Mapping Extreme Heat Vulnerability

IN SUPPORT OF THE DISTRICT OF COLUMBIA'S CLIMATE ADAPTATION PLAN

Extreme heat presents serious public health and urban planning challenges to cities across the United States, as they adapt to changing climate conditions. Research conducted as a part of the TEX-ICLEI Challenge[1] focuses on extreme heat vulnerability mapping at a neighborhood scale in the District of Columbia. This work supports call for actions outlined in the District of Columbia's climate adaptation plan, Climate Ready DC, to mitigate the District's urban heat island and the effects of extreme heat on population health.

KEY QUESTIONS

- **What areas of the city contain the most heat-sensitive populations?**
- **What areas of the city have the highest outdoor heat exposure?**
- **What areas of the city are most vulnerable to adverse heat-health outcomes?**

KEY FINDINGS

- A Heat Vulnerability Index was calculated for Census Block Groups in each of the eight wards of the District of Columbia.
- Each ward exhibited specific characteristics of heat vulnerability, based on exposure and sensitivity indicators.
- Ward 3 ranked the lowest in terms of extreme heat vulnerability, while Wards 5, 7 and 8 included some of the most vulnerable neighborhoods.
- Neighborhoods with high percentage of impervious, paved surfaces and low vegetation cover had the highest outdoor exposure to heat.
- Neighborhoods with high percentage of African American and Hispanic population, low-income residents, elderly, and persons with disabilities were more vulnerable to extreme heat.
- Maps of exposure, sensitivity, and vulnerability scores highlight geographic and socio-economic variability in heat health risks in the District of Columbia.

RECOMMENDATIONS

- Reduction of population vulnerability to extreme heat in the District of Columbia requires both public health interventions and modifications to the urban environment.
- Priority in vulnerability reduction activities should be given to more heat-vulnerable neighborhoods.
- Coordination among local government agencies as well as collaboration between District government and academia will lead to more informed vulnerability reduction strategies and sustainable partnerships for climate adaptation planning.
- Future research should focus on the evaluation of extreme heat thresholds for issuing heat alerts and adverse health outcomes of extreme heat.

[1]Thriving Earth Exchange (TEX) is a program powered by the American Geophysical Union. TEX helps volunteer scientists and community leaders work together to use science to tackle community issues and advance local priorities related to natural hazards, natural resources, and climate change. The DC-TEX collaboration started in early 2016 thanks to the TEX partnership with ICLEI USA – Local Governments for Sustainability.

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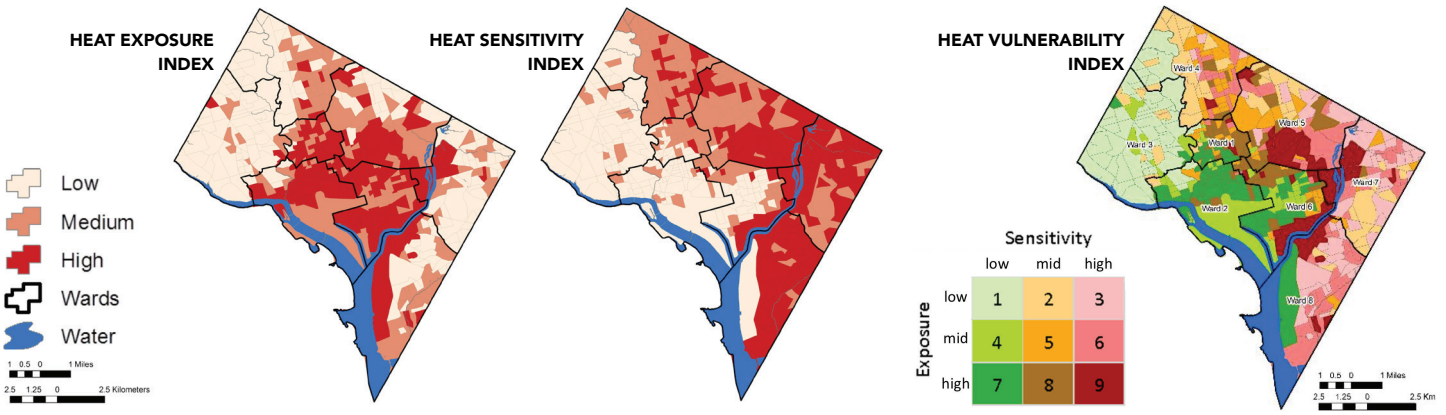

A simplified index design methodology useful to clearly communicate the locations of heat-vulnerable people and places to prioritize for public health (sensitivity) and modification of the built environment (exposure) interventions.

BACKGROUND

Among weather-related hazards, extreme heat is the number one killer of people in the U.S. [1]. In cities, extreme heat is magnified by the Urban Heat Island (UHI) effect, a phenomenon caused by urbanization and changes in land surface characteristics. The combined impacts of the UHI and projected climate change may further increase risks of heat-related morbidity and mortality among urban residents. As cities develop climate adaptation plans, it is critical to identify the people and places at risk of heat-related health effects. Heat Vulnerability Indices (HVI) can help identify heat-sensitive populations and the characteristics of the built environment that increase heat exposure. HVI represent extreme heat sensitivity, exposure, and adaptive capacity – common dimensions of vulnerability [2, 3].

METHODS

We developed a HVI for Census Block Groups in the District of Columbia. The HVI combines the sensitivity and exposure dimensions into an indicator of cumulative extreme heat vulnerability. We assembled socio-economic, demographic, and built environment variables, known in the heat health literature to be predictors of extreme heat morbidity and mortality [4]. Based on an earlier, unpublished version of the index [5], we built individual indices of sensitivity and exposure. We chose a simplified index design methodology to clearly communicate the locations of heat-vulnerable people and places to prioritize public health interventions and the modification of the built environment.

RESULTS

The results show differential extreme heat vulnerability in the District of Columbia. Ward 3 has a mostly white and wealthy population, with large amounts of vegetation. It registers both low exposure and sensitivity, and thus low vulnerability scores. Wards 7, 8, and parts of 5 have high rates of minorities, low income and other sensitive populations, thus high sensitivity scores. Exposure is moderate to high, resulting in medium to high vulnerability. High exposure but low sensitivity in Ward 2 results in moderate vulnerability scores. Low to medium exposure offsets high sensitivity scores in Ward 4, resulting in moderate vulnerability. This study is a necessary step in understanding vulnerability of urban populations to extreme heat in Washington DC. Future research is needed to better understand population adaptive capacity, examine temperature thresholds in issuing heat warnings and advisories, and comparing the HVI against heat-related mortality and morbidity data.

CONTACT

Juan Declet-Barreto
Union of Concerned Scientists
Boston, MA | jdeclet-barreto@ucsusa.org

Kate Johnson
Department of Energy & Environment,
Washington DC | katherine.johnson@dc.gov

Olga Wilhelmi
National Center for Atmospheric Research
Boulder, CO | olgaw@ucar.edu

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