Mapping Climate Vulnerability in Greater Boston

Seleeke Flingai, PhD, MPA
Metropolitan Area Planning Council

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MAPC
METROPOLITAN AREA PLANNING COUNCIL

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NATIONAL NEIGHBORHOOD INDICATORS PARTNERSHIP

BACKGROUND

Why are we interested in climate vulnerability?

- The climate crisis presents major planning challenges, particularly for coastal regions
- However, climate impacts are not distributed equally
- As such, it's important that planners, policymakers, etc. center populations and communities most at risk when planning for climate change responses and building climate resliency

BACKGROUND

How do we think about vulnerability?

Vulnerability is often characterized as encompassing three dimensions: *exposure*, *sensitivity*, *and adaptive capacity*.

Vulnerability as exposure: Vulnerability is a function of the proximity of an individual or group to a hazard, stressor, or disturbance (Dow, 1992)

Vulnerability as sensitivity: Vulnerability is a function of the pre-existing social, economic, and political conditions of a given community, and how those conditions influence access to resources and exposure to hazards (Tonmoy, El-Zein, & Hinkel, 2014)

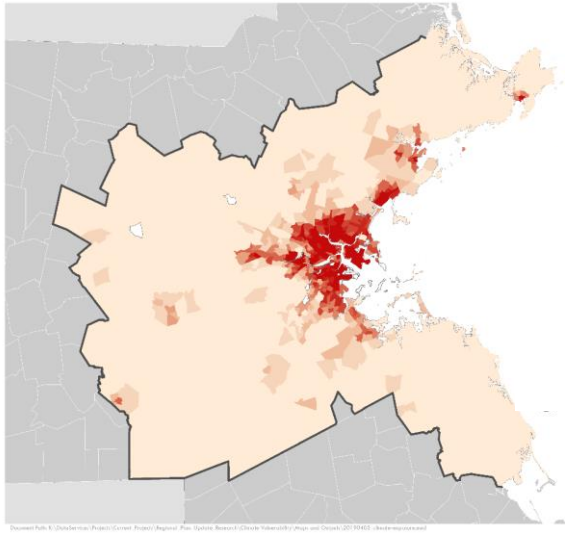
Vulnerability as adaptive capacity: Vulnerability is a function of a group's ability (or lack thereof) to plan for and adapt to changing conditions using social or technical skills, resources, or strategies (Füssel & Klein, 2006).

RESULTS

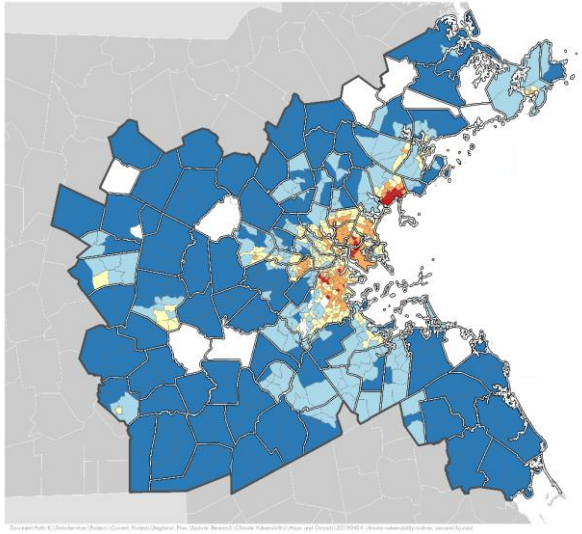
Climate vulnerability assessment

We produced a suite of analyses and maps to assess the current *relative* exposure and vulnerability to climate hazards throughout Greater Boston.

