardo*

Transportation Both Influences Heat & is Influenced by Heat

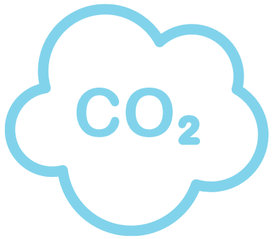


Transportation & Land Use System



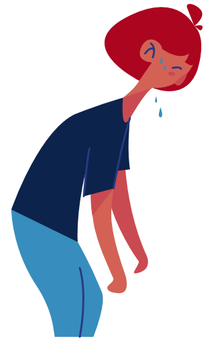
Travel Behavior/Mode Choice

Health



Green House Gas

Urban Heat Island



Personal Heat Exposure

Tucson Cool Pavement Project

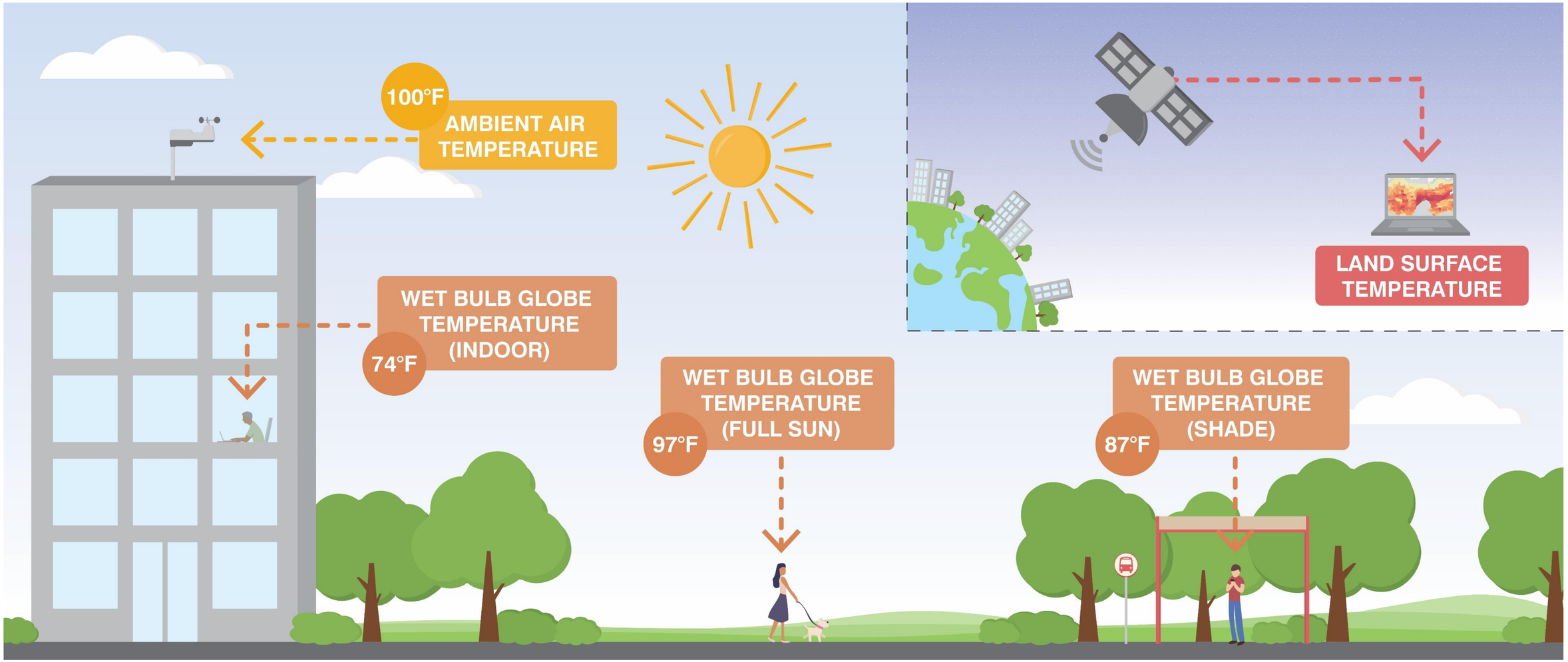
Pilot of Cool Pavement

- 1.5 mile
- TiO2 embedded via asphalt rejuvenator

Partnerships

- City of Tucson
- University of Arizona
- NITC

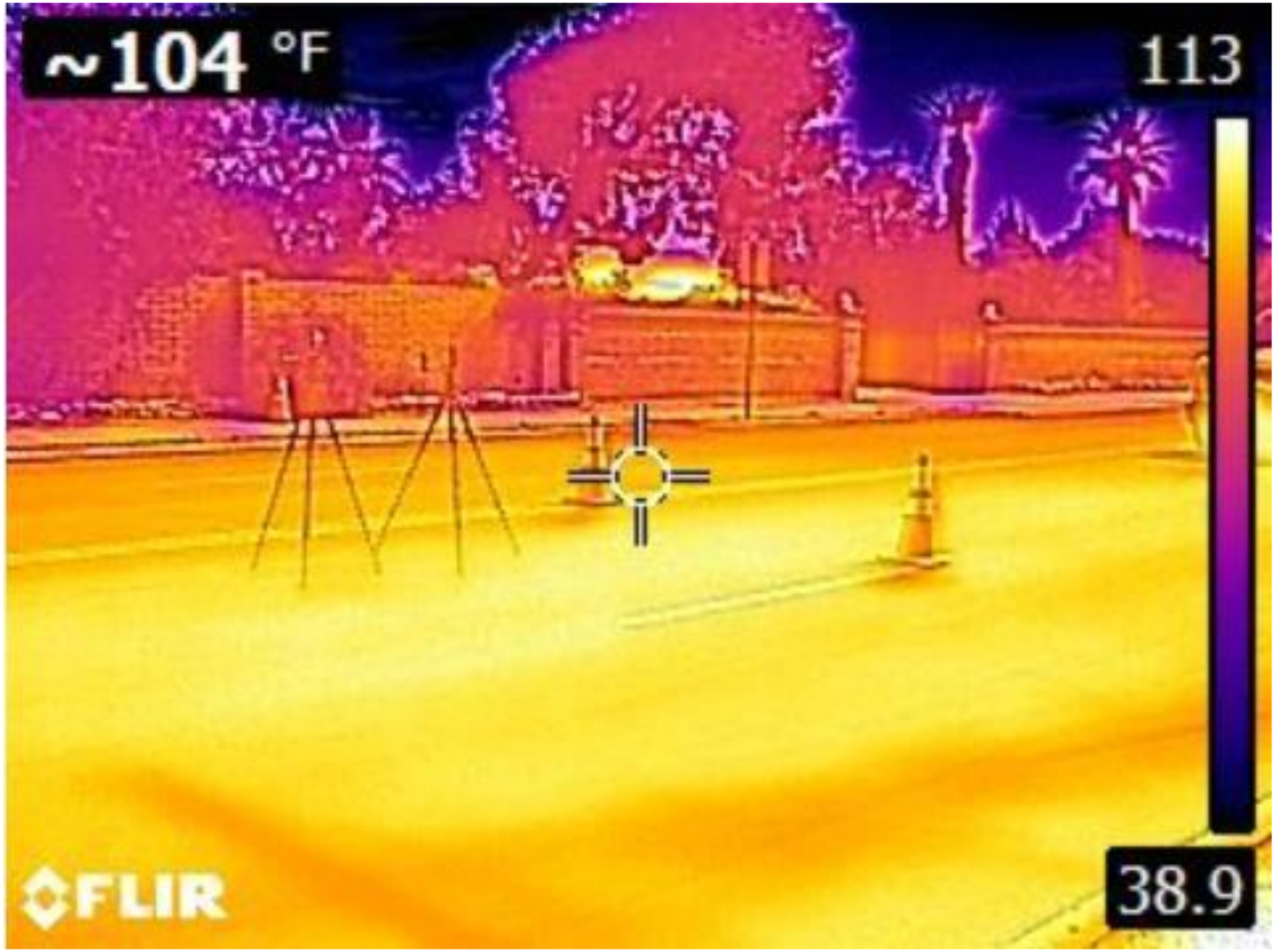
What Scale & How Do we Measure?



