

# SATELLITE DATA FOR ENVIRONMENTAL JUSTICE

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## Introduction

- The health outcomes of marginalized populations may be impacted by disproportionate exposures to environmental burdens and lack of access to environmental benefits
- Satellite earth observations -- or **satellite data** -- can be combined with other geographic, socioeconomic, demographic, and health outcome data to identify differential exposure and vulnerability to environmental conditions that disproportionately impact racial, ethnic, and socioeconomically marginalized communities

In this scoping review, we ask:

How are researchers using satellite data to illuminate and address environmental justice (EJ) concerns?

## Methods

### ENVIRONMENTAL JUSTICE

is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies  
-- United States Environmental Protection Agency

### Inclusion Criteria

- U.S.-based
- Peer-reviewed and published between 2000-2022
- Direct or indirect **satellite data** used as an independent variable
- Reports on some **differential exposure, vulnerability, or other health impact** resulting from environmental condition that was observed using satellite data

### PRISMA 5-step framework extension for Scoping Reviews (Arksey and O'Malley, 2005)



Figure 1. Breakdown of literature search, screening, and selection process following PRISMA guidelines for scoping reviews.

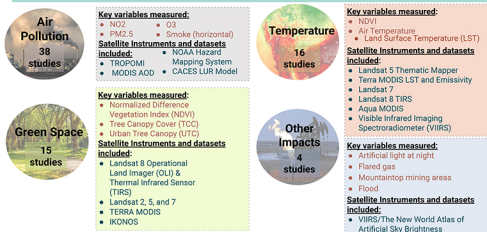
## Results

- 73 studies identified that met inclusion criteria
- Near even distribution of longitudinal and cross-sectional study methods



Figure 2. Geographic distribution and scope of studies across the United States. Researchers used different approaches to using satellite data and chose to examine different geographic scales, from national to regional, state, county, city and neighborhood levels.

### Environmental Measures, Satellite Instruments, and EJ Findings



11 of the studies looked at the simultaneous impacts or modifying impacts of **green space and heat**, **green space and air pollution**, and **air pollution and heat**



Figure 3. Distribution of environmental justice topics studied in included literature between 2000 and 2022. Air pollution continues to be overrepresented in the literature. Gap in leveraging satellite data to explore cumulative impacts and multiple compounding environmental conditions.

### Health Risks Examined

- COVID-19 infection and mortality rates
- Mental health
- Mortality related to air pollution or heat
- Asthma hospitalizations.

### Key Takeaways

- Non-white and populations with low-income have the largest disparities and vulnerability, which may also pose potential health risks
- Most researchers used remotely sensed optical imagery data

### Implications and Advantages of SD4EJ



- Target interventions to vulnerable areas
- SD complements ground-based air and temperature monitors, which may be sparsely located (e.g., rural areas) or prone to bias
- High spatiotemporal resolution of exposure data can be linked to local health data as Hu et al (2014) and Holloway et al (2021) demonstrated
- Public health monitoring of the Climate Vulnerability Index can benefit from satellite data products for NO2 and O3, such as those provided by HAQST researchers (Lewis et al, 2023).
- Enables simultaneous examination of multiple exposures, and collects data from every location, including areas in which populations reside but ground monitors are less present (e.g. rural areas)
- Provides objective data

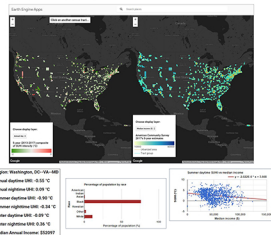


Figure 4. US SUHI Disparity Explorer developed by Chakraborty et al. (2020). Platform displays census-tract level surface urban heat island (SUHI) intensities for US urbanized areas, alongside socioeconomic information (race, median income) at same level of aggregation.

**Acknowledgements:** Thank you to Kelvin Fong, Amber Soja, and Emily Gargulinski for their review and research guidance. Thank you to NASA HAQST for providing funding support for a presenter to attend the HAQST Missouri Meeting. UMBG Center for Social Sciences Small Research Grant provided funding for UMBG student to attend HAQST.