

Social Vulnerability to Flooding

An Analysis of Vulnerability in Massachusetts Towns

Introduction

One potentially devastating impact of climate change is an increase in severity and frequency of storms. It is more important than ever that researchers assess society’s preparedness to severe storm events and flooding.

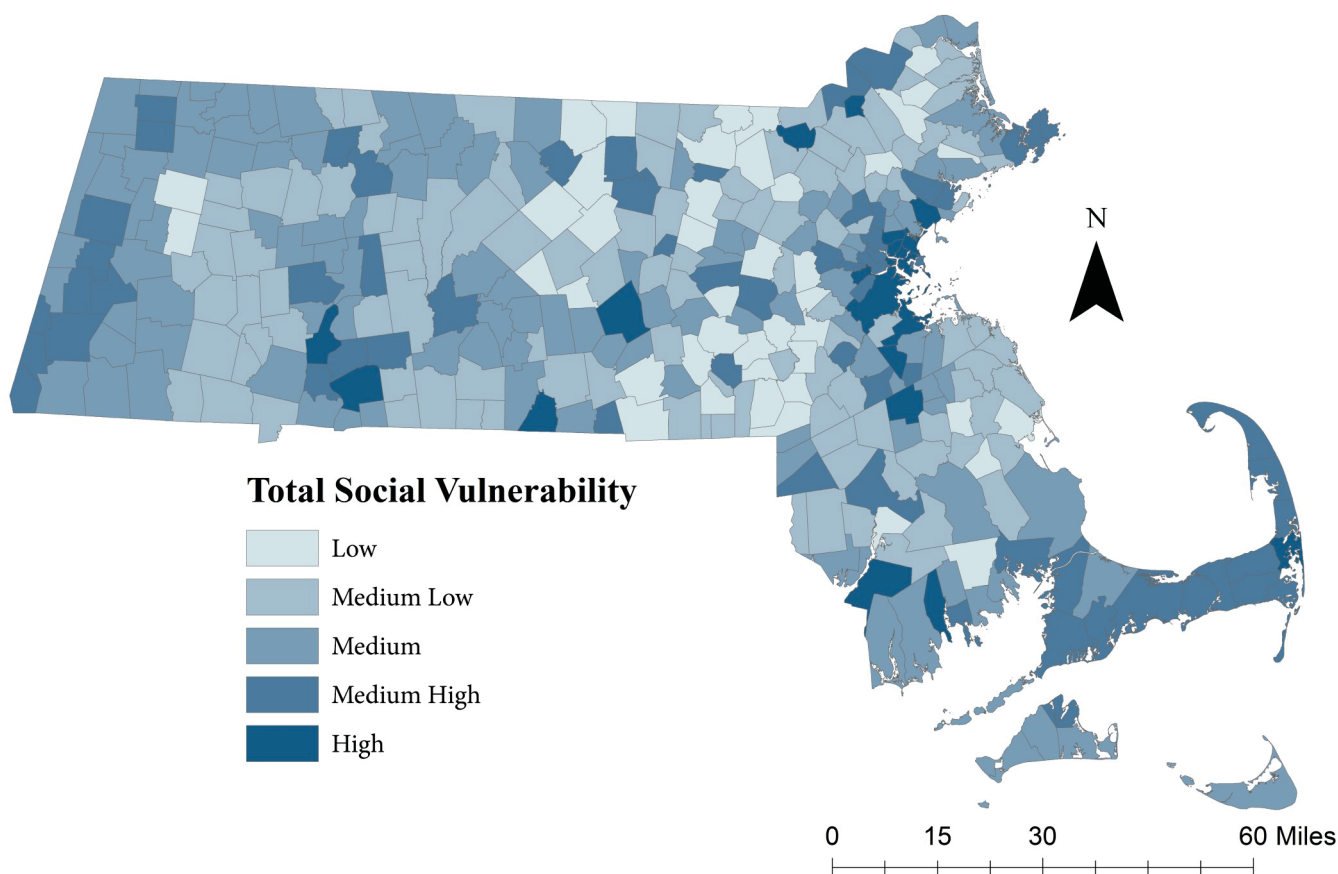
Researchers have identified that some population are more at risk for losses from severe storms because of varying levels of vulnerability. The ability of a populations to react to, respond to, and recover from disasters has been coined “social vulnerability,” and researchers and policy makers are currently trying to quantify what it means to be socially vulnerable.

