Research Institutes | Chemical Insights

TECHNICAL BRIEF

A Strategic Research Initiative on the Combined Impact of Urban Heat and Indoor Air Quality Exposure on Human Health

Chemical Insights Research Institute (CIRI) and its research partners from Duke University are developing an approach to map urban heat stress and its correlation to measured air pollution.

Introduction

Many urban regions within the U.S. are currently experiencing 50 days or more with dangerously high heat index values over 100°F, a trend that is expected to increase in the future. In addition, the amount of heating that occurs across urban regions is not uniform, with some areas being hotter than others by 6°F or more. In many cases, the hottest urban locations are in areas with low-socioeconomic populations that are also near sources of air pollution from roadways and industrial activities. This suggests that the highest heat stress experienced by urban populations will be accompanied by similarly high air pollution exposure. Currently, it is difficult to estimate the combined impact of heat and air pollution on human health in urban settings due to a lack of overlapping data on urban heat stress, indoor and outdoor air quality, and health response.

CIRI and its research partners from Duke University are developing an approach to map urban heat stress and its correlation to measured air pollution. Residential occupant health outcomes will be measured to understand how these factors could negatively affect health. Furthermore, mitigation strategies will be developed to minimize urban heat and air pollution exposures in a warming climate. Initial research studies will be conducted in Durham, NC. This approach will build a framework that can be extended to other major urban areas of the U.S., with an overall methodology that can be applied globally.

Study Objectives

- Develop high-resolution (neighborhood-level) maps of heat stress and indoor and outdoor air pollution across Durham, NC, and other major urban regions of the U.S.
- Determine the combined influence of heat stress and air pollution on human health within communities of varying socioeconomic status in Durham, NC.
- Establish mitigation strategies to reduce heat and the exposure to indoor air pollution in the Durham, NC, study area.

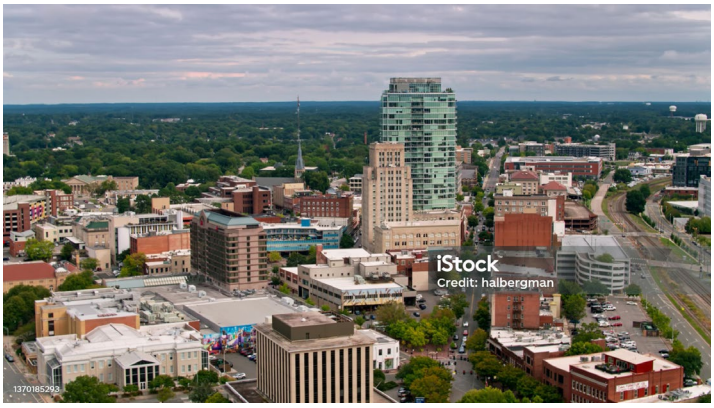

Figure 1: Durham, North Carolina

Study Plan Overview

To accomplish our research objectives, measurement and assessment approaches will include:

1. Combining existing meteorology measurements with advanced machine learning/satellite imagery methods to determine neighborhood-level heat stress in Durham and other key urban regions of the US.
2. Using low-cost air quality sensors for real-time measurement of pollutants inside and outside of approximately 40 homes in selected hot and cool spots across communities of varying socioeconomic status in Durham, NC.
3. Using wearable sensor devices such as Oura rings to continuously measure key health parameters, including heart rate, heart rate variability, skin temperature, and activity patterns in Durham, NC.
4. Developing mitigation strategies (e.g., modifications in urban surface reflectance, green space, building heat emissions) to minimize the combined impact of heat and indoor air pollution on human health.

Scientific Outcomes

1

Development of a novel method to combine heat and air pollution mapping with measured health outcomes to understand the combined impacts on human health.

2

Identification and quantification of key mitigation and adaptive measures that will reduce heat stress.

Research Partners

Duke University, School of Civil and Environmental Engineering

Duke University, School of Biomedical Engineering

Duke University, School of Biostatistics and Bioinformatics