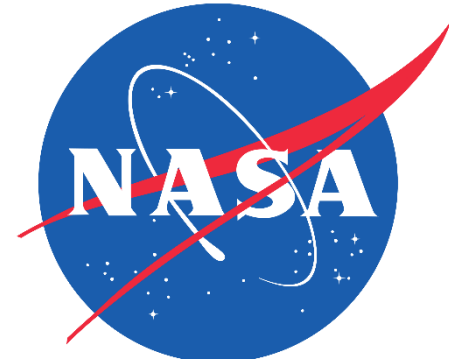# Utilizing NASA Earth Observations to Evaluate Urban Tree Canopy and Land Surface Temperature for Green Infrastructure Development and Urban Heat Mitigation in Huntsville, AL

Greta Paris, Sabine Nix, Thomas Quintero, & Amanda Tomlinson

Abstract

Huntsville, Alabama's population has grown by 10.8% since 2010, due in part to the city's advancing engineering industry. Rapid urban growth negatively impacts the environment by decreasing tree canopy cover and increasing impervious surface cover, which can intensify the urban heat island effect. To examine the impacts of this urban growth on the environment, the team partnered with the City of Huntsville to utilize Landsat 5 Thematic Mapper (TM), Landsat 8 Operational Land Imager (OLI), Landsat 8 Thermal Infrared Sensor (TIRS), Terra Moderate Resolution Imaging Spectroradiometer (MODIS) and the International Space Station's Global Ecosystems Dynamic Investigation (GEDI) and ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS). The team utilized these Earth observations in combination with ancillary datasets to create a suite of end products to assist in mitigating the effects of extreme heat due to urban expansion and tree canopy loss. Rasters of annual land surface temperature (LST) was calculated in Google Earth Engine from 2010 to 2019. The team derived land cover classes through supervised and threshold classification methods to distinguish trees, other vegetation types, impervious surfaces, and water. From 2010 to 2019, LST increased approximately 4 °F for all census tracts within the city and the total amount of tree cover increases less than 3%. The findings will aid the city in future decision-making processes by indicating areas that would benefit from increased green infrastructure.