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

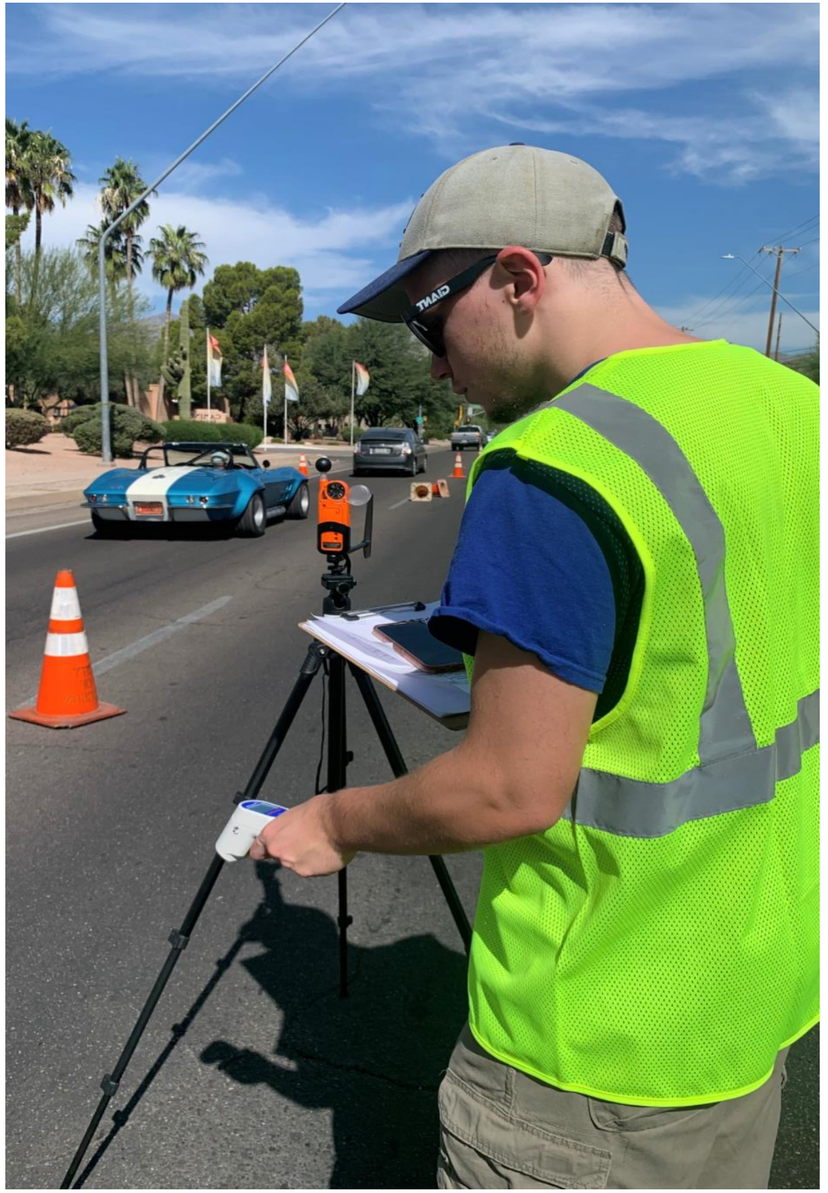
- A general level of heat
- Measured by standard thermometer
- Analogous to the weather station readings