This project attempts to quantify the social vulnerability and flood vulnerability in the state of Massachusetts. The results will indicate the most vulnerable towns to flooding and provide policy makers with an idea of what towns to target as flooding becomes more devastating.

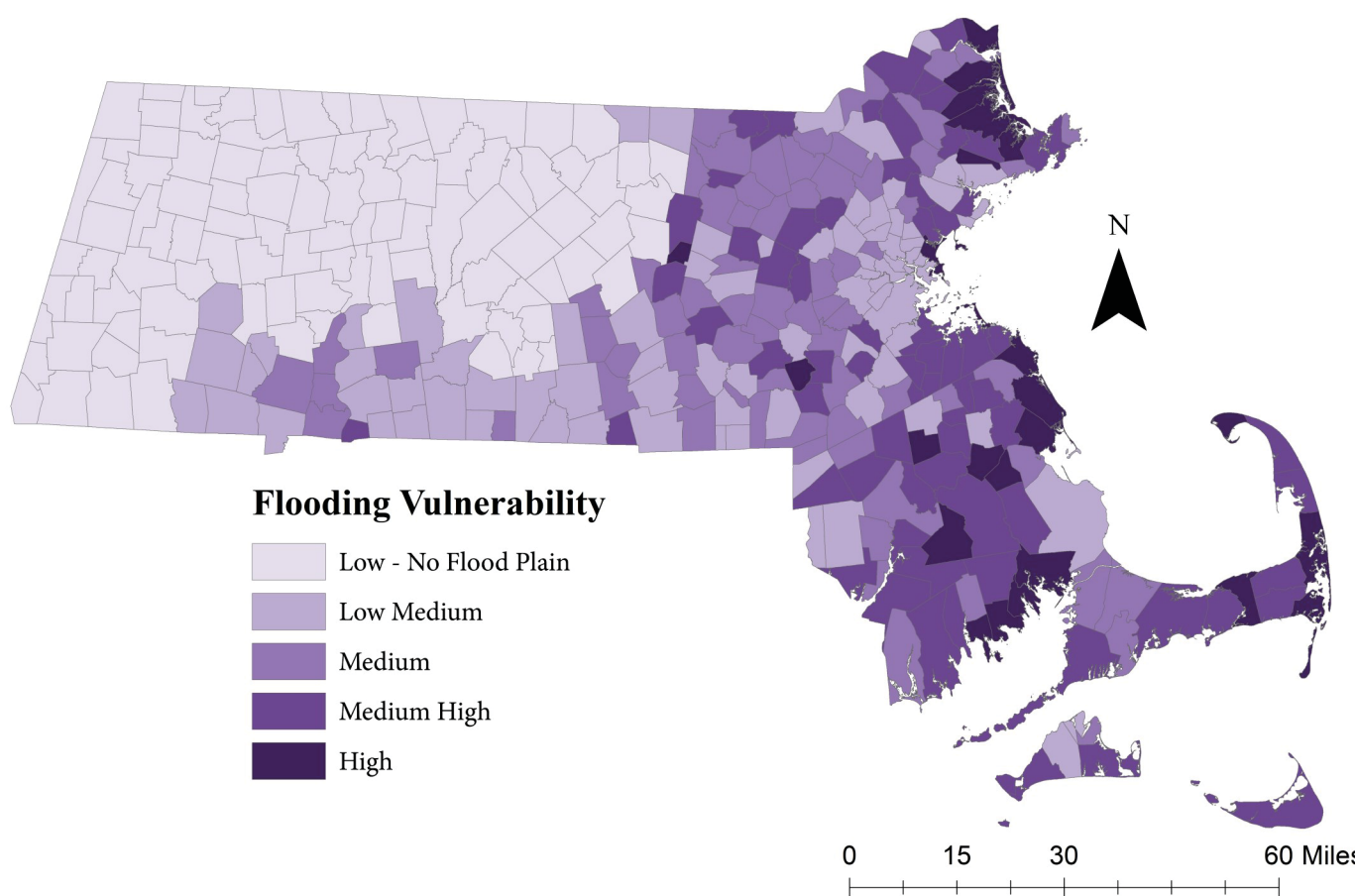
Methodology

To create the social vulnerability indicator (SOVI) for Massachusetts towns I used six variables, often cited as contributing to social vulnerability. First, I standardized the data to a fraction of the indicator per total population. I then normalized the data by creating a z-score for each