Objectives

- **Quantify** the impact of Huntsville's urban expansion on tree canopy cover, impervious surfaces, and land surface temperature
- **Assess** the relationship between factors of social vulnerability, tree canopy cover, expansion of impervious surfaces, and land surface temperature
- **Provide** tree canopy and heat vulnerability analysis to allow end users to incorporate this information into future decision-making
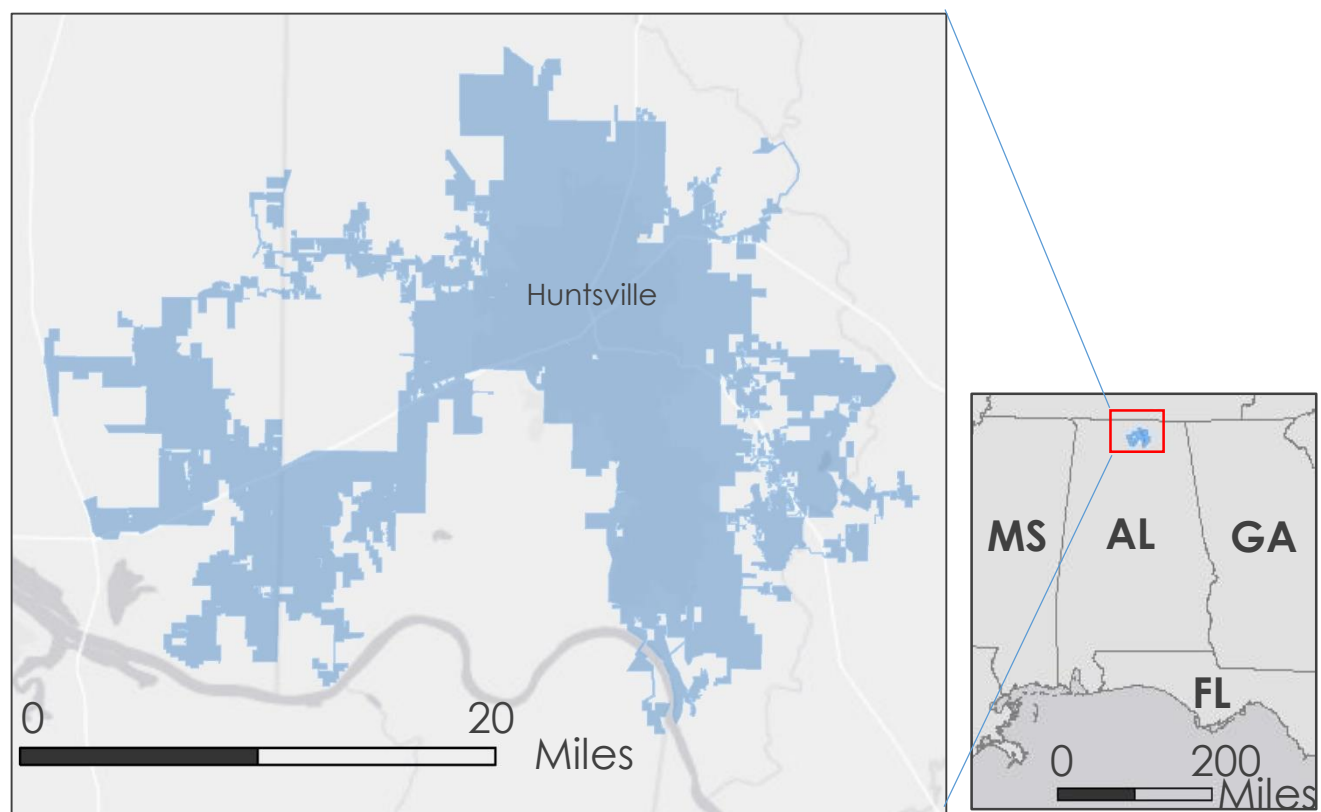
Methodology
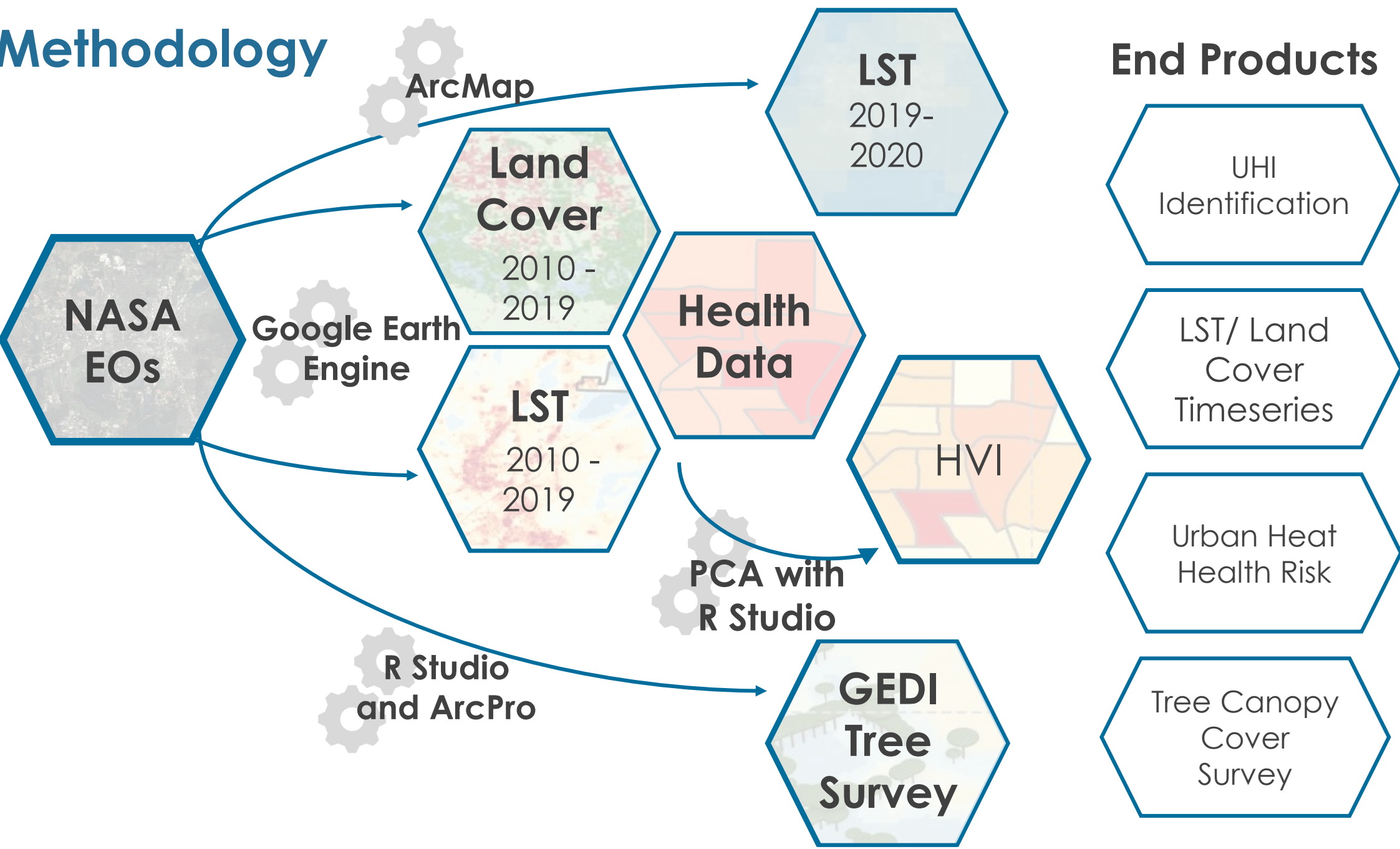
Project Partners