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



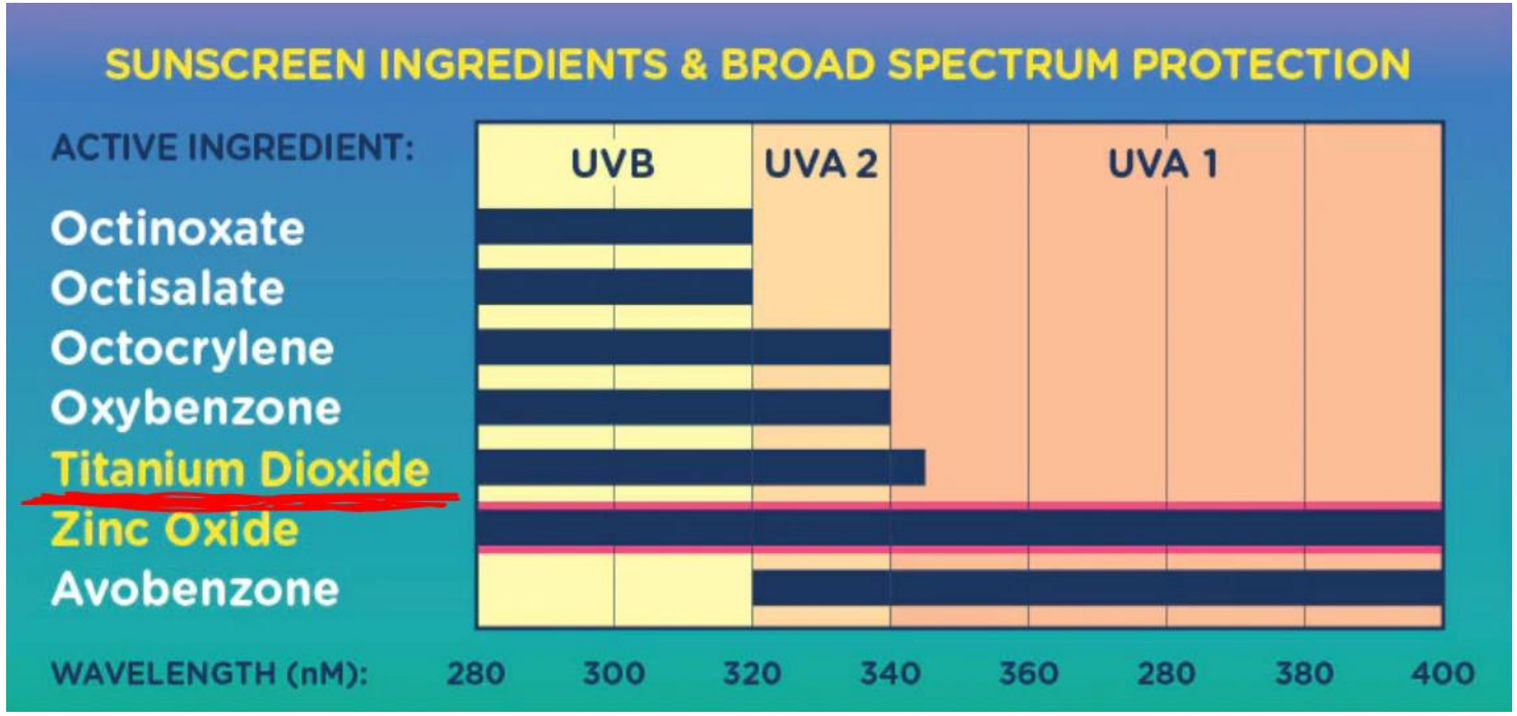
Measuring Impact of UV

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



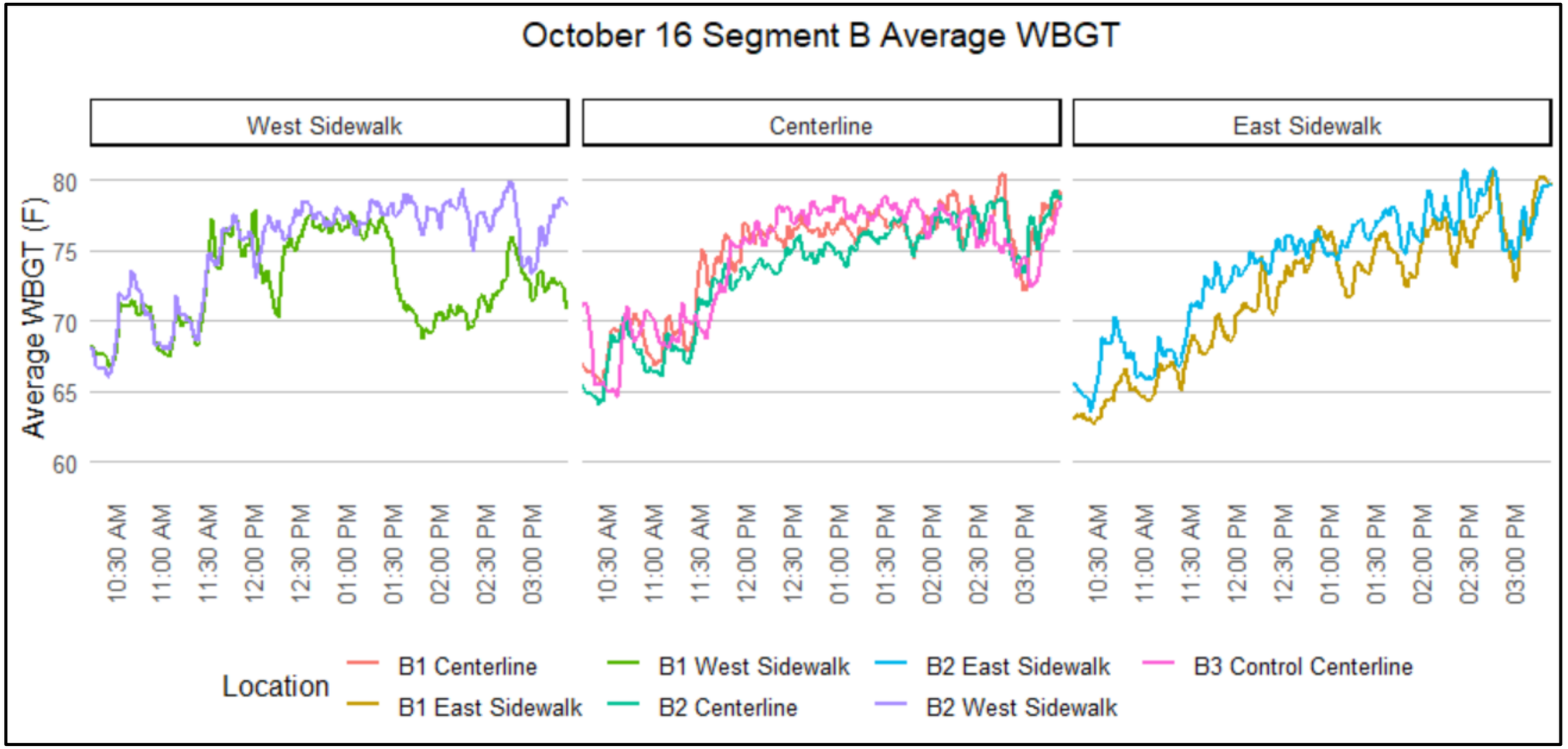
Tucson Cool Pavement Project- Times

Before: October 2021

After: April 2022

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