census tract. In excel, I added up the z-scores for each indicator and then normalized the total z-score using another z-score.

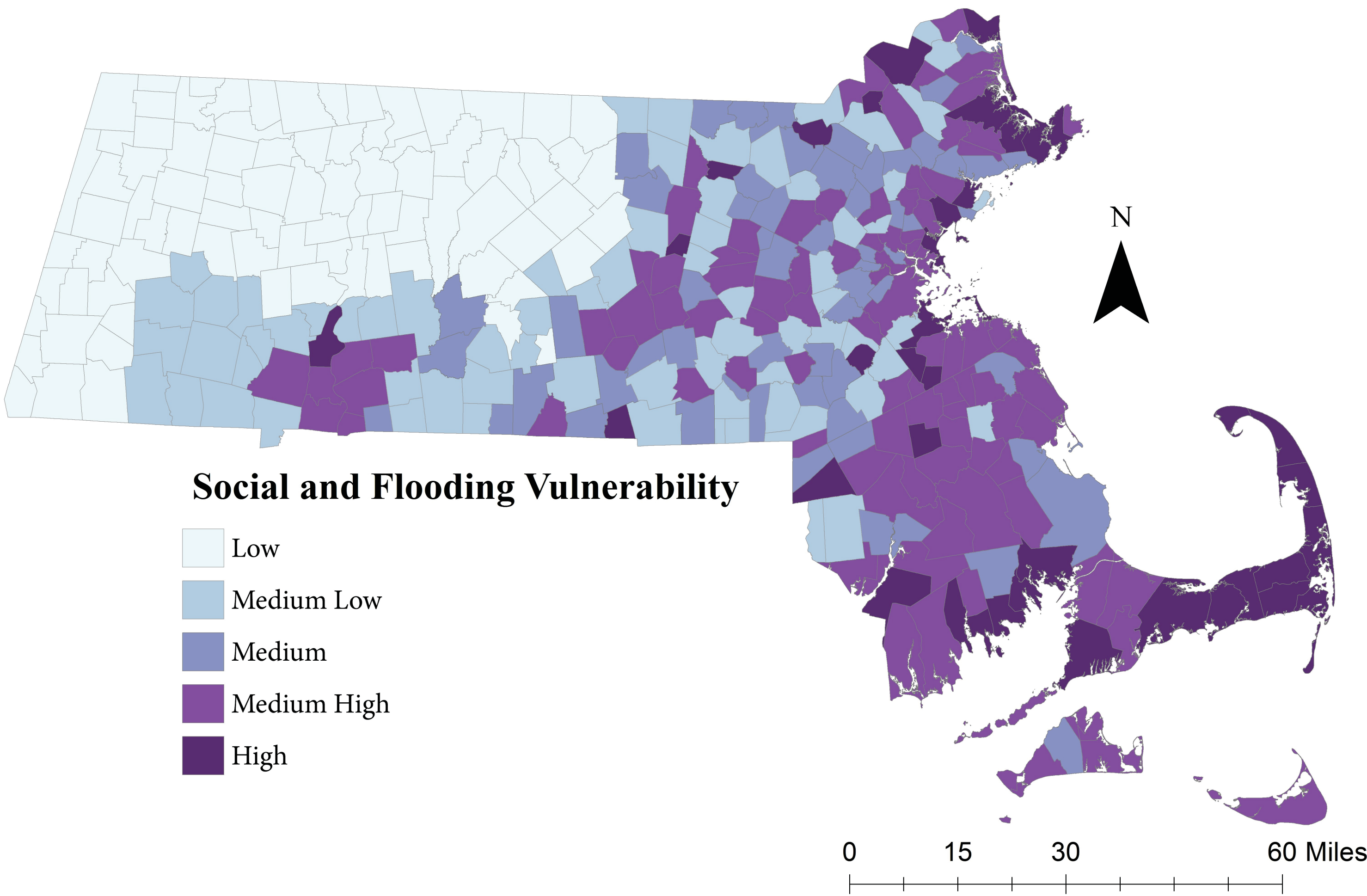
To create the social vulnerability index, I combined the z-scores with spatial data and mapped the social vulnerability for each town in Massachusetts. I also found the hazards vulnerability of each town using percent area of FEMA floodplains in each town. For the final map, I used GIS to reduce the social and hazard vulnerability to a single number (1-5) and combined the two scores to find the overall vulnerability to flooding for Massachusetts towns.



