

# Intra-Urban Temperature Variability and Vulnerable Populations in Knox County, TN

Sarah Elizabeth Scales,<sup>1</sup> Jennifer First,<sup>2</sup> and Kelsey Ellis,<sup>3</sup> Kristina W Kintziger,<sup>1</sup>

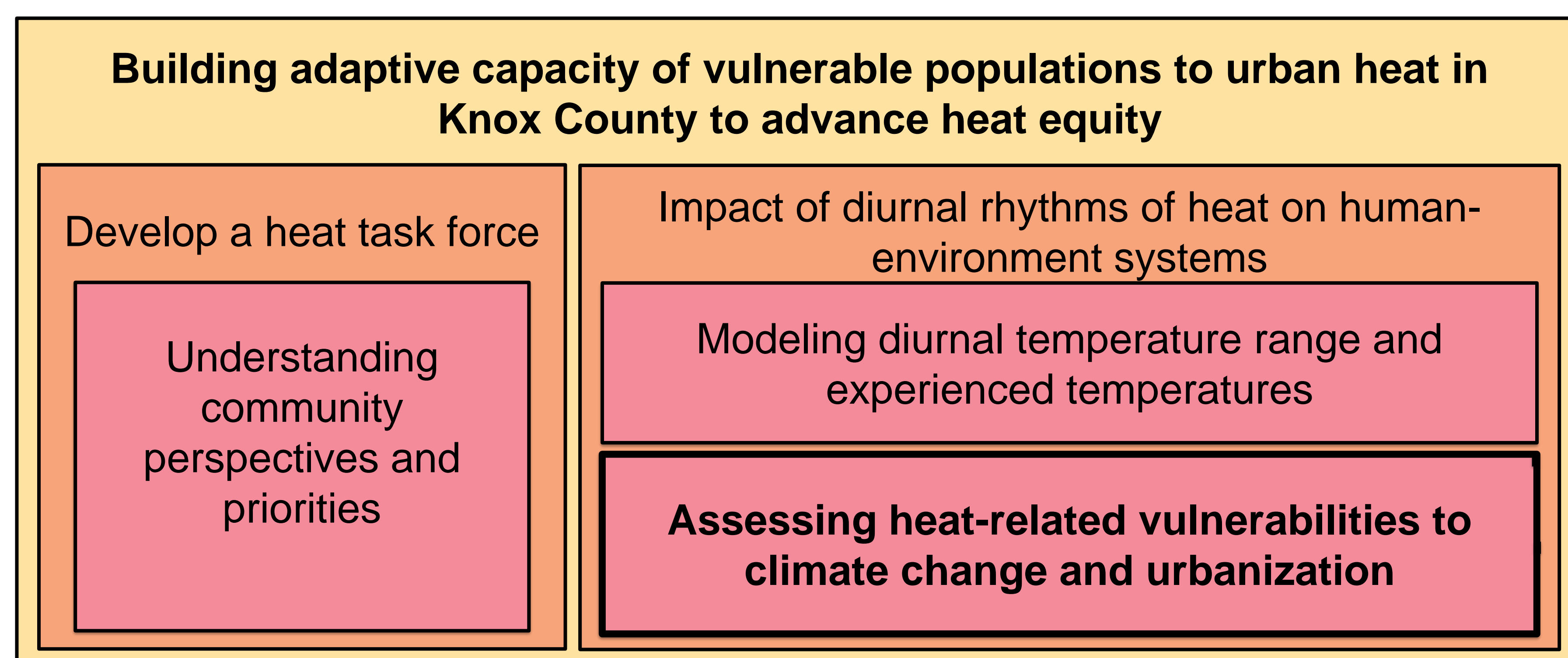
<sup>1</sup> University of Nebraska Medical Center; College of Public Health; Water, Climate, and Health Program

<sup>2</sup> University of Tennessee Knoxville, College of Social Work

<sup>3</sup> University of Tennessee Knoxville, College of Arts and Sciences, Department of Geography