Tucson Cool Pavement Project- Baseline WBGT



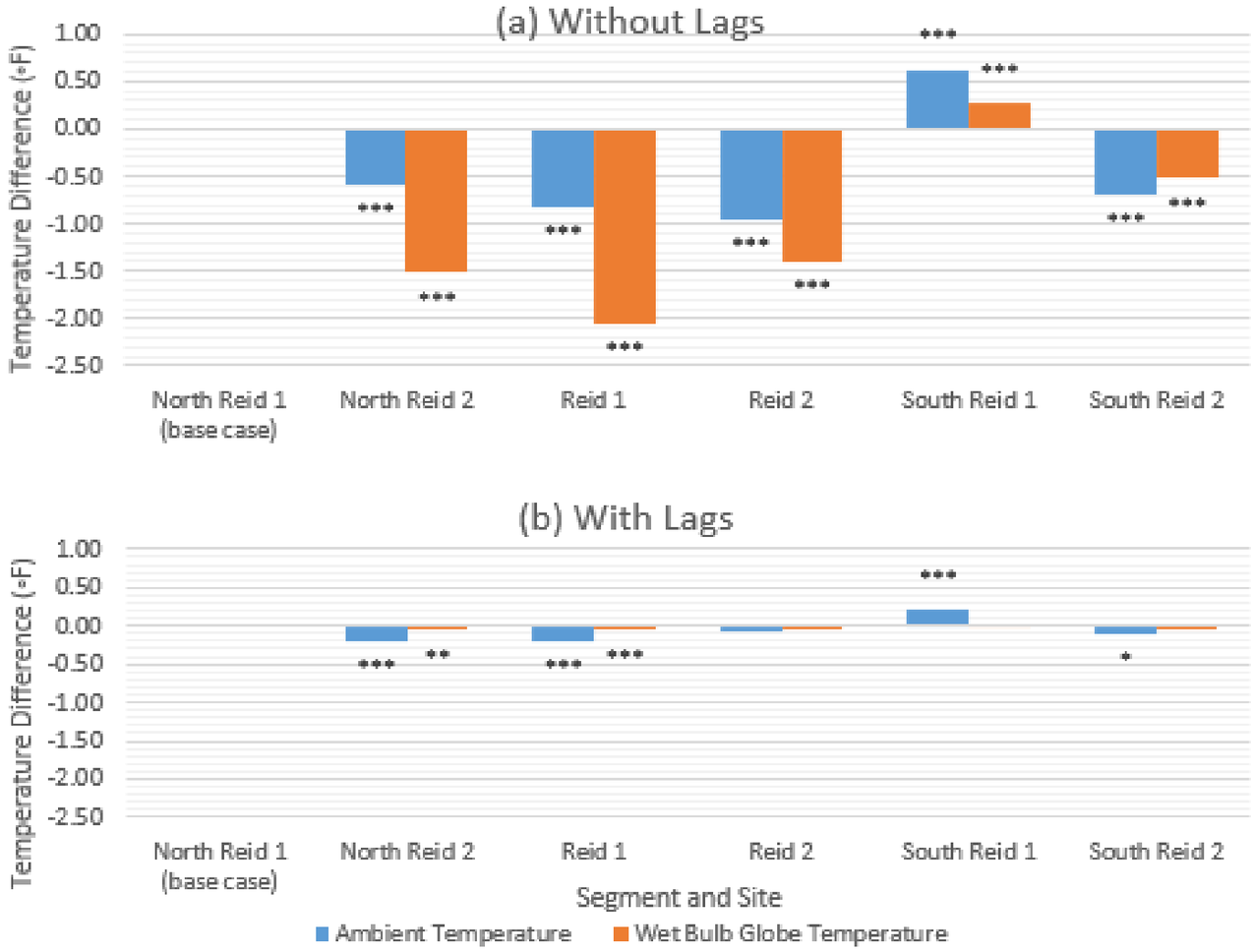
Summary of Findings

Focusing on Before/After, Treatment Only

Controlling for temporal autocorrelation

Centerline Analysis

	Ambient (^{o}F)	WBGT (^{o}F)
Autocorrelation one-min. lags	1	3
Shade	-0.3	-0.08
Wind	-1.0	-0.04
After (vs. Before)	-0.3	*Not sig.*