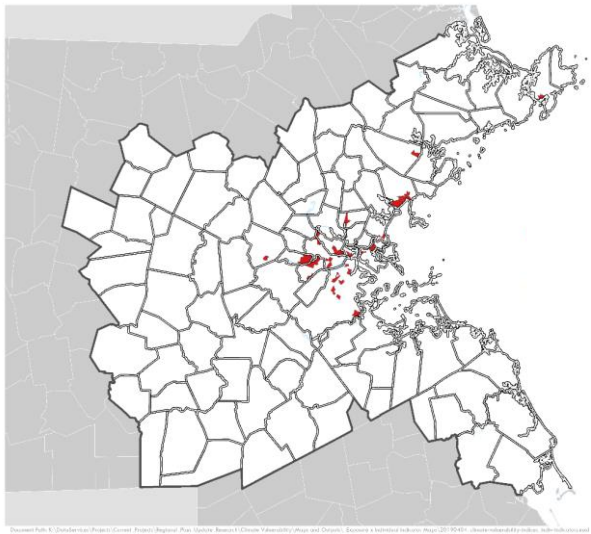
Heat and Flood Hazard Exposure Mapping



Climate Vulnerability Mapping



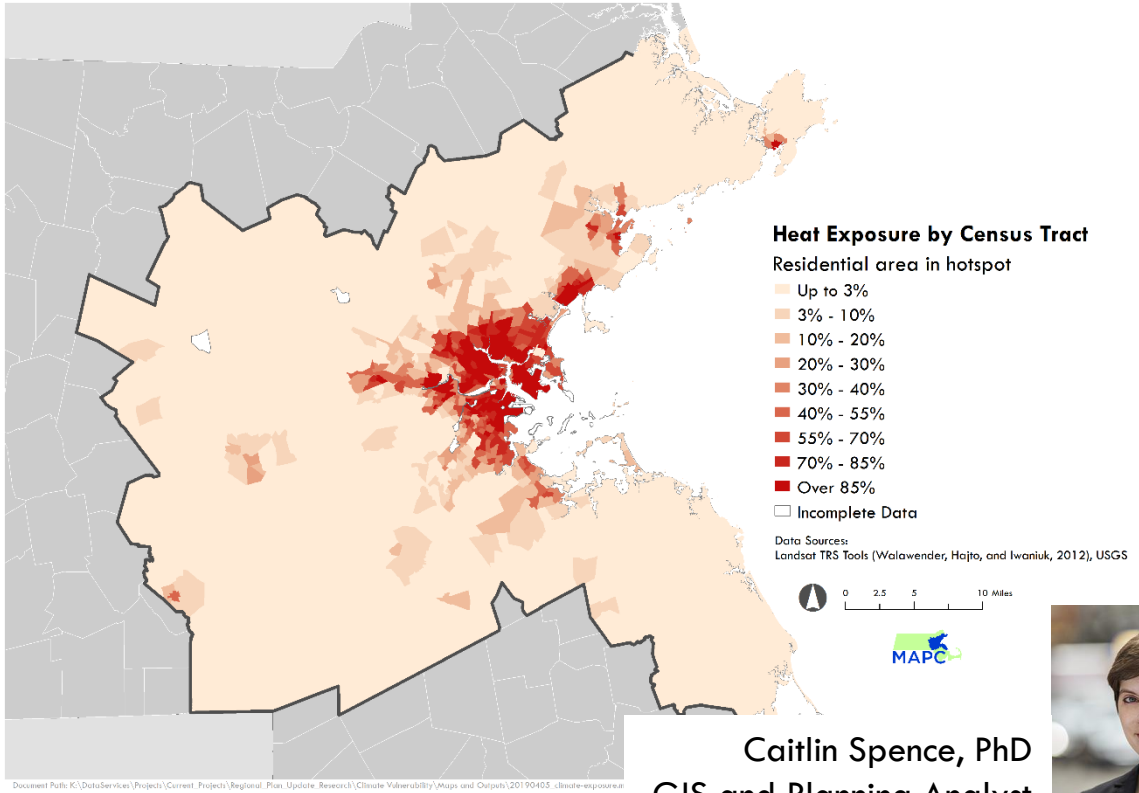
Specific Vulnerable Population Mapping



METHODS AND RESULTS

Heat and flood hazard exposure mapping

Heat: Proportion of residential area in census tract within the hottest areas of MAPC region