## Project Goals, Tasks, and Approach

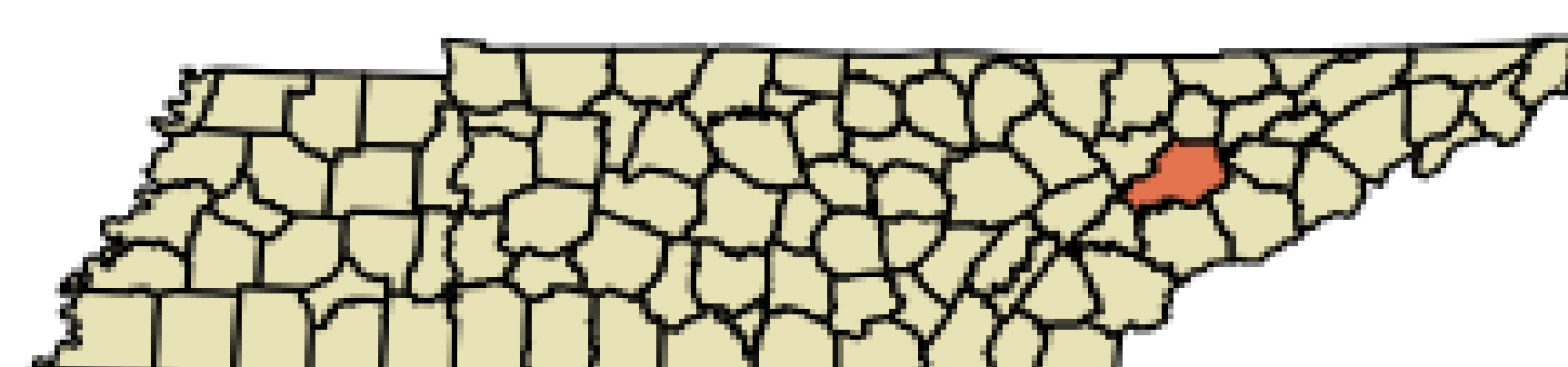
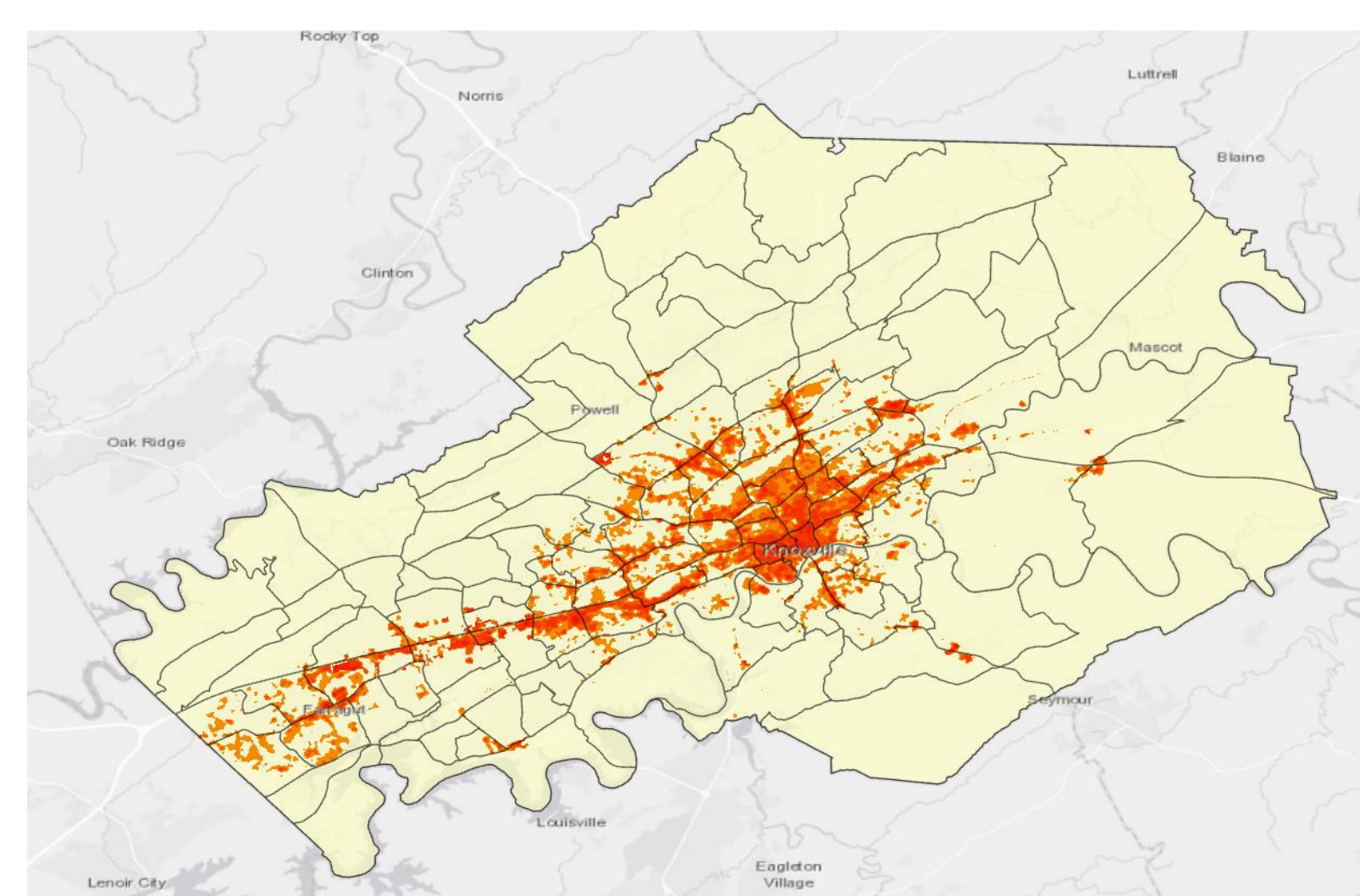