The total social vulnerability map was created by adding each vulnerability indicator.



The flooding vulnerability map was created using the percent of FEMA flood plains in each town.



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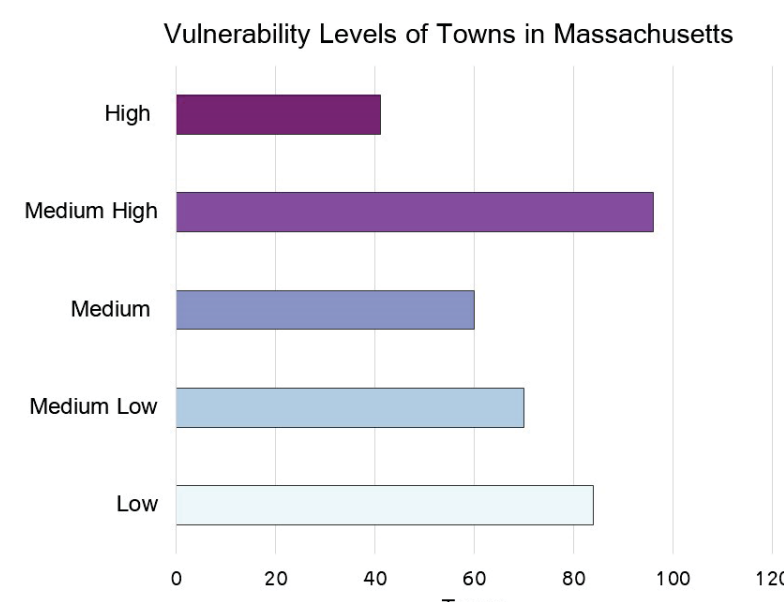
Tufts

Sources:
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Projection: NAD_1983_StatePlane_Massachusetts_Mainland_FIPS_2001

