

INTRODUCTION

It is generally believed that public green space could improve the quality of life and provide various benefits for urban residents. Nevertheless, the unequal distribution of urban green open space is one of the most common urban issues in today's cities. What's worse, low-income and minority communities are at a greater risk of environmental burdens and at the same time lack environmental assets in their neighborhoods. Therefore, it is very meaningful to understand and evaluate current accessibility to green open space and explore its relationship with the quality of environment.

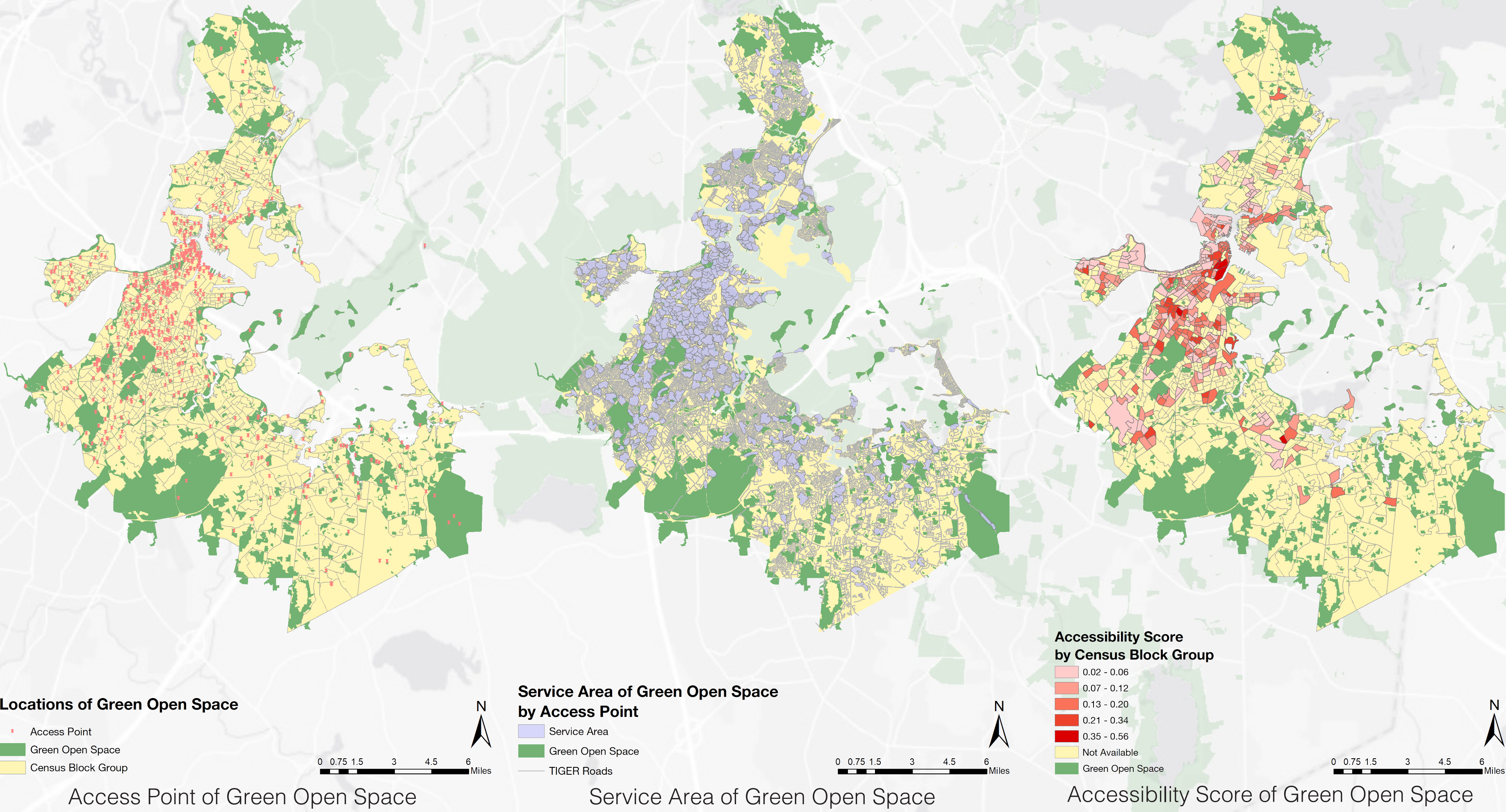
This poster takes the Metro Boston region as the study area, assessing the current green open space access and the distribution of Environmental Justice (EJ), further attempts to examine if there is any correlation between them. This analysis will not only identify the areas where the environmental quality truly needs to be enhanced, but also provide background information for urban planners and policymakers to formulate effective strategies and plans to ease such spatial imbalance in the future.



