

Different Building Materials Influence on Comfort for Urban Outdoor Dining

Jordan Fritz¹, Sandra Yuter^{1,2}, Laura Tomkins², Matthew Miller¹

¹Department of Marine, Earth and Atmospheric Sciences and the ²Center for Geospatial Analytics, NC State University, Raleigh, NC



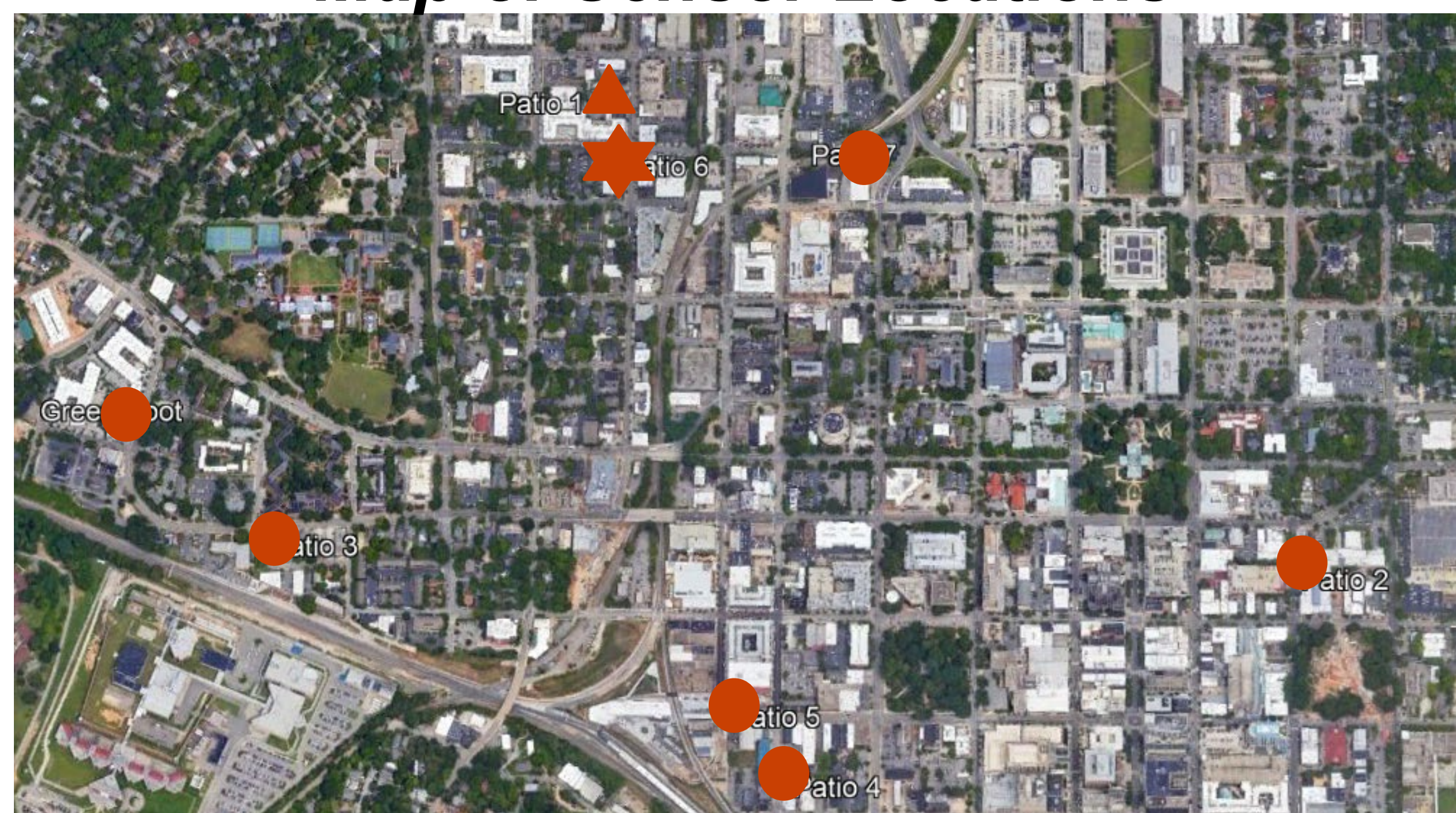
Motivation

It is well known that cities, especially in the summer, are “heat islands” experiencing higher temperatures than outlying rural areas. These high temperatures can cause heat stress in people, leading to a variety of adverse health effects. This study aims to understand how different building materials within a city influence the temperature and heat stress experienced by people.