- **The City of Huntsville**: Urban and Economic Development, Geographic Information Systems (GIS), Urban and Long-Range Planning, City Planning, Landscape Management, and City Engineering
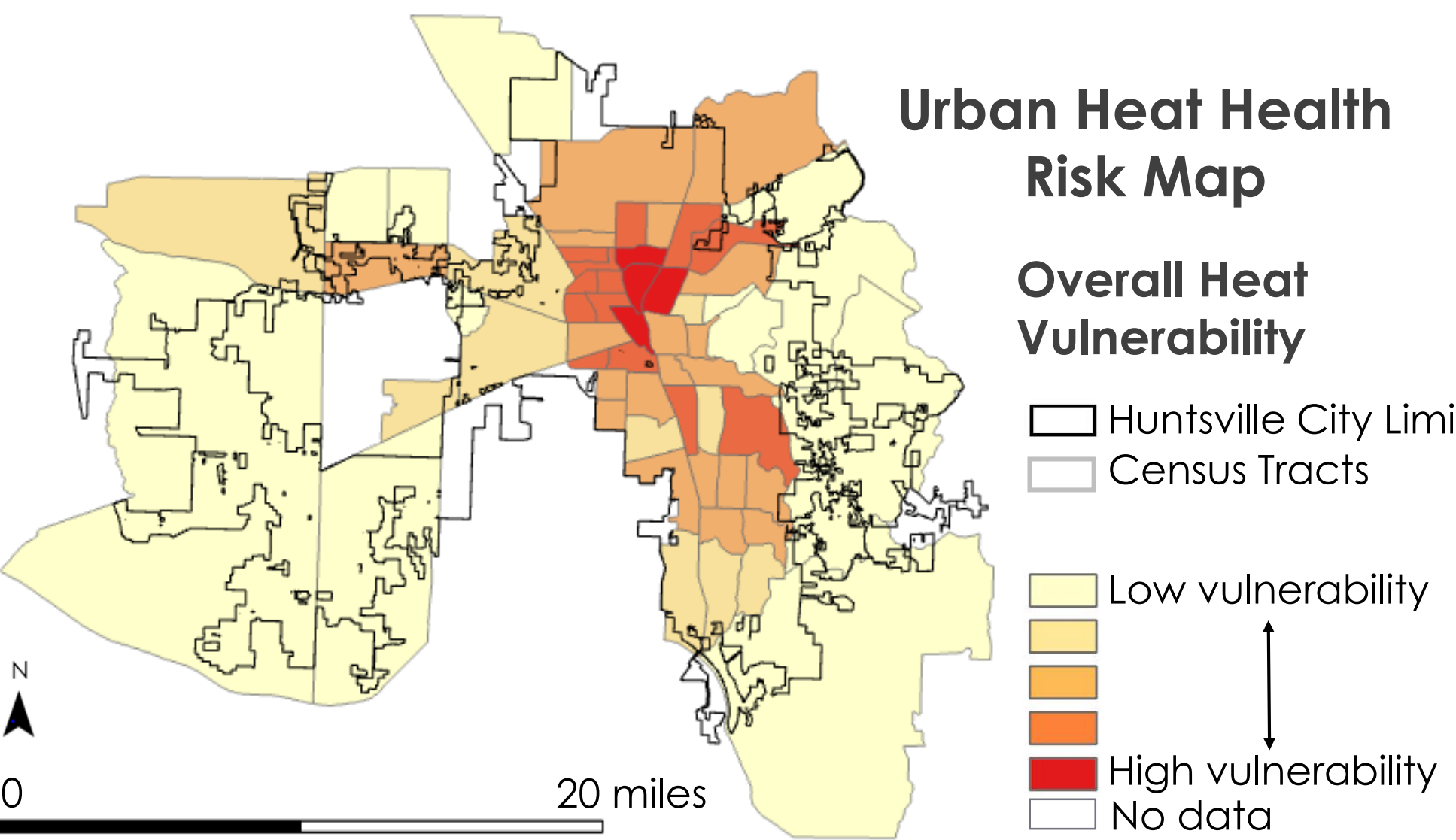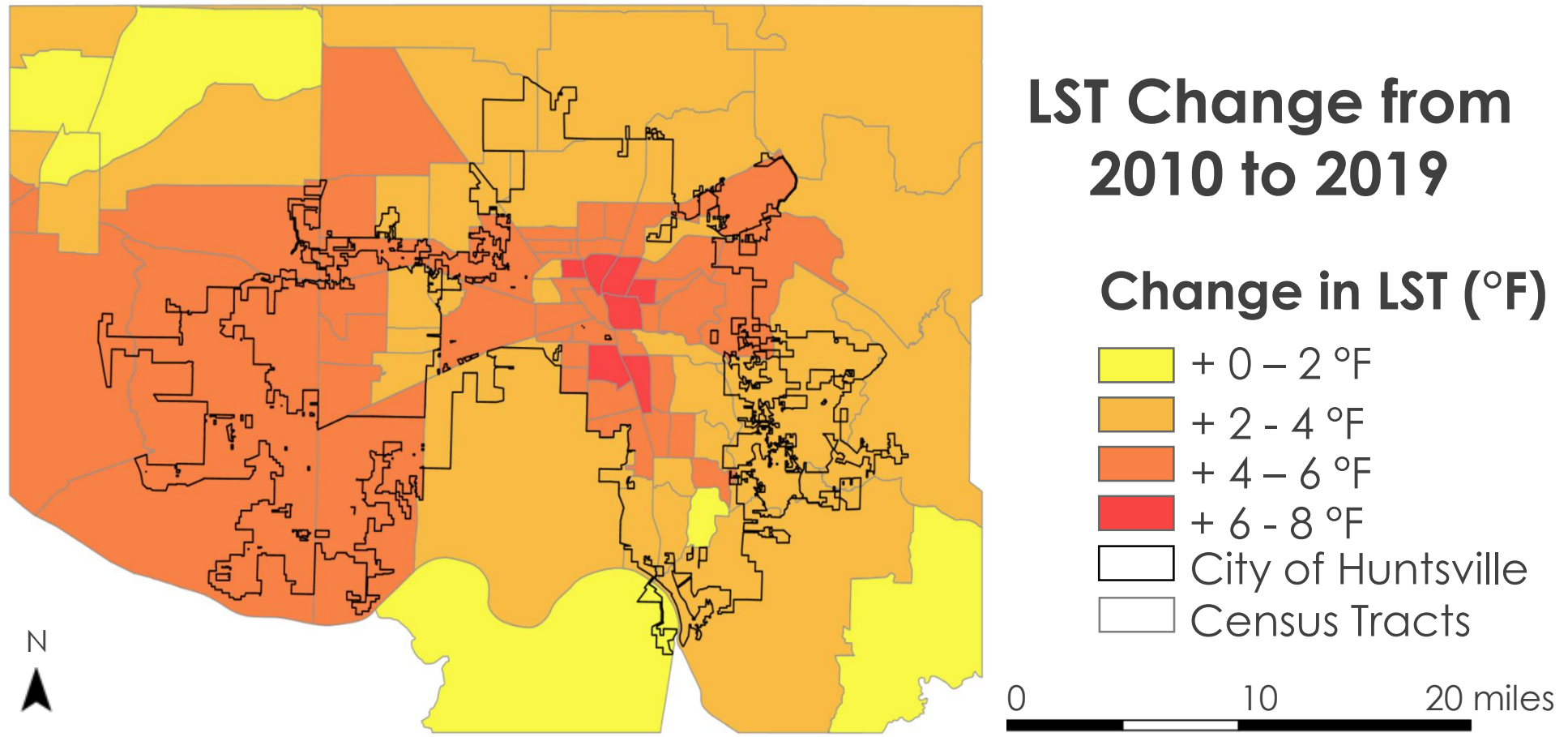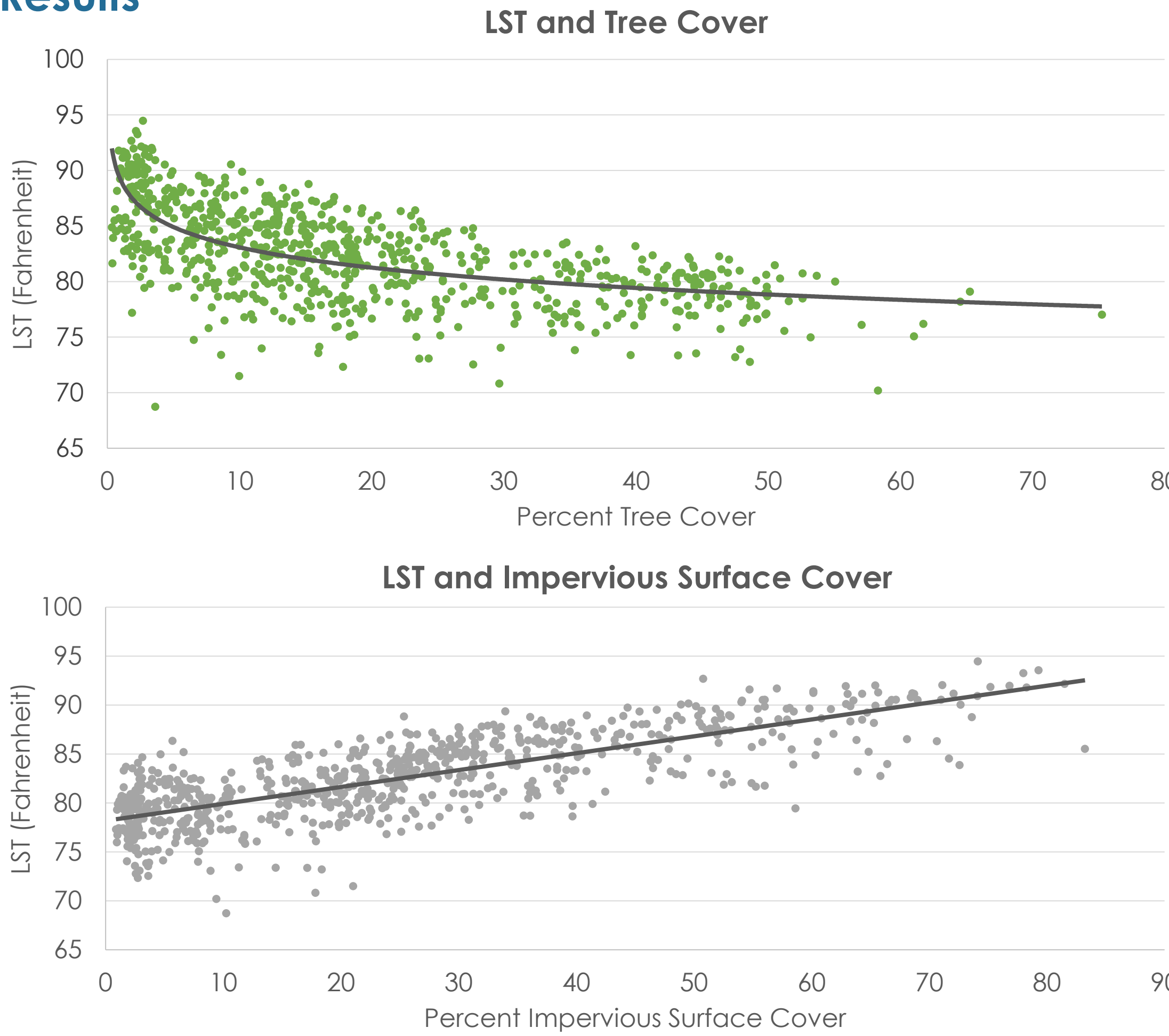
Study Area

