

Quantifying Intra-Urban Heat Vulnerability in Johannesburg: Environmental Justice and Climate Adaptation



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HE²AT CENTER - RESEARCH PROJECT 2: URBAN HEAT VULNERABILITY ASSESSMENT

RESEARCH CHALLENGE

Urban heat vulnerability in Global South cities is a critical climate-health issue.

JOHANNESBURG CONTEXT

- Population: 6.1M inhabitants
- Heat record: 38°C (Jan 2016)
- Health impact: +0.9% mortality per 1°C above 18.7°C
- Climate projection: +2°C by 2050, 4x hot nights
- Legacy: Apartheid urban planning disparities

KNOWLEDGE GAP

Limited integrated heat vulnerability assessments for African cities.

METHODOLOGY

Environmental Data
Landsat 8 satellite imagery
Dec-Feb 2020-21

Social Survey
GCRO Quality of Life
8,215 households

VARIABLES

- Environmental: LST, NDVI, UTFVI, NDBI
- Social: Healthcare access, housing quality, poverty
- Health: Chronic diseases, infectious diseases

ANALYTICAL APPROACH

- PCA for dimensionality reduction
- LISA for clustering analysis
- Heat Vulnerability Index (HVI)
- Spearman correlations

SPATIAL COVERAGE: 135 urban wards

RESEARCH OBJECTIVES

1. QUANTIFY spatial heat vulnerability patterns
2. ANALYSE historical urban development impacts
3. IDENTIFY priority areas for climate adaptation

PRINCIPAL COMPONENT ANALYSIS

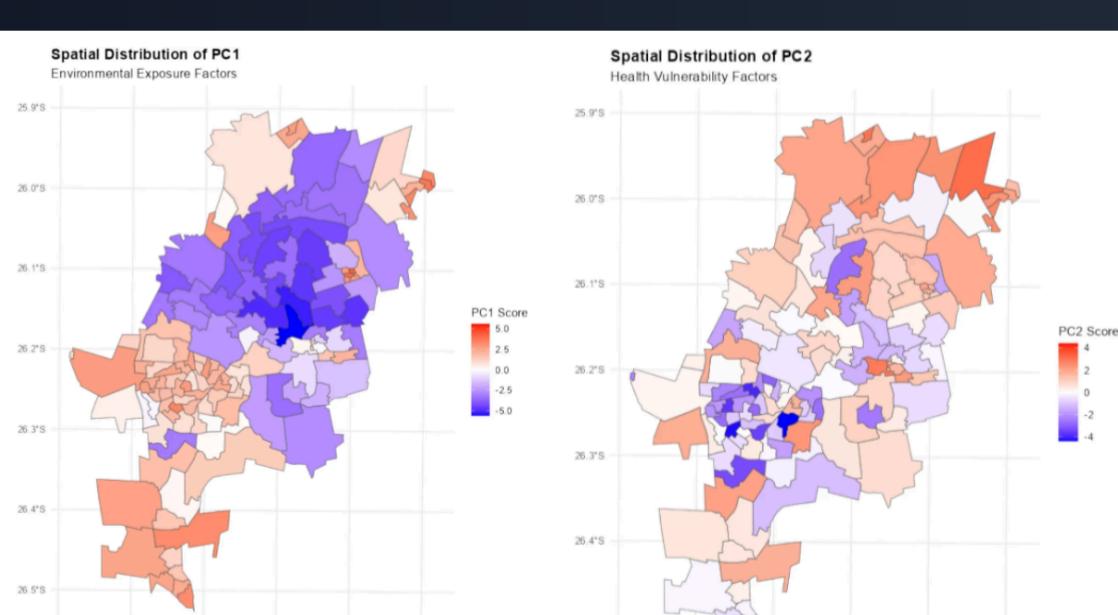


Figure 2: Vulnerability Component Mapping
Left: PC1 Environmental Exposure | Right: PC2 Health Vulnerability