Methods

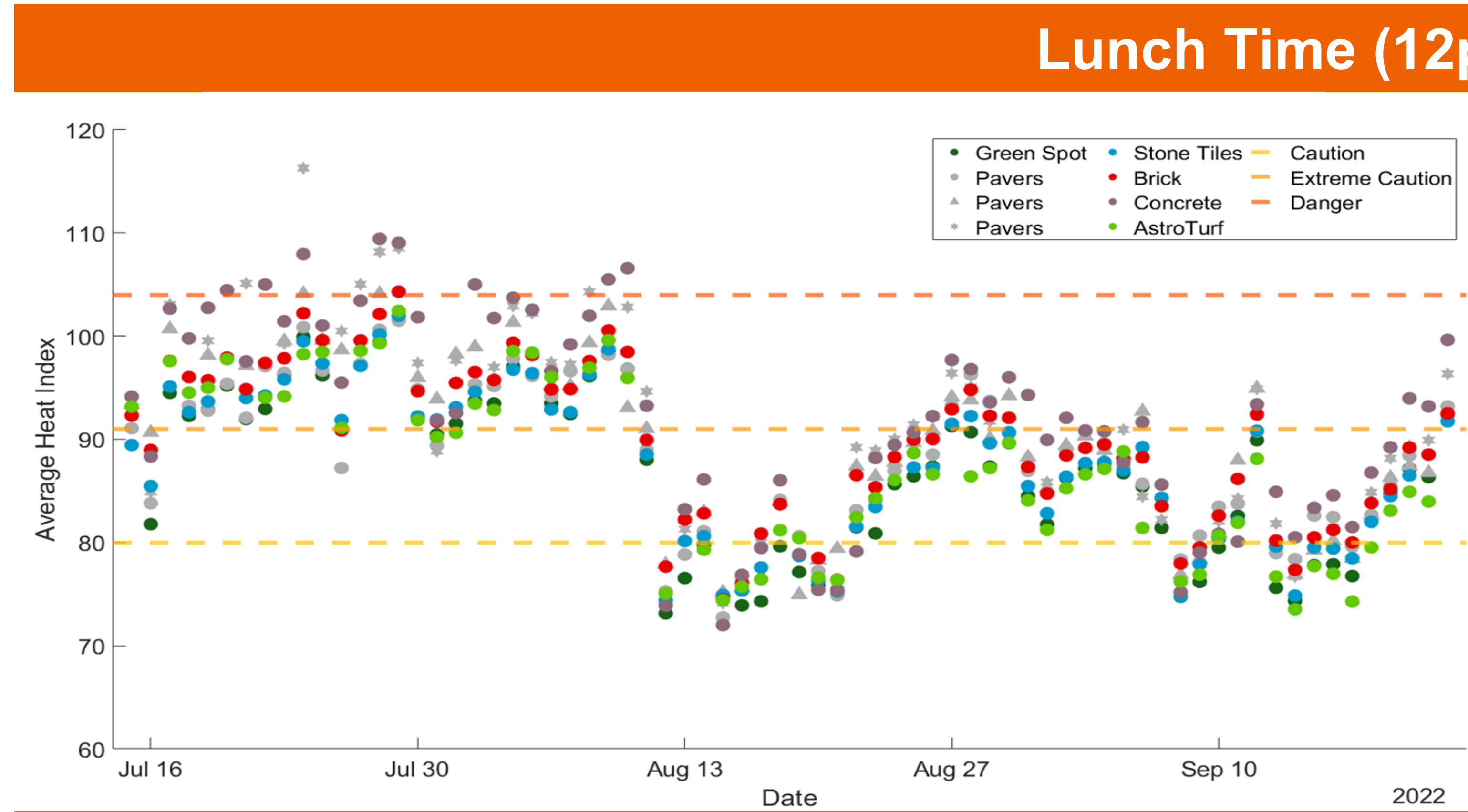
We deployed eight temperature and humidity sensors from July 15, 2022 to September 23, 2022. Seven sensors were deployed in patio eating areas across downtown Raleigh, NC. One sensor was deployed in greenery near a house in downtown to act as the “green spot” control. We focus on air temperatures and the heat index during lunch time (12pm - 3pm local time) and dinner time (5pm - 9pm local time) which correspond to peak times when people are outside in the downtown area. People start to feel heat stress when the air temperature is above 86 °F or the heat index (which combines air temperature and humidity) is above 91 °F. The patio locations include concrete pavers, stone tiles, red brick, concrete, and AstroTurf. We removed data that have obvious discrepancies related to watering of foliage near the sensor. The calculation of heat indices follows the National Weather Service (NWS) Heat Forecast Tools standard.