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%

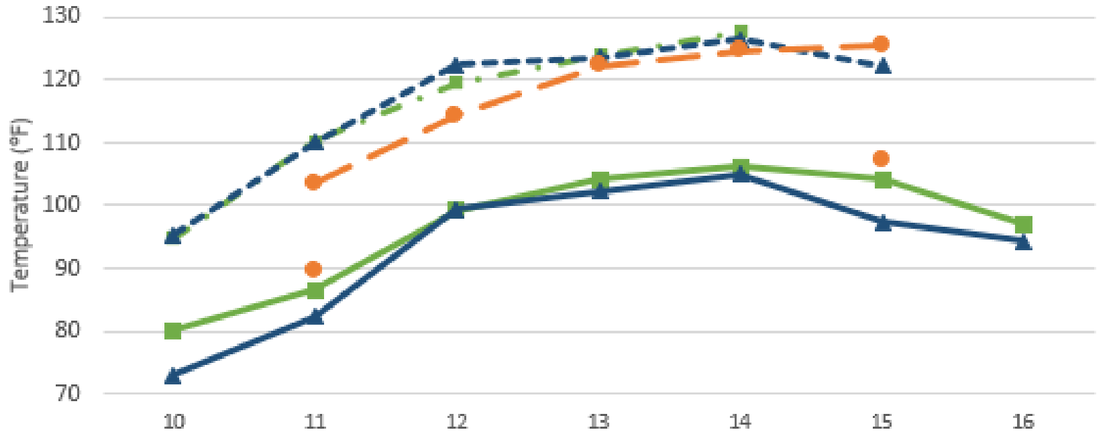
Summary of Findings

Surface Temperatures

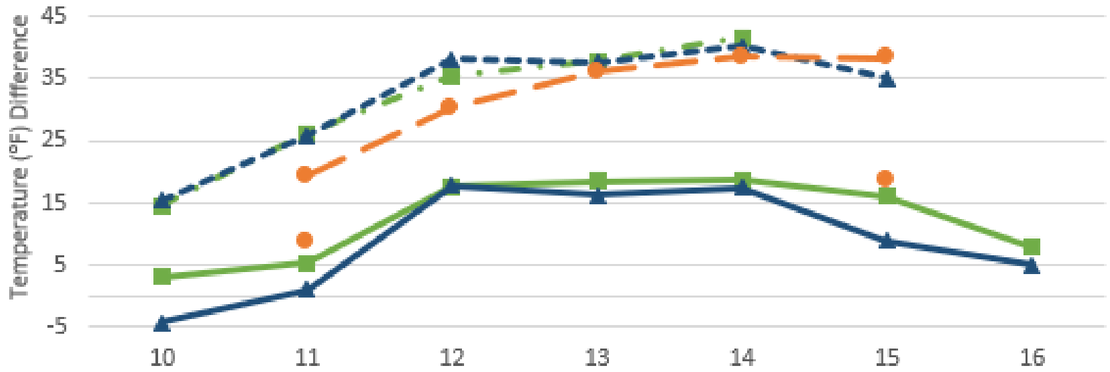
- Collected hourly

Complications in case/control with micro-climates