The Metro Boston region includes the towns of Saugus, Revere, Everett, Chelsea, Winthrop, Boston, Milton, Quincy, Braintree, Hingham and Weymouth.

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GREEN OPEN SPACE ACCESS & ENVIRONMENTAL JUSTICE A SPATIAL ANALYSIS IN THE METRO BOSTON REGION



GREEN OPEN SPACE ACCESS

Green open space, as defined by the state of Massachusetts, includes conservation land, recreation land, town forests, parkways, agriculture land, aquifer protection land, watershed protection land, cemeteries, and forest land. In this analysis, the accessibility to green open space was examined by two methods: Network Analysis and Two-step Floating Catchment Area (2SFCA).

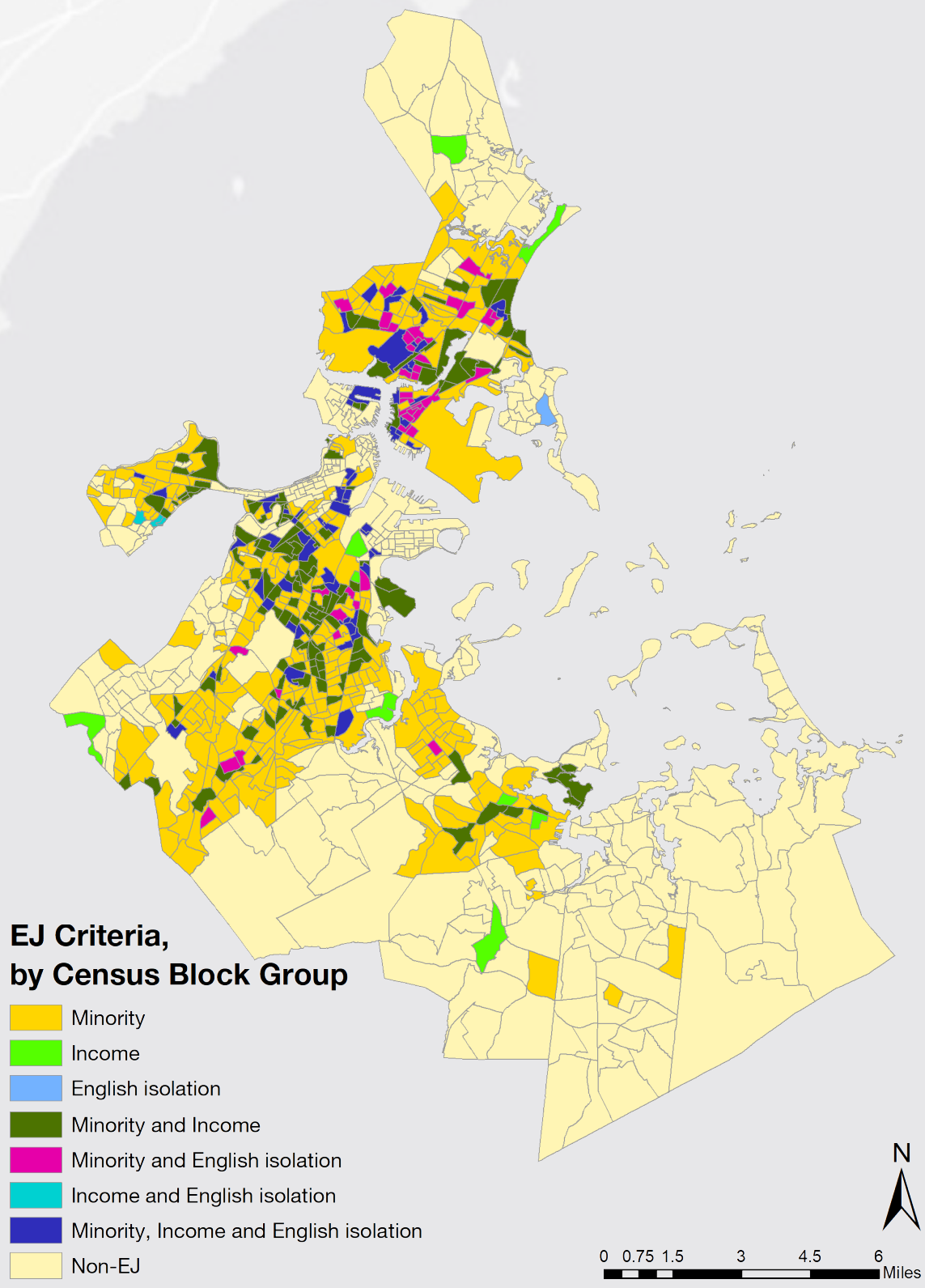
• Network Analysis This evaluation method could generate service area for every access point of green open space in the Metro Boston region. A service area refers to a region that encompasses all accessible streets based on a specified impedance (time or length). For instance, the 5-minute service area for a point on a network includes all the streets that can be reached within five minutes from that point. Since the distance of 0.25 miles (400 meters) is often used as an acceptable walking distance in U.S. research studies, the quarter-mile service area was used as impedance in this analysis.