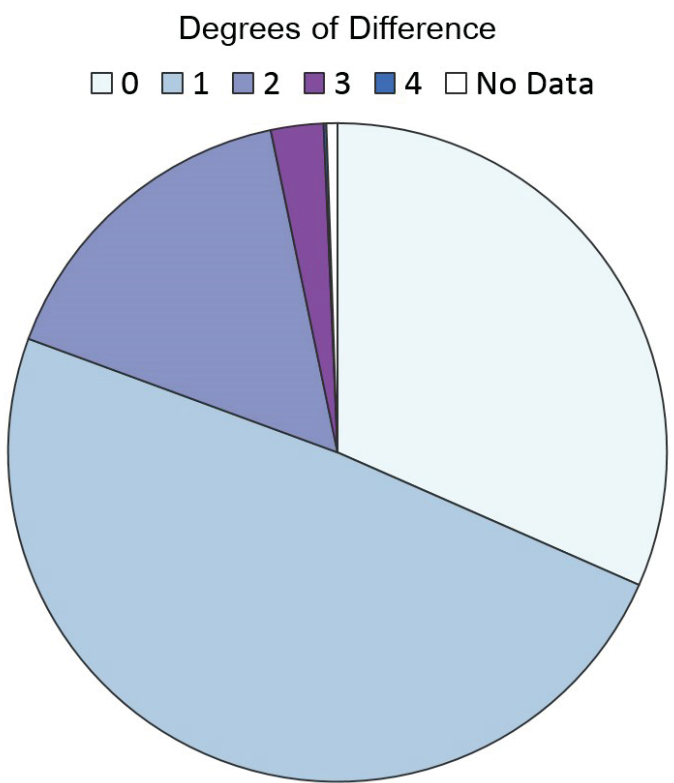
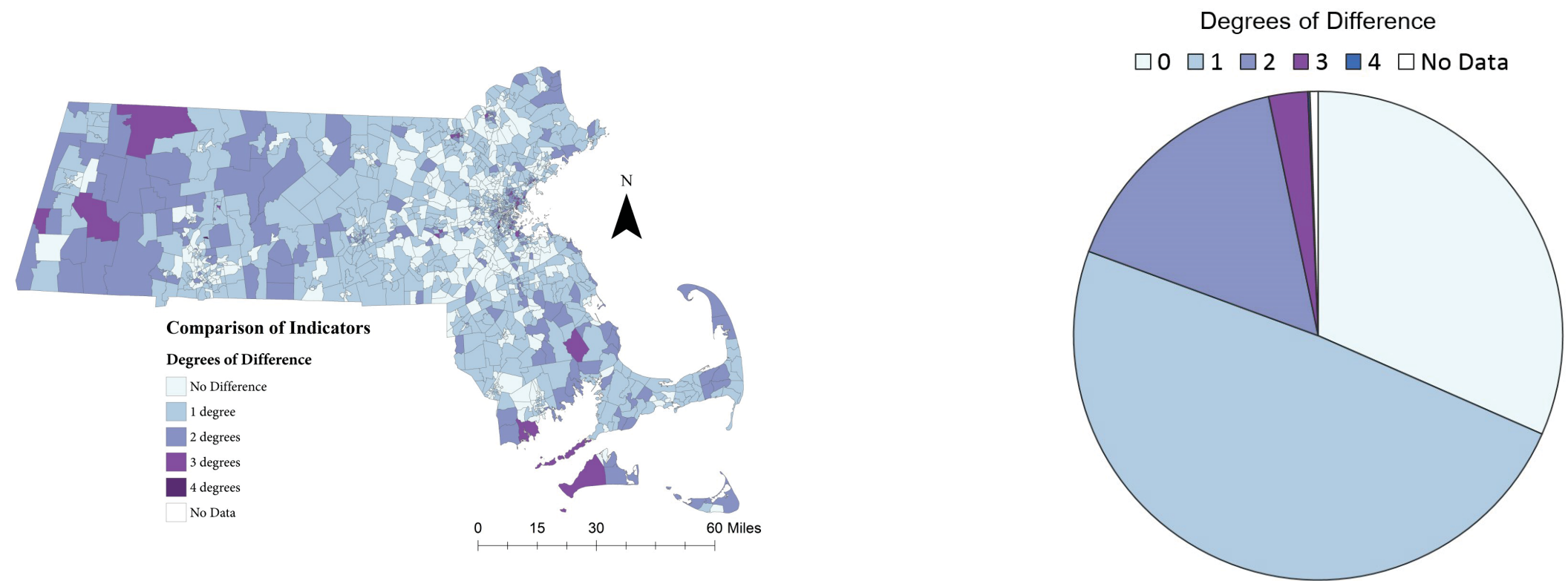
Results and Limitations

The flood and social vulnerability indicator identified that 44 percent of Massachusetts towns have a high or medium-high social and flooding vulnerability. The two towns most at risk are Revere and Orleans, both lower-income coastal communities . Revere has a high non-white population and Orleans has a high over-65 population. The majority of high vulnerability areas are urban coastal towns.