Map of Sensor Locations

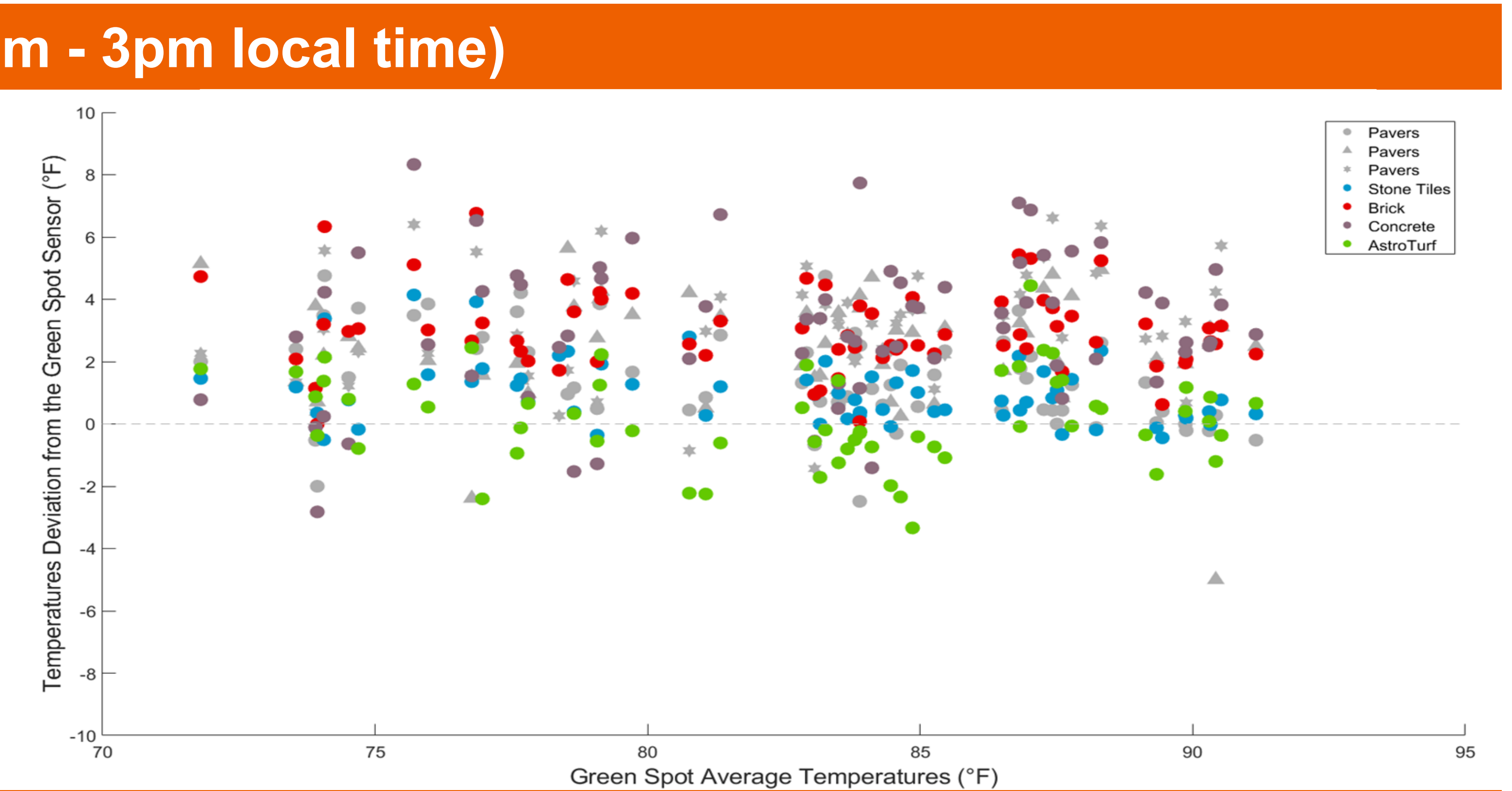


Above: A map of downtown Raleigh with the sensor locations marked in orange red.