• 2SFCA On the basis of service area, the 2SFCA method could further quantify accessibility to green open space, which measures the accessibility as a ratio of supply (employment or treatment facilities, in this case, they are access points of green open space) to demand (population needing facilities).

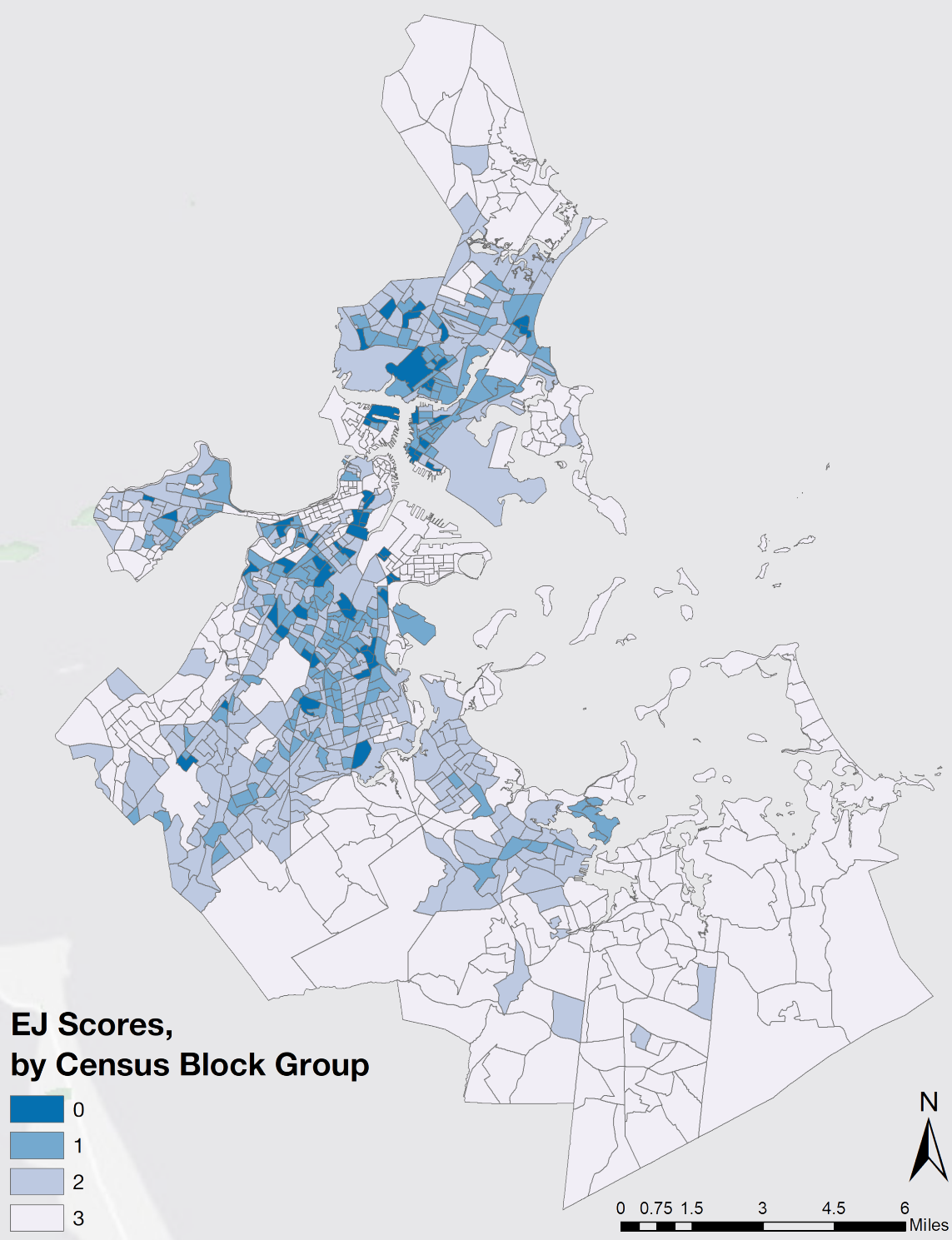
Using the service area generated in the Network Analysis, it first assesses "supply availability" at all access points as the ratio of supplied facilities to their surrounding population. Specifically, if the centroid of a census block group is inside the service area of an access point, then take the population of the census block group as surrounding population of that access point.

After that, sums up the ratios of supply availability around (within the same threshold, namely, quarter-mile service area) each census block group. In particular, if an access point is inside the service area of a census block group, then the corresponding ratio will attach to that census block group as accessibility score.