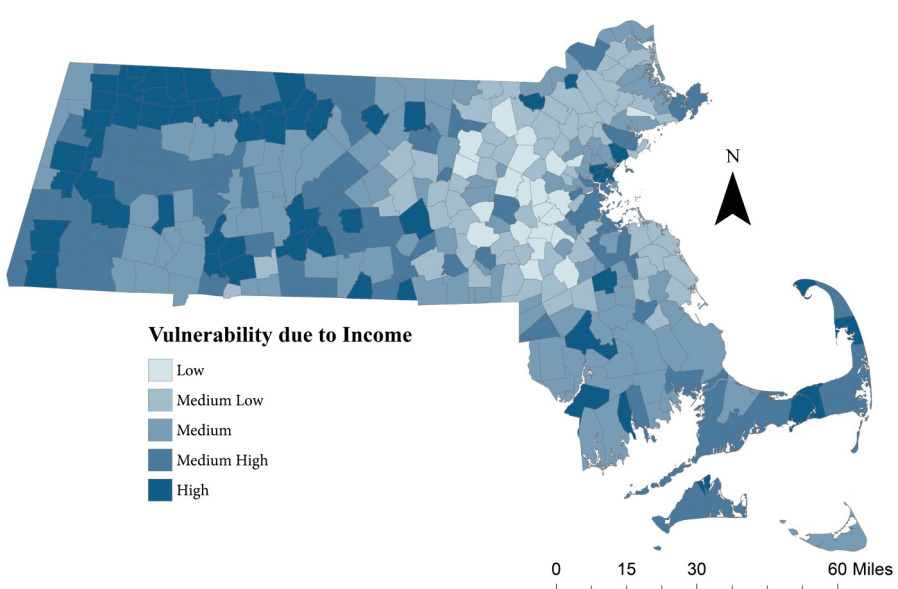
There are some limitations to this study. For example, the FEMA flood plains are for a 100-year flood in 2015. The map does not account for a flood bigger than a 100-year flood, and as climate change increases, so will the intensity of severity of floods. In addition, the vulnerability indicator groups the vulnerabilities by town and cannot account for the differing levels of vulnerability within a town. Finally, the SOVI included six of the most important indicators, but many other indicators influence social vulnerability. Overall, this study was successful in providing a general guide to the most socially vulnerable towns to flooding in Massachusetts.

Comparison to Existing Indicators



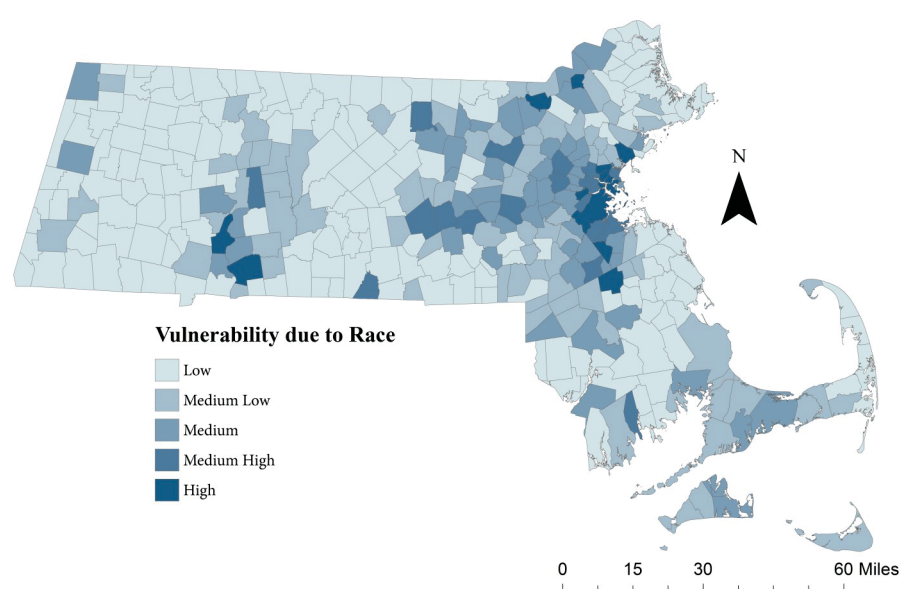
To examine the accuracy of my SOVI, I compared it to the SOVI created by the University of South Carolina Hazards and Vulnerability Research Institute (HVRI). To achieve this, I reduced each variable (low, medium, etc.) to a single number and subtracted the numbers from the two indicators . The indicators are relatively similar, with 80 percent of the census tracts having one or less degree of difference. My SOVI placed more emphasis on the vulnerability of densely populated towns, while the HVRI SOVI placed more emphasis on rural towns. The differences can be attributed to the indicators chosen; for example, the HVRI SOVI included unemployment, which is usually higher in rural areas.