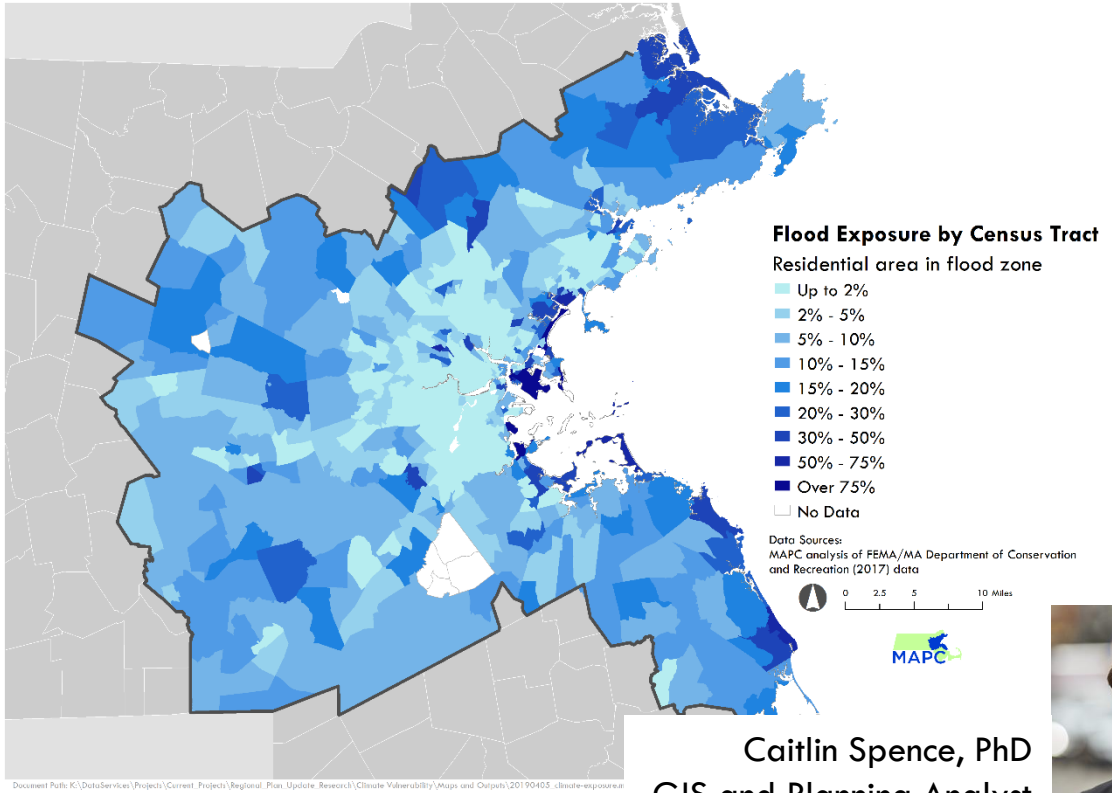
Caitlin Spence, PhD
GIS and Planning Analyst
cspence@mapc.org

METHODS AND RESULTS

Heat and flood hazard exposure mapping

Flood: Proportion of residential area in census tract located within a flood zone*

* Based on the FEMA 2017 National Flood Hazard Layer



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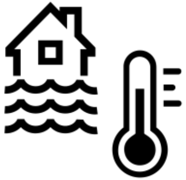
Climate Vulnerability Mapping



Exposure
- 2 indicators

Sensitivity
- 11 indicators

Adaptive Capacity
- 17 indicators

Exposure:
- Land surface temperature
- Flood risk

Sensitivity:
- Overcrowding
- Living in group quarters
- Age 5 and below
- Age 65 and up
- Housing units built before 1960
- Housing units built in 1980 or later
- Disability prevalence
- Cardiovascular disease prevalence
- Asthma hospitalization rate
- Diabetes prevalence
- High exposure workers (firefighters, farmers, fishers, forestry workers)

