The Geography of Climate Inequity

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With a lot of help from a lot of other amazing people

@jer_science
The Fifth National Climate Assessment

The Fifth National Climate Assessment is the US Government’s preeminent report on climate change impacts, risks, and responses. It is a congressionally mandated interagency effort that provides the scientific foundation to support informed decision-making across the United States.
Already experiencing & expecting a: hotter, wetter, sneezier and wheezier climate
DEADLIEST WEATHER-RELATED HAZARDS


- 134 - EXTREME HEAT
- 85 - FLOODING
- 69 - TORNADOES
- 47 - HURRICANES
- 44 - LIGHTNING
- 40 - WINTER
- 30 - EXTREME COLD

Inequitable Heat Burden and Future Heat Exposure

b) Projected change in extreme heat days, 2050 compared to 1991–2020

Change in Number of Days at or Above 95°F

0 10 20 30 40 50
Inequitable Heat Burden and Future Heat Exposure

a) Energy-burdened households overlap with communities of color

b) Projected change in extreme heat days, 2050 compared to 1991–2020
Shandas et al., 2019: https://www.mdpi.com/2225-1154/7/1/5/htm
Richmond's Urban Heat Islands

Afternoon (3PM) Temperatures on July 13, 2017

- < 94°F
- 94-95°F
- 95-95.5°F
- 95.5-96.2°F
- > 96.2°F

Shandas et al., 2019
EXTREME HEAT (2017)

Shandas et al., 2019

Data: Richmond Ambulance Authority

AMBULANCE RESPONSES FOR HEAT ILLNESS (2015-2019)
EXPOSURE
Hoffman et al., 2020

REDLINING MAP (1937)
Mapping Inequality

A B C D
The long-run effects of the 1930s HOLC “redlining” maps on place-based measures of economic opportunity and socioeconomic success ☆

Daniel Aaronson a, Jacob Faber b, Daniel Hartley a, Bhashkar Mazumder c, d, Patrick Sharkey c
Descriptions of A & B neighborhoods
Hotter, Wetter, Sneezier, & Wheezier

Present-day Environmental Disparity Among HOLC Neighborhoods

J.S. Hoffman

Whether they’re walking, biking, bussing, or driving through virtually any city in the United States, people tend to make the same sorts of observations when considering any particular neighborhood’s environmental quality: wealthy areas—which tend to have disproportionately monolithic non-Hispanic white populations—are quiet, shaded by mature trees, and defined by large single-family houses occupying larger-than-average tracts of land, while just a few blocks away, poorer neighborhoods—which also happen to be communities of color—have many fewer trees, tend to have more multifamily dwellings, and are choked with traffic (or, are at least more...
Why the "wrong side of the tracks" is usually the east side of cities
How Decades of Racist Housing Policy Left Neighborhoods Sweltering

By Brad Plumer and Nadja Popovich
Photographs by Brian Palmer  Aug. 24, 2020
In 94% of the cities studied, this pattern was observed.
Average Tree Height in Meters by HOLC Grade

- A: 19.3 meters
- B: 17.3 meters
- C: 16.5 meters
- D: 15.2 meters

Ross Donihue, Esri
% Parcels with High Flood Risk

- A: 10.7
- B: 11.8
- C: 13.4
- D: 15.3

Data from Jeremy Porter
Higher flood risks in formerly redlined areas

Top 10 Metros with Greater Share of Homes at Risk in Redlined and Yellowlined Areas
Percentage of homes, by redlining grade, that face high flood risk; %

<table>
<thead>
<tr>
<th>Metro</th>
<th>Greenlined/Bluelined</th>
<th>Redlined/Yellowlined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacramento, CA</td>
<td>11.8</td>
<td>21.6</td>
</tr>
<tr>
<td>New York, NY</td>
<td>7.1</td>
<td>13.8</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>8.7</td>
<td>13.8</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>7.9</td>
<td>12.6</td>
</tr>
<tr>
<td>Indianapolis, IN</td>
<td>4.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Camden, NJ</td>
<td>2.9</td>
<td>7.3</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>3.6</td>
<td>7.2</td>
</tr>
<tr>
<td>Portland, OR</td>
<td>4.0</td>
<td>7.1</td>
</tr>
<tr>
<td>Newark, NJ</td>
<td>4.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>3.0</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Source: Redfin analysis of First Street Foundation flood risk data (FSF) and HOLC redlining maps
Modern air pollution disparities in historically redlined areas

![Map of Philadelphia, PA and Chicago, IL showing 202 redlining maps drawn in the 1930s and population weighted NO2 (ppb) in 2010 with 1930s redlining grade.]