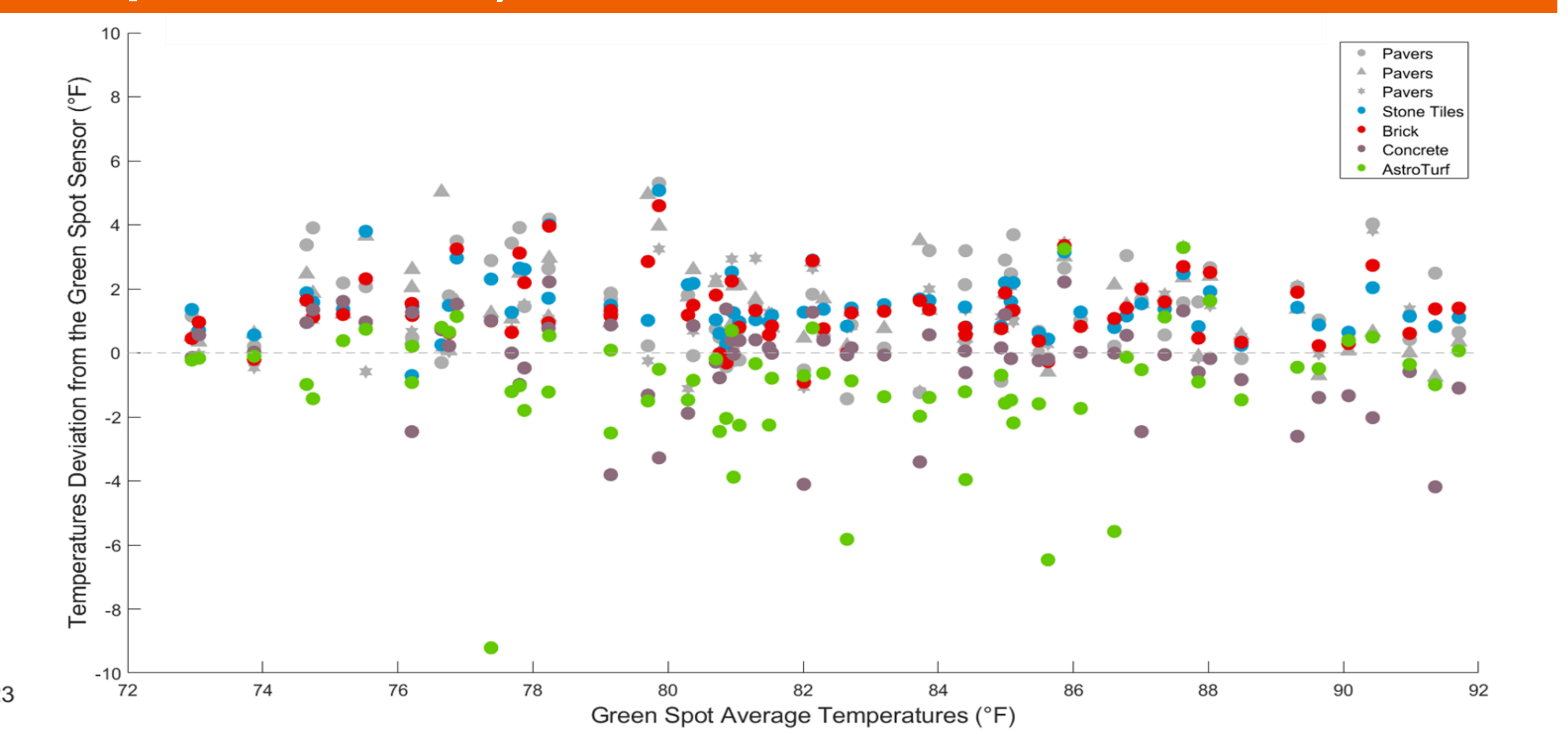