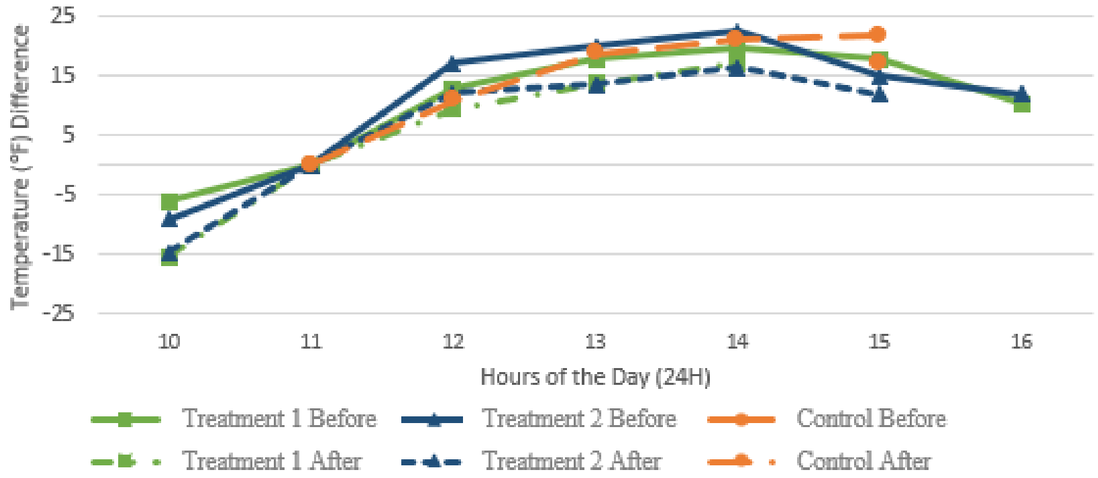
Temperature (^{O}F)



Temperature (^{O}F) Difference with Airport Ambient



Temperature (^{O}F) Difference with Surface Temperature



Challenges and Caveats

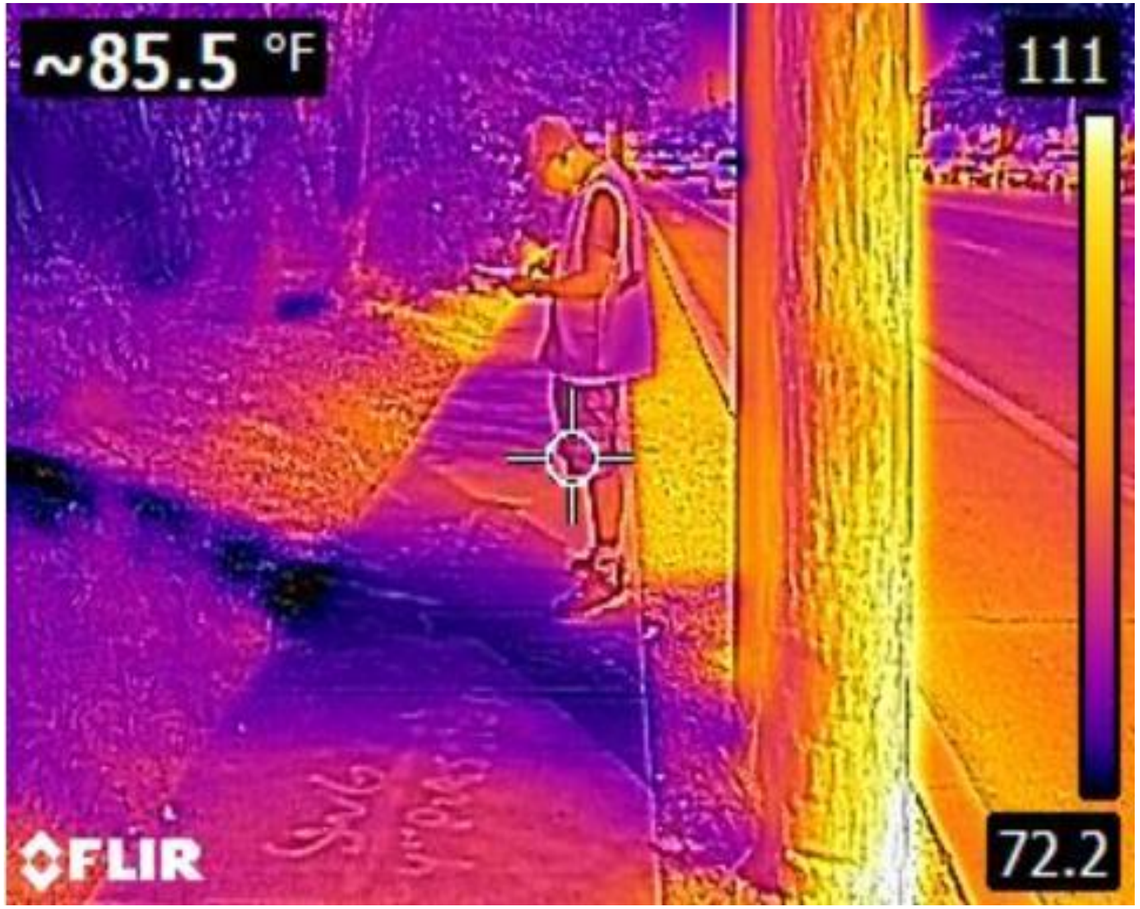
Observations (vs. Predictive Modeling)