Lane et al., 2022
Health outcomes in redlined versus non-redlined neighborhoods: A systematic review and meta-analysis

Eun Kyung Lee 1,*, R. Gwendolyn Donley 1,*, Timothy H. Ciesielski, Indra Gill, Owusu Yamoa, Abigail Roche, Roberto Martinez, Darcy A. Freedman

**“Redlined” areas**
- Discriminatory lending practices
- Neighborhood (dis)investment
- Residential segregation and disparities in home ownership

**“Non-redlined” areas**
- More green space, recreational facilities
- Less sources of pollution (e.g., industries, highways) and improved water infrastructure
- Better access to health care, quality education, public transit, healthy food stores

**Built environmental factors**
- Vacant spaces/less green space
- Urban heat island effect
- Proximity to sources of pollution and poor water infrastructure
- Deteriorating housing conditions
- Decreased access to health care, quality education, public transit, healthy food stores

**Social/Socioeconomic factors**
- Higher crime & incarceration rates
- Higher levels of stress & racial segregation
- Lower income, more people of color

**Disparities in environmental exposures (e.g., air pollution, endocrine disrupting chemicals) & biological responses**

**Health disparities:**
- Asthma
- Cancer
- COVID-19
- Gun-related injuries
- Preterm birth
- Chronic diseases
- Heat-related illnesses

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**“Great Depression” (Home Owners’ Loan Corporation (HOLC) risk grades created)**

**“Great Recession” 2007-2009**

**COVID-19 Pandemic (2019- )**

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**Housing discriminatory practices outlawed through the “Fair Housing Act”**

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**1930s**

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**1960s**

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**2000**

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**2010**

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**2020**
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Disparities in environmental exposures (e.g., air pollution, endocrine disrupting chemicals) & biological responses

Health disparities:
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- Chronic diseases
- Heat-related illnesses
Our neighbors are already experiencing a hotter, wetter, sneezier and wheezier climate.
So what do we do now?
PLANNING FOR URBAN HEAT RESILIENCE

Ladd Keith, PHD, and Sara Meerow, PHD

Solutions

Heat mitigation
Reducing the built environment’s contribution to urban heat

Heat management
Preparing and responding to chronic and acute heat risk

= Heat-resilient communities
Climate-Resilient Neighborhood Design

- Community-led equitable development
- Green roofs
- Green walls
- Urban tree cover
- Transit infrastructure
- Pedestrian and bicycle access
- Flood culverts
- Flood gardens
- Living shorelines
- Community centers distributing emergency kits
- Engaged, informed, and coleading residents
- Nature-based solutions
- Climate-resilient infrastructure
Mitigation and Adaptation Benefits of Natural Infrastructure in Cities

**Mitigation benefits**
- Sequester and store carbon
- Reduce building energy use
- Reduce municipal water use
- Facilitate active mobility

**Adaptation co-benefits**
- Reduce heat stress
- Reduce flooding
- Improve health
- Improve air quality
- Promote biodiversity
Hyperlocal data, collected by community scientists, bestows civic legitimacy.
Mayor Stoney announces 5 new green spaces in Richmond’s southside
Climate Safe Neighborhoods
UNPACK HISTORY
Understand why our neighborhoods look the way they do—this is no accident.

PRIORITIZE CHANGES
Data informed, resident led changes to built environment

INTERVENE IN SYSTEMS
Build the capacity of residents to self advocate for more equitable distribution of resources

THREE PRONGED STRATEGY
OVER FOUR YEARS
Climate Safe Neighborhoods

Developing a community-based approach for addressing the climate safety needs of urban communities disproportionately impacted by extreme heat and increased urban flooding due to the legacy of redlining and housing discrimination.
Climate Safe Neighborhoods

Identified heat islands and places of interest on paper maps

Community-led tree planting at schools and homes

Outreach and installing raised bed gardens and rain barrels at homes
Thanks!

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