## Background

Extreme heat events are becoming more severe and frequent, due in part to climate change and urbanization-related changes in humidity, precipitation, and air temperature. Certain populations – such as unhoused individuals, those without access to air conditioning or transportation to cooling centers, and those living in urban heat islands (UHI) – are at disproportionate risks for increased morbidity and mortality. Further, chronic conditions like cardiopulmonary diseases, are exacerbated in extreme heat events, further contributing to increased heat-related illness, injury, and death.

## Study Location

To address gaps in research around the socioeconomic and environmental factors that influence heat vulnerability in the southeastern United States, we sought to assess social and health vulnerabilities resulting from climate change and urbanization, with specific interest in UHI effects, in Knox County, TN.



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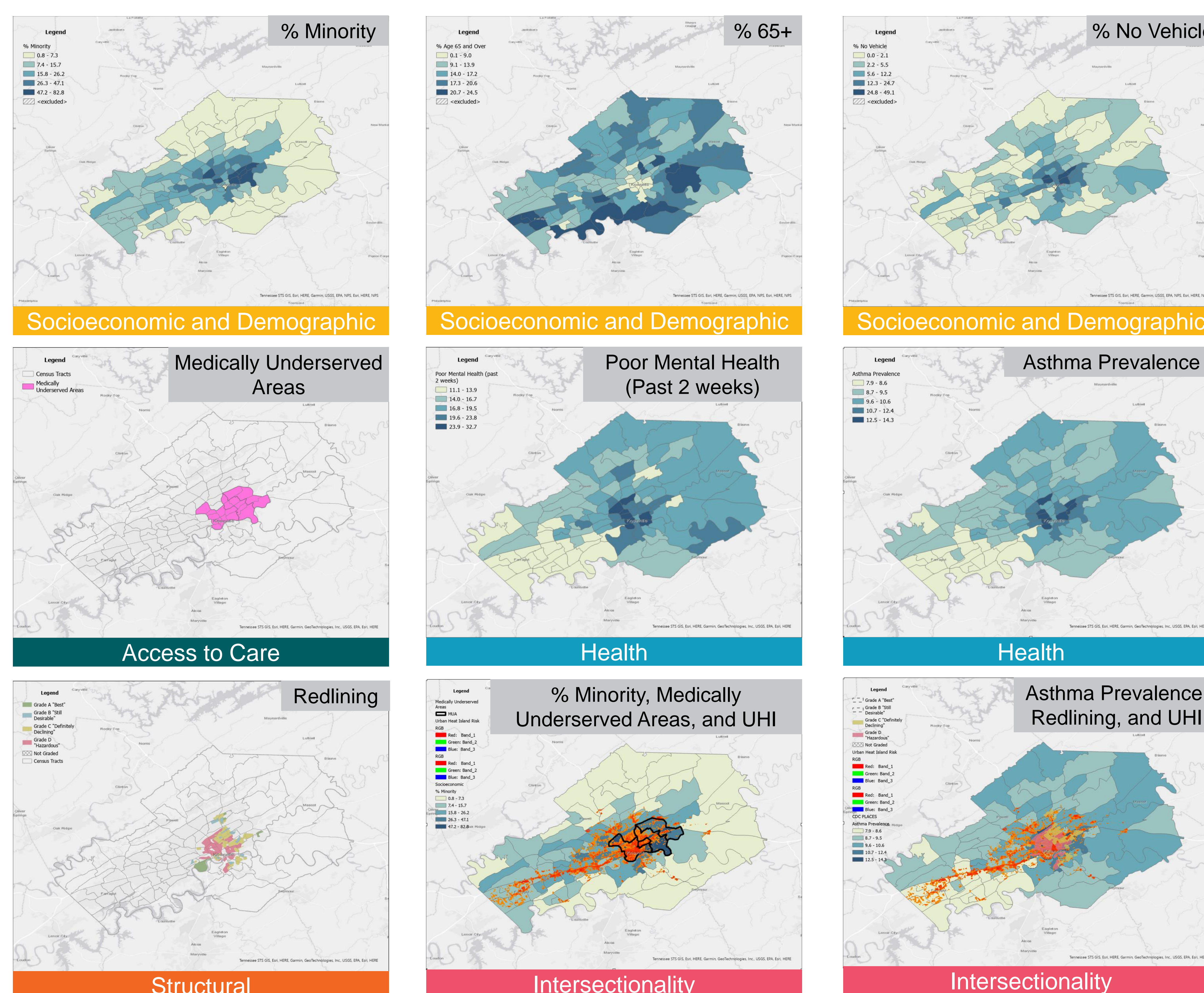
Knoxville is the largest city in Knox County with a population of 187,487. The entire county has a humid, sub-tropical climate, with an average maximum July temperature of 29.6°C/85.28°F in July. Knox County is situated between the Appalachian Mountains to the southeast and by the Cumberland Mountains to the northwest. This geography affects weather patterns and air quality throughout the county.

## Methods

We compiled publicly available data from a variety of sources to address Knox County vulnerabilities to heat. Basic descriptive statistics, Spearman correlation analysis examining the relationship between social and health-related vulnerability variables and increased risks of UHI effects, and principal component analysis (PCA) to reduce data explaining heat vulnerability were conducted. A geographic information system (ArcGIS, ESRI) and SAS v.9.4 (SAS Institute) software were used to visualize and analyze these data to explore the factors driving vulnerability across Knox County.

## Results

Thirty-three variables were significantly correlated with UHI. Social vulnerability index (SVI) and subthemes of SVI (e.g., socioeconomic status, racial and ethnic minority status, and housing type and transportation), health care and preventive care access, disability status, redlining, chronic diseases (e.g., kidney disease, obesity), and overall mental, physical, and general health metrics were represented. These variables were subsequently included in PCA, which returned 4 principal components (PCs) explaining 81.94% of the total data variation. PCs represented socioeconomic and demographic characteristics, health status, minority status specifically, and structural considerations.



## Conclusions

Examining both social and health-related vulnerabilities, in the context of long-standing discrimination and economic inequality, provides a clearer understanding of the wide variety of disparities that exist related to environmental hazards such as climate change and extreme temperatures. Many evidence-based adaptation programs and interventions focus on one aspect of vulnerability, and few incorporate historical context into planning and implementation. The results of this investigation demonstrate the complex issues faced by the residents of Knox County who are most vulnerable to the impacts of extreme heat and climate change. Next steps include using PCA findings to construct a Knox-County specific heat vulnerability index to be incorporated into the county heat action plan and urban sustainability efforts. This framework can be adapted for other southeastern cities that have a similar history of segregation and discrimination through redlining.