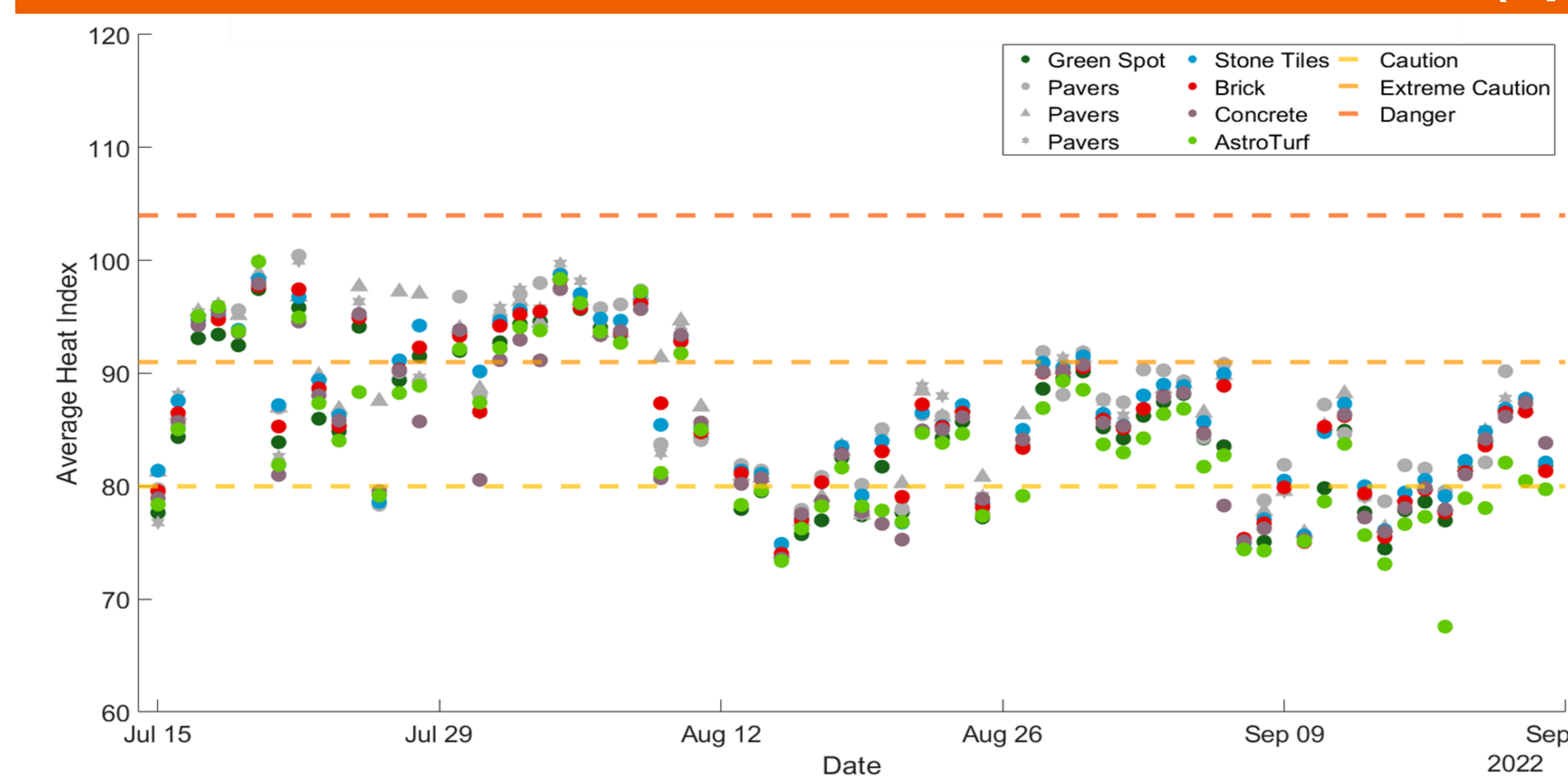
Time Series of Heat Indices