ANALYTICAL FRAMEWORK

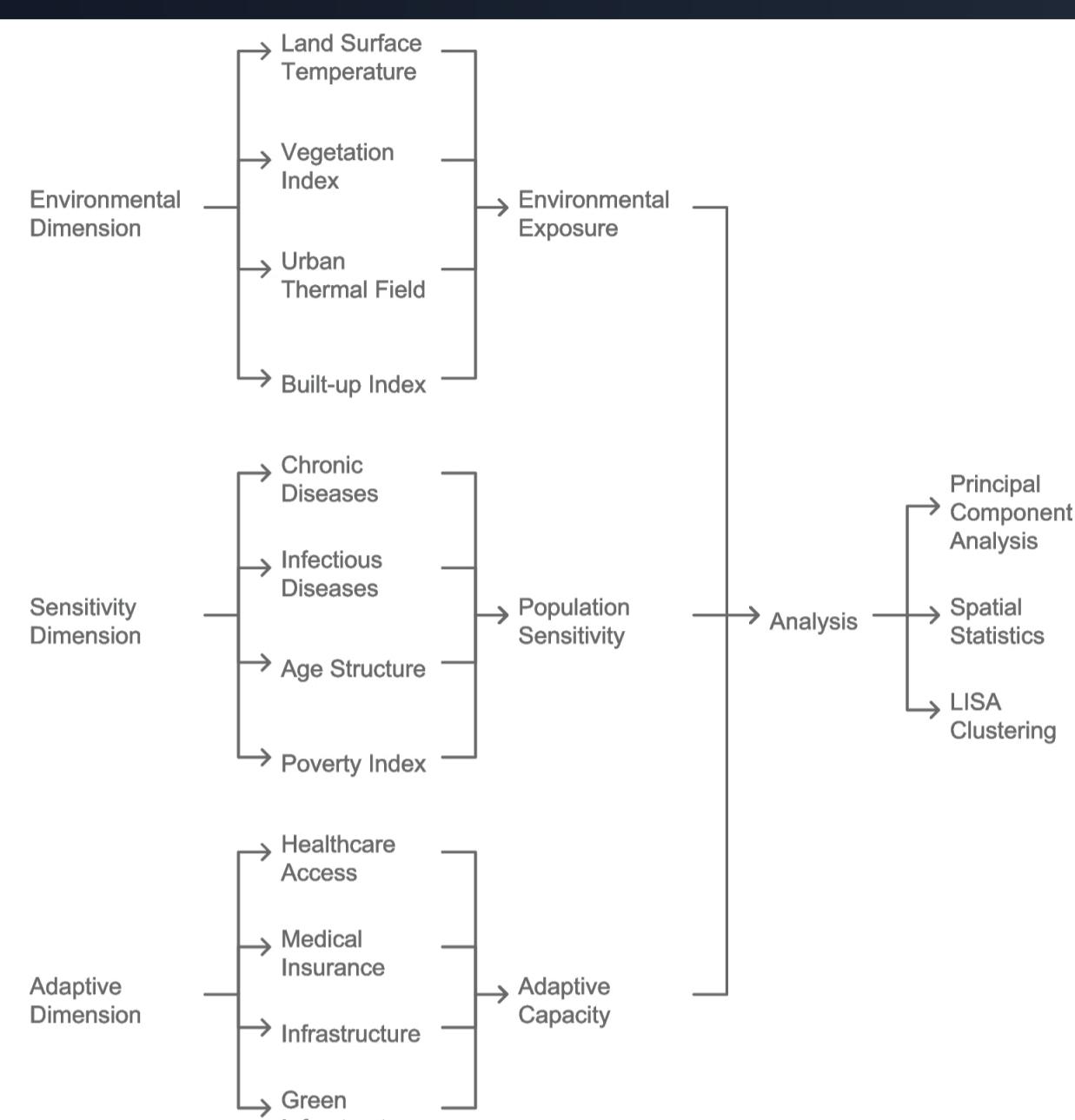


Figure 1: Methodological Framework
Environmental, Social, and Healthcare Integration