Income



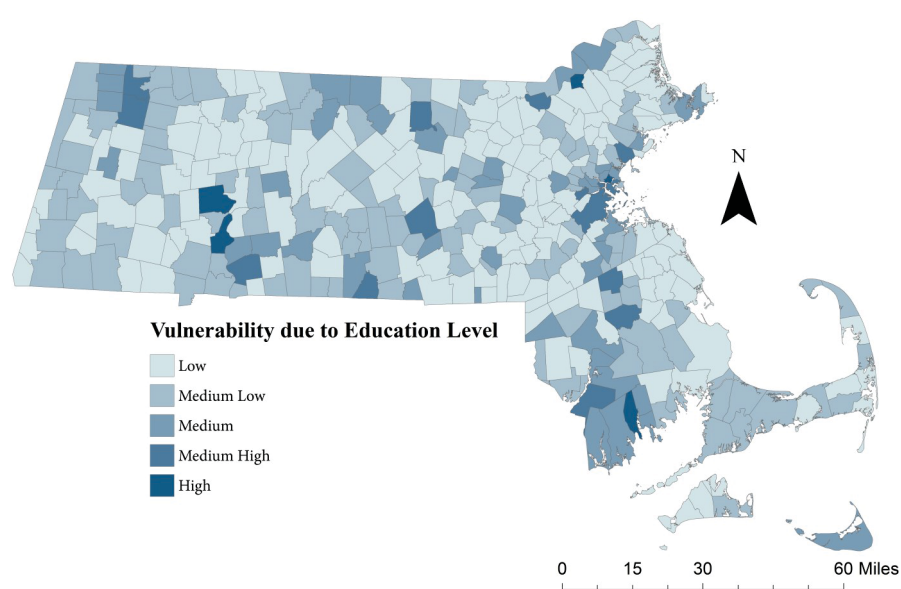
Income is measured by deviation from the medium income in Massachusetts in 2010.

Race



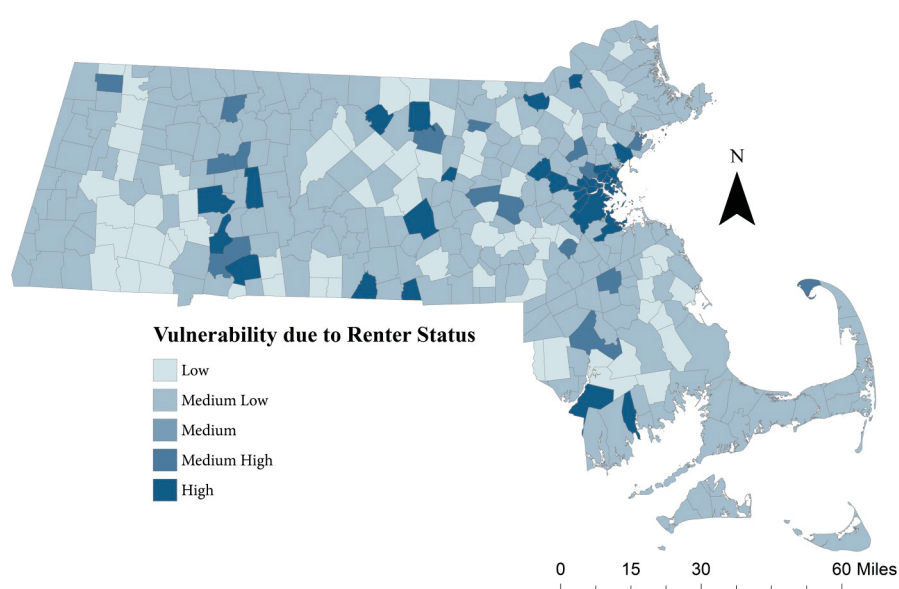
Race is measured by the percent of non-white population.