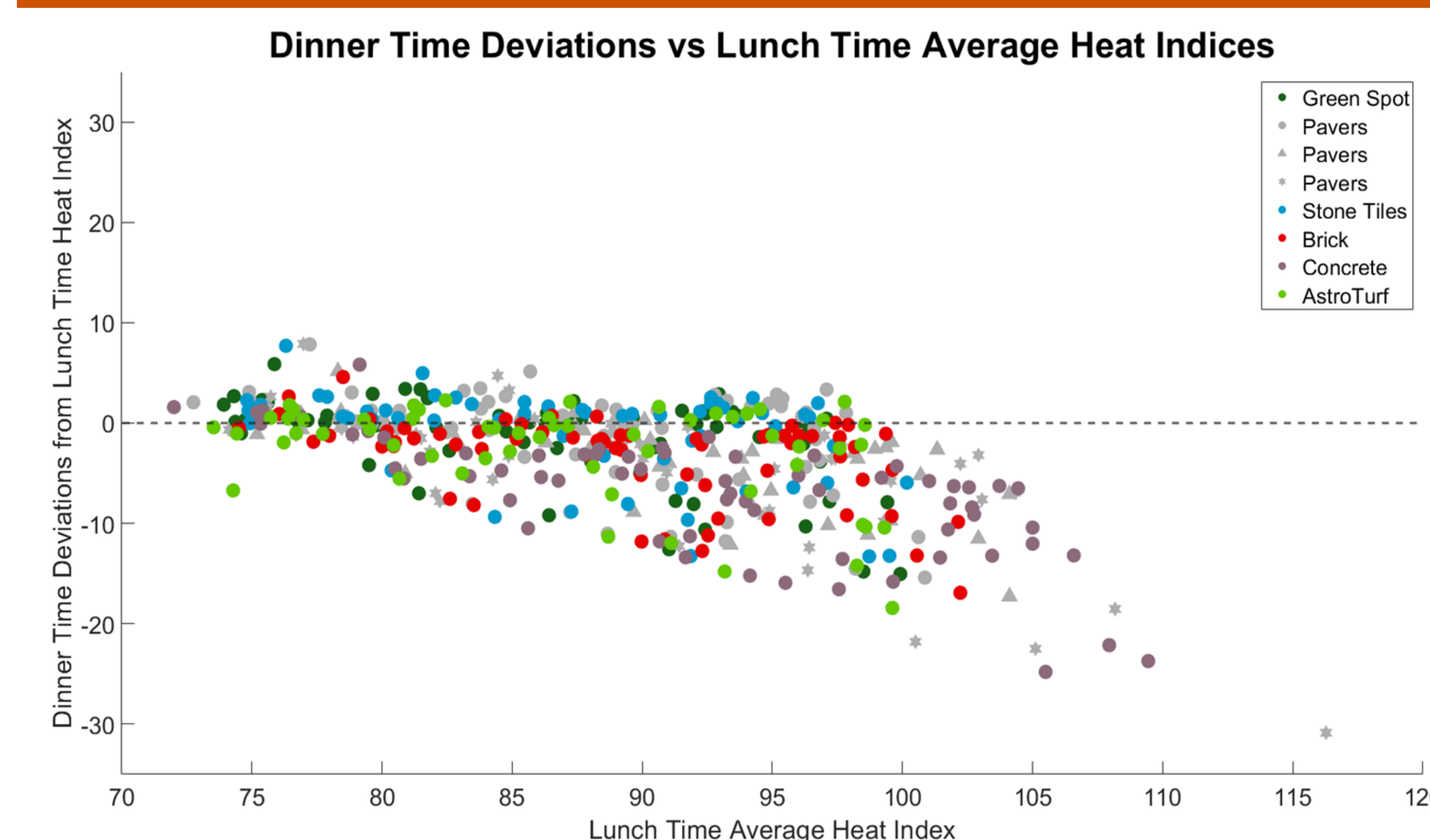
Differences between Patios and Green Spot Control



Dinner Time (5pm - 9pm local time)



Lunch vs Dinner Heat Indices



Summary

- The risk of heat stress tends to be greater during lunch time than dinner time. From 15 June to 10 August 2022, most days had lunch time heat indices above the “extreme caution” range.
- Patios of concrete and pavers tended to have warmer average temperatures and heat indices during lunch.
- The patio with AstroTurf tended to have cooler average temperatures and heat indices during lunch and dinner time.
- If someone is sensitive to heat stress, they should be advised not to dine outside in downtown Raleigh during lunch time in the summer months.

Acknowledgments

This work was supported by the Robinson Brown Ground Climate Study donation funds, NASA 80NSSC19K0354, NSF AGS-1905736, ONR N000142112116. Special thanks to McKenzie Peters, Logan McLaurin, McKenzie Seiver, and Cameron Gilbert for their feedback.