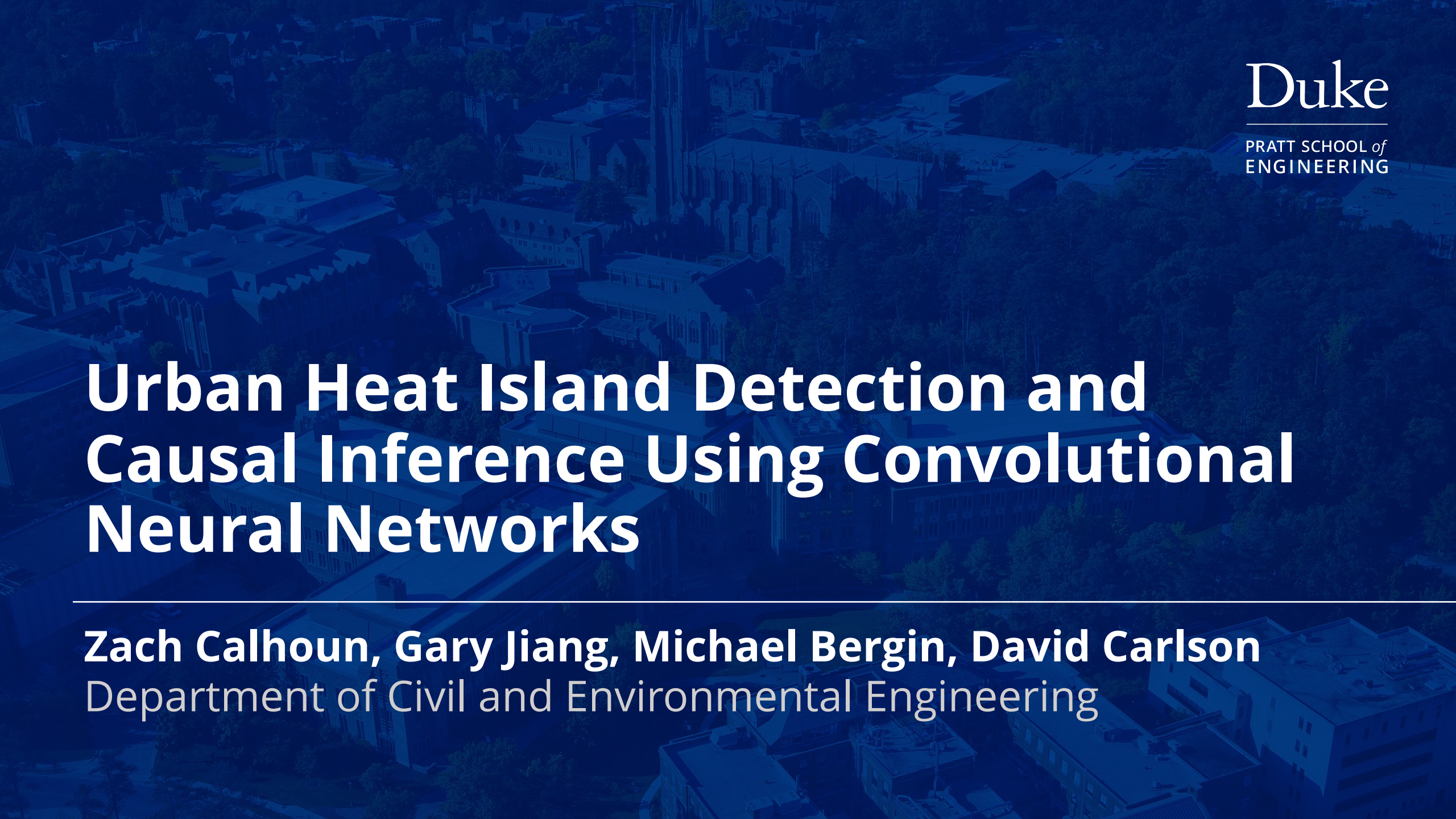


Duke
PRATT SCHOOL of ENGINEERING

Urban Heat Island Detection and Causal Inference Using Convolutional Neural Networks