Huntsville

MS AL GA
FL

0 ... 20 Miles
0 ... 200 Miles

Earth Observations

Landsat 5 TM

Landsat 8 OLI and TIRS

ISS ECOSTRESS and GEDI

Terra MODIS

Results

LST and Tree Cover

LST (Fahrenheit) vs Percent Tree Cover

LST and Impervious Surface Cover

LST (Fahrenheit) vs Percent Impervious Surface Cover

LST Change from 2010 to 2019

Change in LST (°F)

- + 0 – 2 °F
- + 2 – 4 °F
- + 4 – 6 °F
- + 6 - 8 °F
- City of Huntsville
- Census Tracts

0 ... 10 ... 20 miles

Urban Heat Health Risk Map

Overall Heat Vulnerability

- Huntsville City Limits
- Census Tracts

- Low vulnerability
- High vulnerability
- No data

0 ... 20 miles

Conclusions

- LST has **increased** by approximately **4˚F** while tree cover has increased by **3%** across the city from 2010 to 2019.
- Urban expansion in Huntsville has **not substantially** impacted tree canopy cover from 2010-2019.
- GEDI data showed an average tree height of **82 feet** and mean plant area index of 3.

Acknowledgements

About DEVELOP
#NASADEVELOP

Contact
Questions?
About Project – nixs@sas.upenn.edu
About DEVELOP – NASA-DL-DEVELOP@mail.nasa.gov