Education



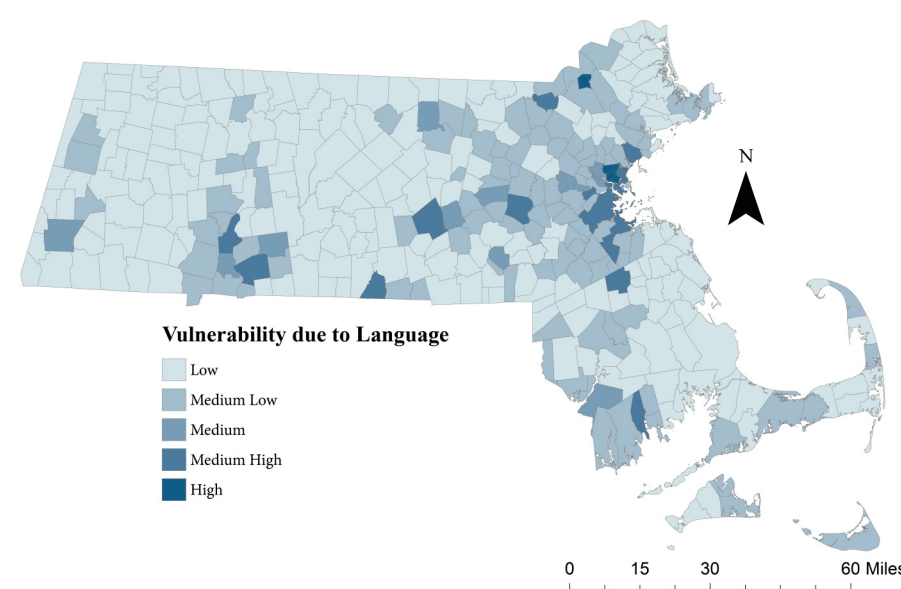
Education is measured by the percent of population with less than high school education.

Renter Status



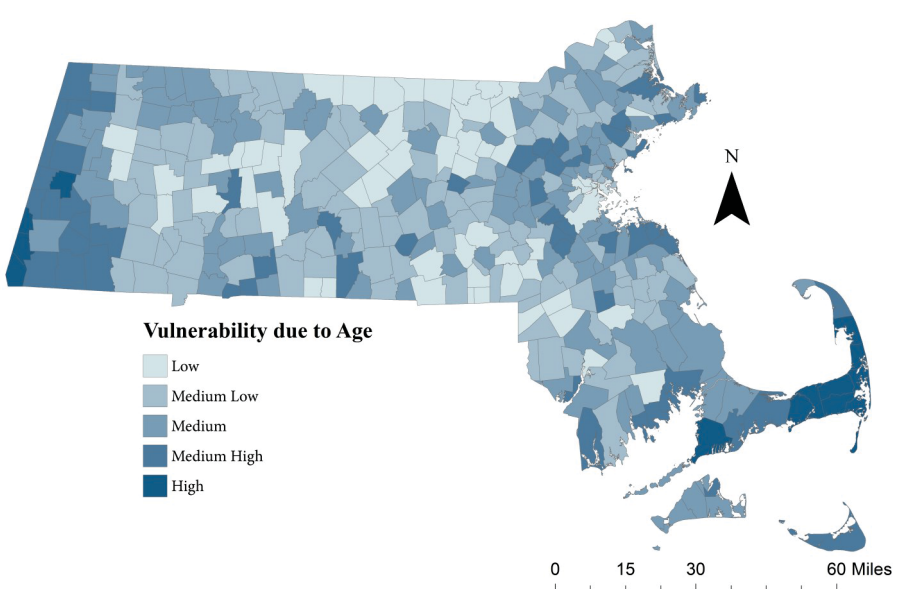
Renter status is measured by the percent of a the population renting their homes.

Language



Language is measured by the percent of population with limited English proficiency.

Age



Age is measured by the percent of population under 5 years old and over 65 years old.