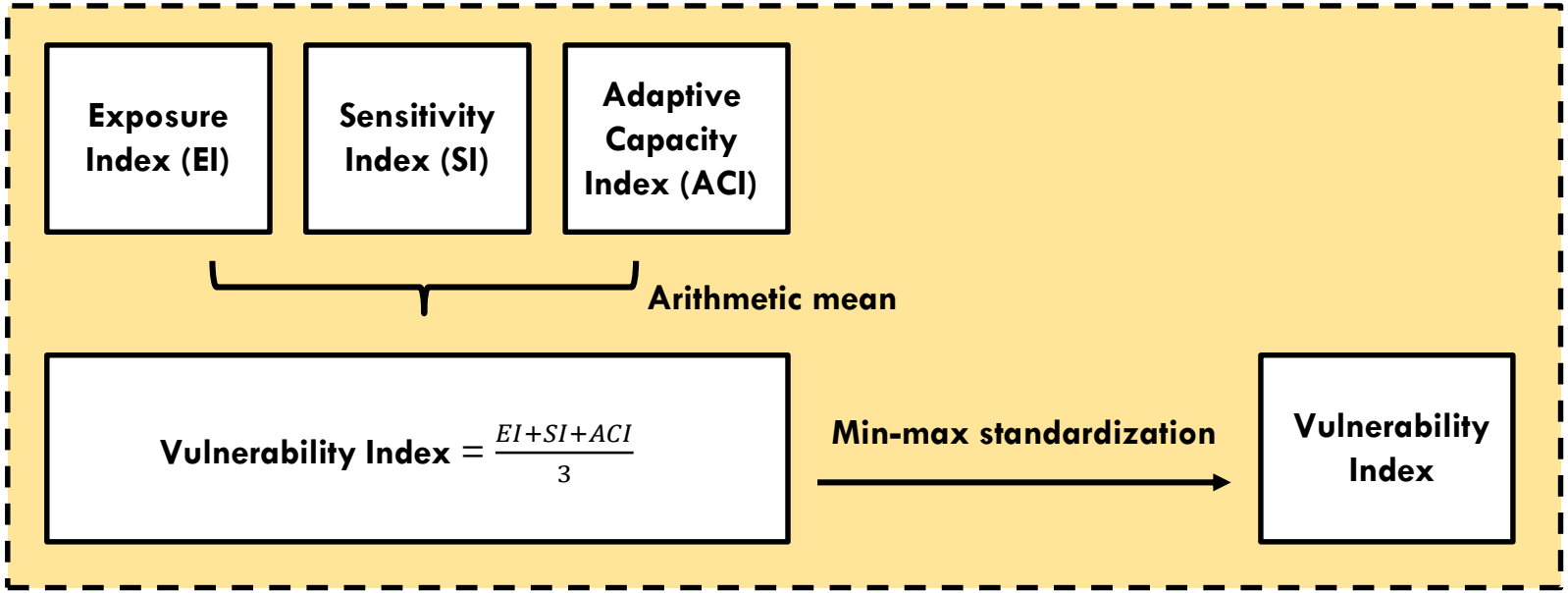
Adaptive Capacity:
- Renter-occupied housing units
- Mobile housing units
- Households without a vehicle
- Households without internet access
- Educational attainment: High school diploma or more
- Unemployment rate
- Median household income
- Poverty rate
- Race/ethnicity: Hispanic/Latinx, Black, Asian, other non-White races/ethnicities (e.g., Native American, Native Hawaiian, etc.)
- Age 65 and up living alone
- Single-parent families
- Linguistic isolation
- Population living in different residence from 5 years prior
- Population without health insurance

METHODS AND RESULTS

Climate Vulnerability Mapping

How did we use these indicators to create our vulnerability index?