HEAT VULNERABILITY DISTRIBUTION

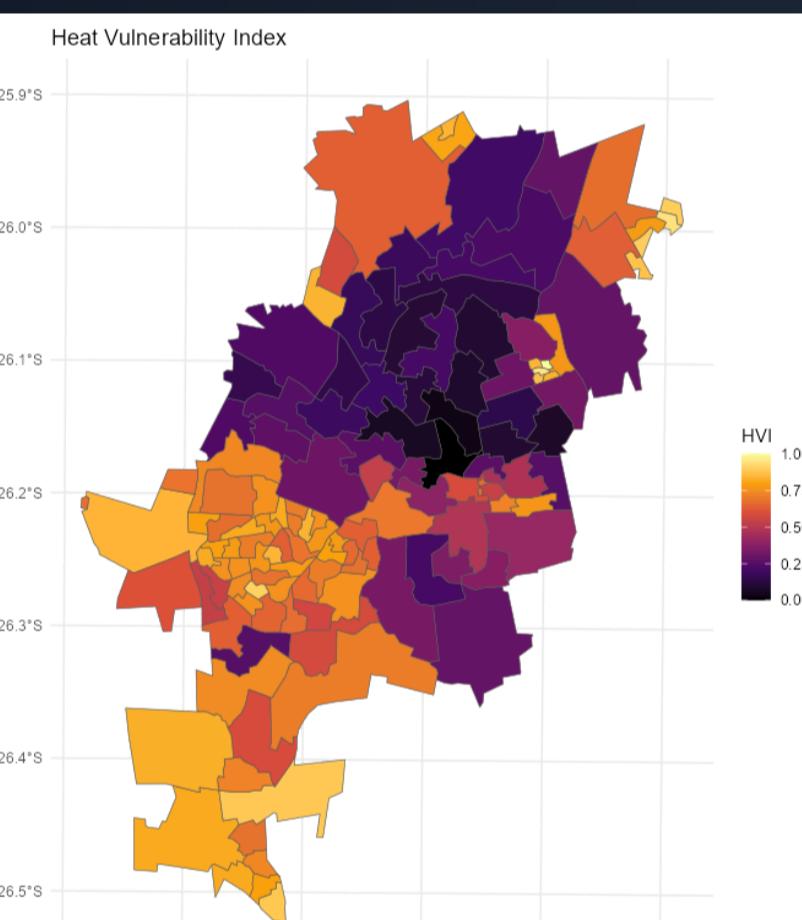


Figure 3: Composite Heat Vulnerability Index
Spatial vulnerability across Johannesburg wards
Darker colors indicate higher vulnerability

SPATIAL CLUSTERING ANALYSIS (LISA)

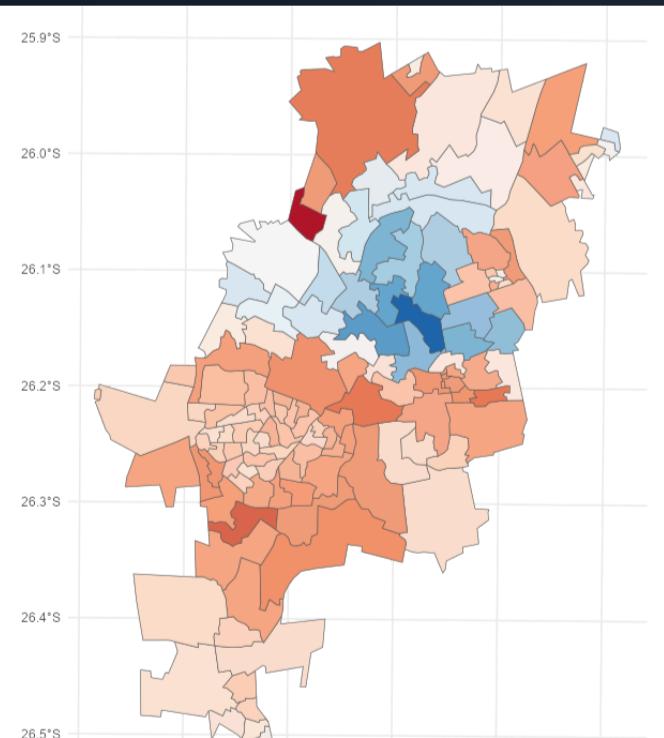


Figure 4: Heat Vulnerability Clusters
High-high clusters (red) | Low-low clusters (blue) | Spatial outliers

REFERENCES & OPEN DATA

Publication: Parker et al. (2025) Int. J. Biometeorol. DOI: 10.1007/s00484-025-02971-y

Open Data: github.com/Logic06183/data_sources

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