- 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?

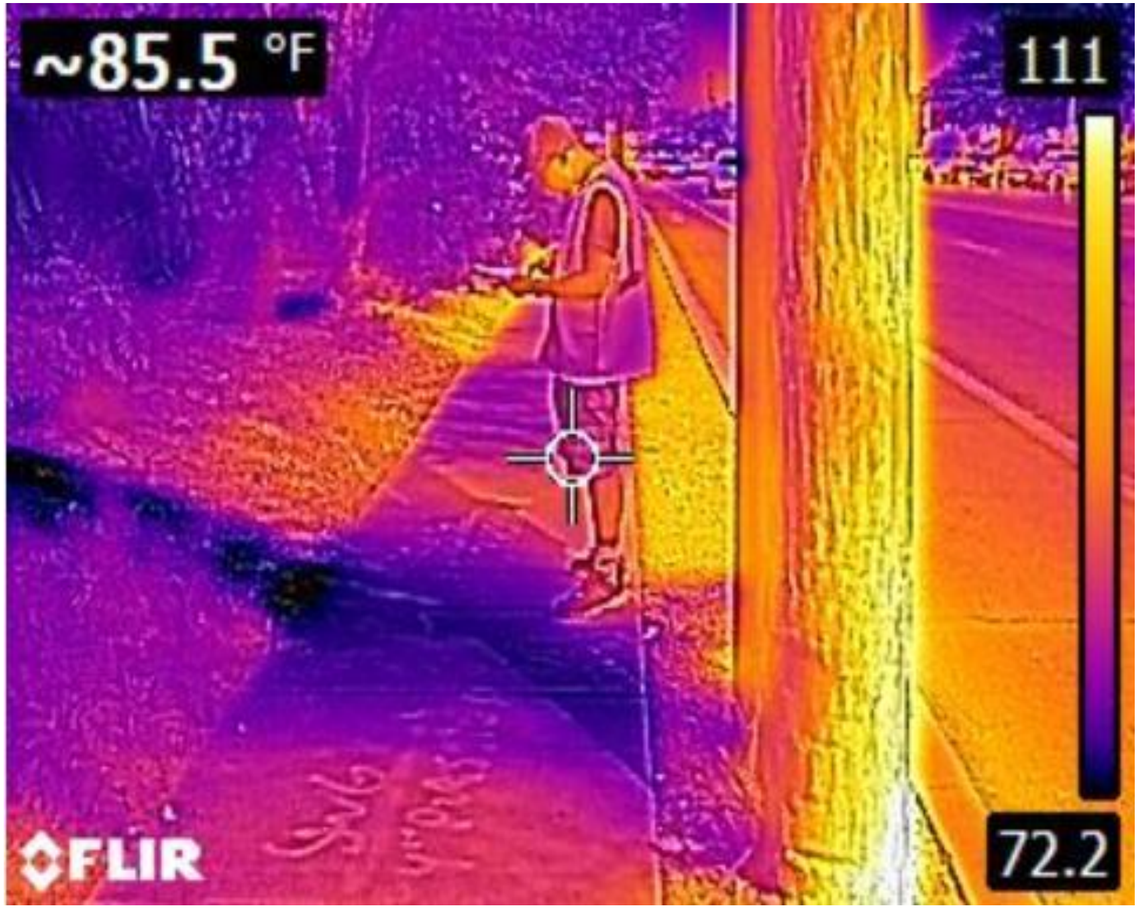
- Greening
- Cool Pavements

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

NITC
NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

THE UNIVERSITY OF ARIZONA