Two ways: **Arithmetic Mean (below) and Factor Analysis**

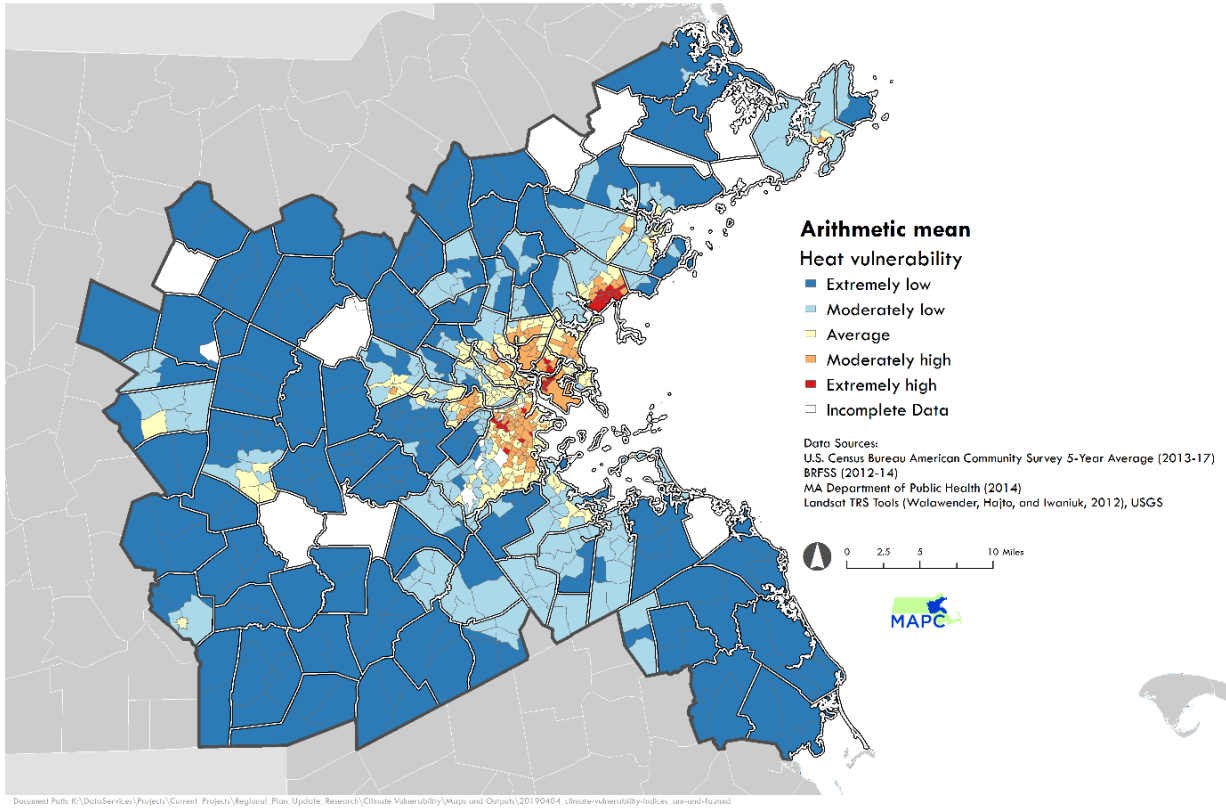


Adapted from Menezes et al., 2018

Climate vulnerability mapping

Heat vulnerability

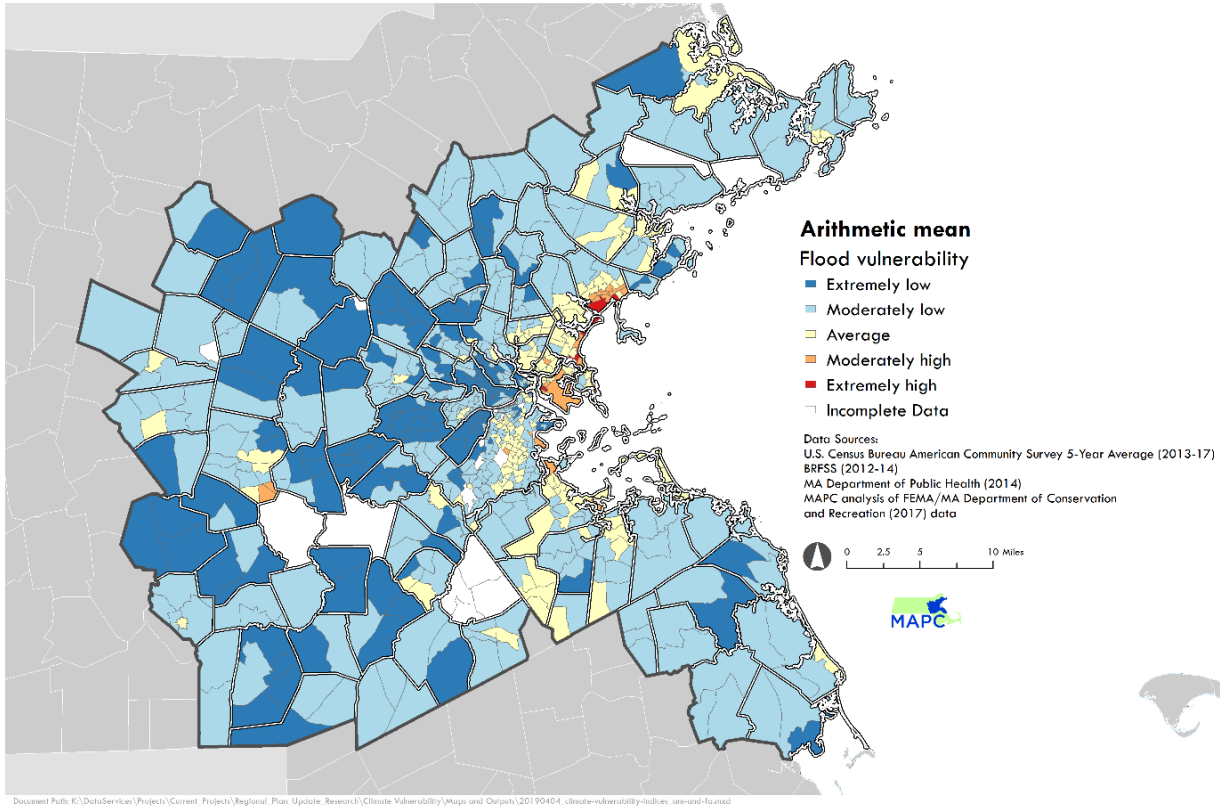
- Highly concentrated in the urbanized inner core communities
- Highest vulnerability to heat and highest heat exposure are spatially concentrated in 7 of 101 municipalities in region



Climate vulnerability mapping

Flood vulnerability

- Flood zones are more evenly distributed than heat hotspots
- Coastal concentration for inner core communities reveals double vulnerability
- High adaptive capacity of many suburban communities reduces many flood zone risks