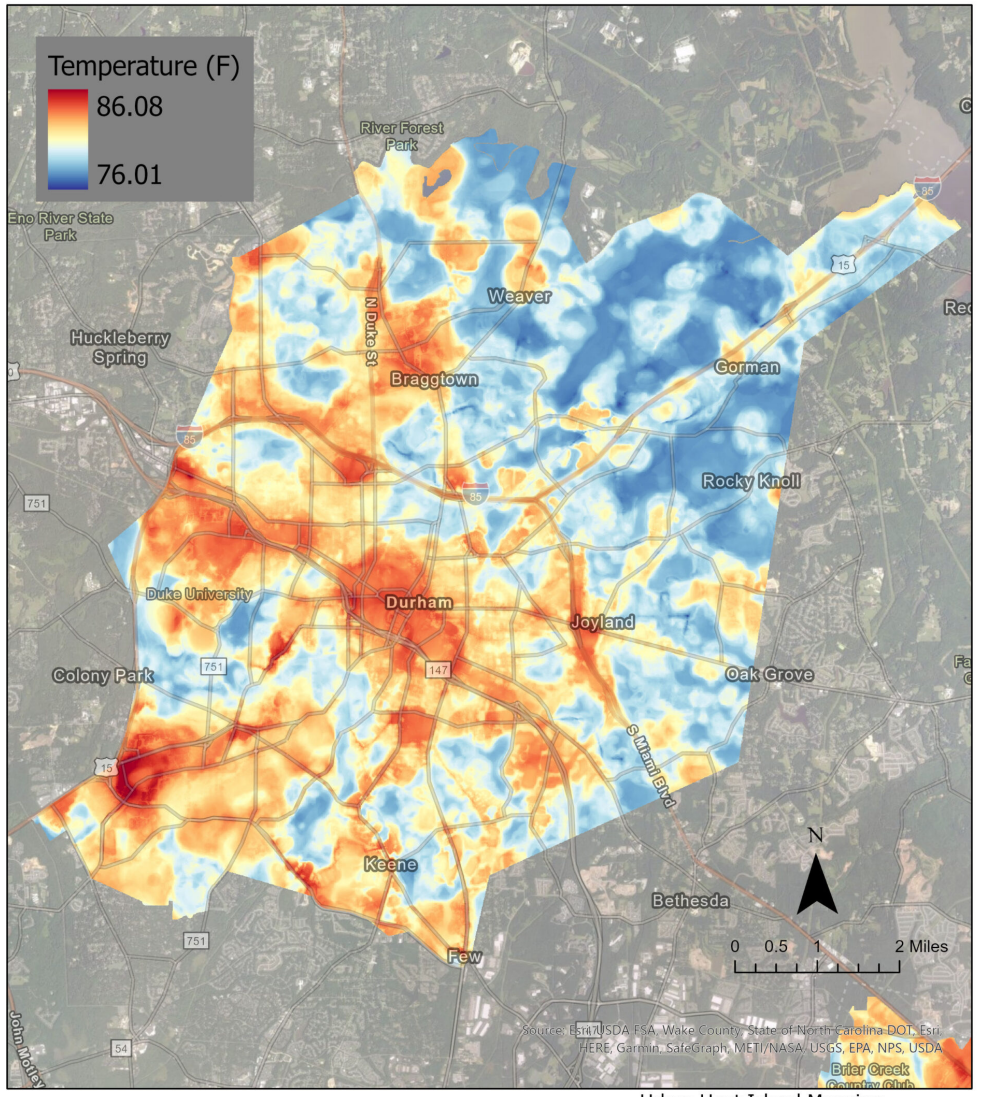
Zach Calhoun, Gary Jiang, Michael Bergin, David Carlson
Department of Civil and Environmental Engineering

Heat stress is worse in cities because of the urban heat island effect

- More heat = higher mortality, electricity consumption
- Good city design → decreased UHI effect.
- One-size-fits-all solutions may fail (e.g., a tree planted to provide shade during the day may inhibit airflow at night).
- Regionally developed solutions are needed.

Durham Evening Temperature (7-8pm)
July 23, 2021

NORTH CAROLINA CLIMATEOFFICE



Urban Heat Island Mapping
climate.ncsu.edu/research/uhi

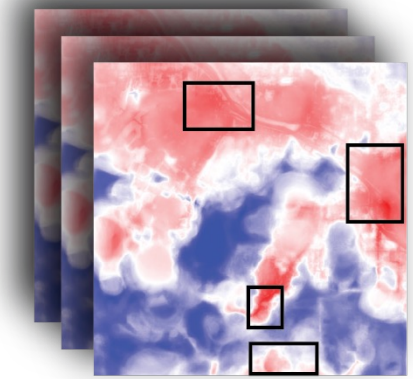
We propose a methodology to understand the localized urban heat island phenomenon

Change detection of urban features over time

Classify changes

Example Classes:

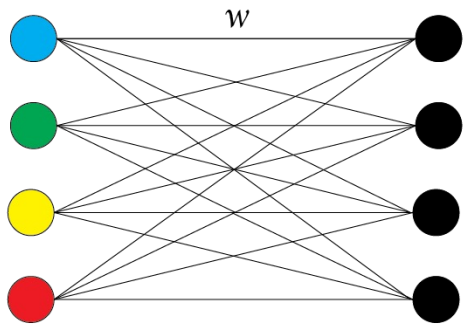
- Low-rise homes
- Green space
- Highway
- Mid-rise homes



Measure changes in UHI over time

Urban features

Heat Islands



Calculate feature importance

Objective 1: Better Model Temperature at the Urban Canopy Layer

Most models today measure land surface temperature, because it is easy.

We want to measure temperature at the urban canopy layer, because this is where humans live!

This requires a combination of satellite imagery, ground-based temperature measurements, and physical understanding.

Objective 2: Understand Causal Relationship between Urban Form and Heat Islands

- Use change detection and semantic segmentation to understand how land use changes.
- How has this land use change affected temperature?
- Can we measure this impact at the city block level?

Objective 3: Generalize to other cities

- We want our methodology to be repeatable.
- Potential domain adaptation problem. Can we re-use our models in new locations? How much new training is required?

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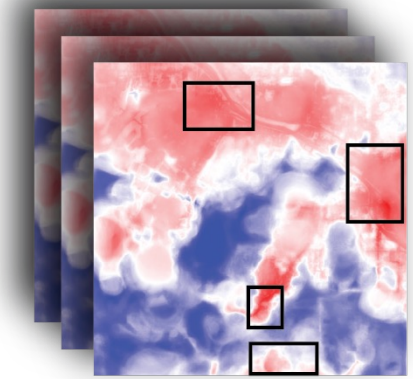

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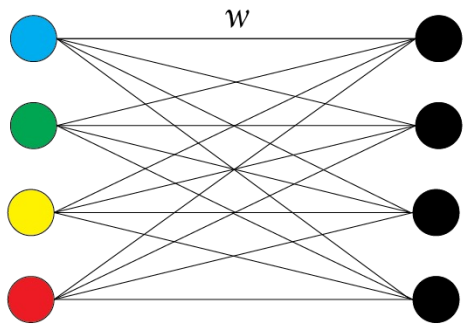

Calculate feature importance