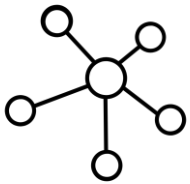


Specific vulnerable population mapping

Health
- Health insurance
- Disability

Housing
- Housing units built before 1960
- Housing units built before 1980

Poverty
- Poverty rate



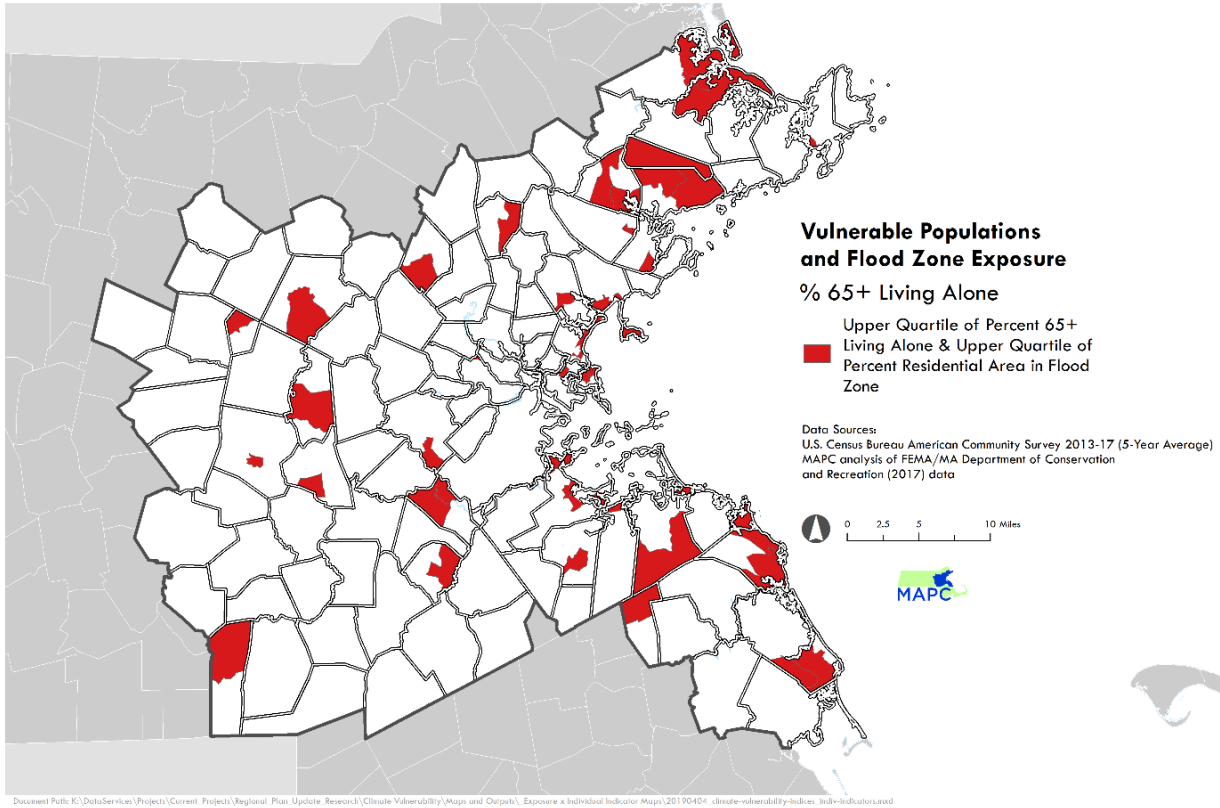
Information access/social networks/mobility
- No Internet access
- No vehicle available
- Age 65+ and living alone
- Limited English proficiency

METHODS AND RESULTS

Specific vulnerable population mapping

Example:

Proportion of total population aged 65+ and living alone



SECTION HEADER

Key takeaways

The Findings

1. Heat vulnerability is highly concentrated in the urbanized inner core communities

2. Flood vulnerability is more diffused, but heavily coastal

3. Mapping of specific vulnerable populations may inform targeted preparedness and mitigation strategies

The Process

1. Working in tandem with planners from different disciplines informed indicators and framing

2. Quantifying and mapping vulnerability is difficult and complicated

3. This analysis is only as useful as its accuracy will allow – ground-truth and refine!

CONCLUSIONS

Considerations and Next Steps

Limitations

- U.S. Census data limits our ability to apply a truly intersectional lens to analysis
- National Flood Hazard Layer may misrepresent flood exposure
- Arithmetic mean approach has several strict theoretical assumptions that our data may not meet

Next Steps

- Create municipal-specific relative vulnerability analyses for planning projects and policy decision-making support
- Ground-truth regional and municipal maps
- Release public-facing, interactive maps

THANK YOU

Seleeke Flingai, PhD, MPA
Research Analyst II
sflingai@mapc.org
617-933-0758

Jessie Partridge Guerrero
Research Manager
jpartridge@mapc.org
617-933-0726