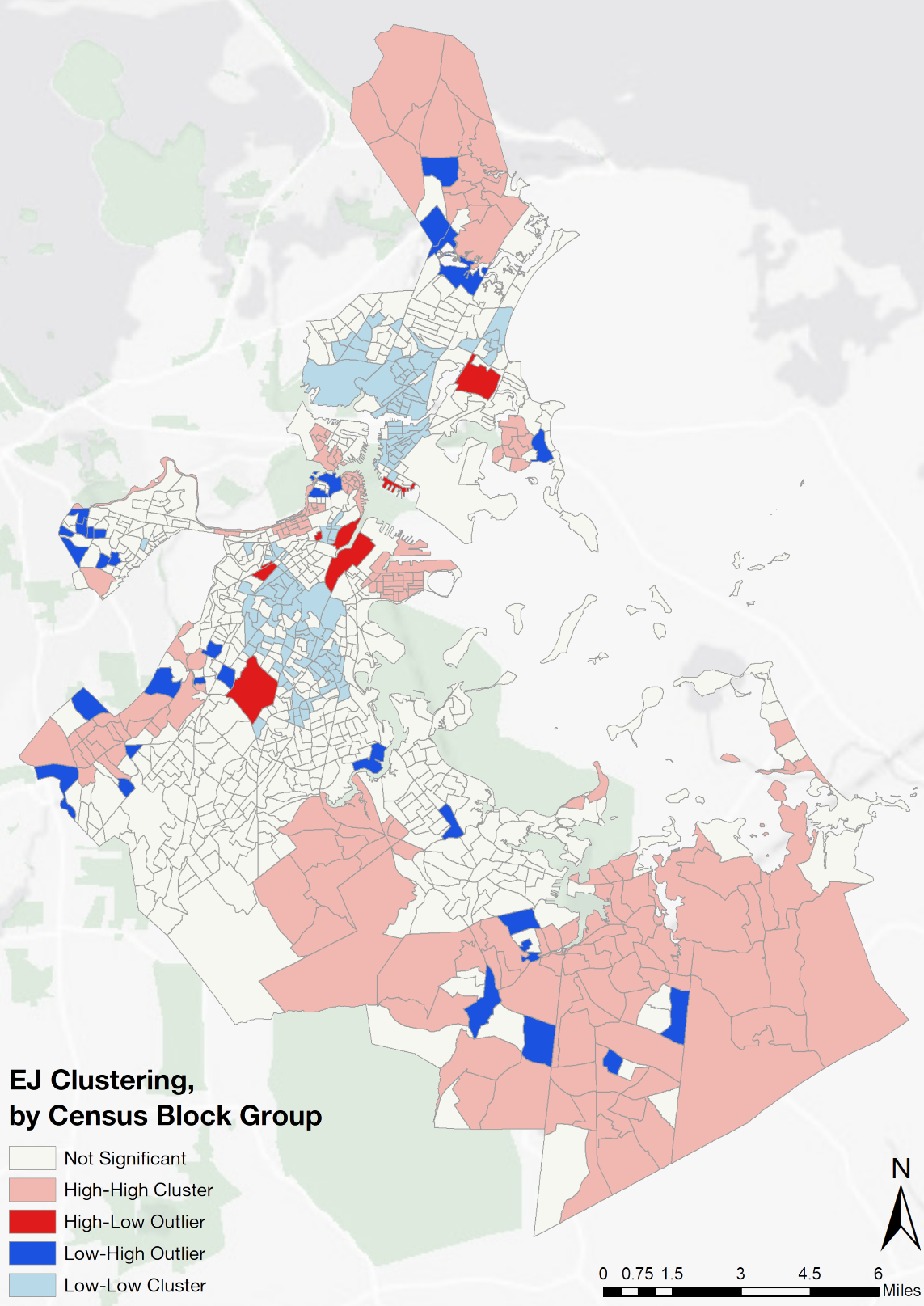
Environmental Justice Communities



Environmental Justice Score



Environmental Justice Clustering



Xianzheng Fang | UEP 235: Advanced GIS | December 17, 2019 Data Sources: BostonGIS, Google Earth, MassEO-EEA, MassGIS, U.S. Census Bureau. Coordinate System: NAD_1983_StatePlane_Massachusetts_Mainland_FIPS_2001 Projection: Lambert_Conformal_Conic

ENVIRONMENTAL JUSTICE

According to The Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), Environmental Justice (EJ) refers to "the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits."The enforcement of environmental justice principles is devoted to enabling everyone to live in and enjoy a clean and healthful environment and to be free of environmental pollution.

In addition, based on census block group level, EOEEA defines EJ population as communities that meet one of more of the following criteria:

- Block group whose annual median household income is equal to or less than 65 percent of the statewide median (\$62,072 in 2010) - Income
- 25% or more of the residents identify as a race other than white - Minority
- 25% or more of households have no one over the age of 14 who speaks English only or very well - English Isolation

Given that, I reclassified EJ communities by giving each census block group a score based on the number of criteria that it meets. For example, a census block group that does not match any criteria will get the highest score, correspondingly, a census block group that meet all criteria will receive the lowest score. After that, Local Moran's I analysis also became viable, which allow me to identify spatial clusters of EJ communities with high or low values and spatial outliers.

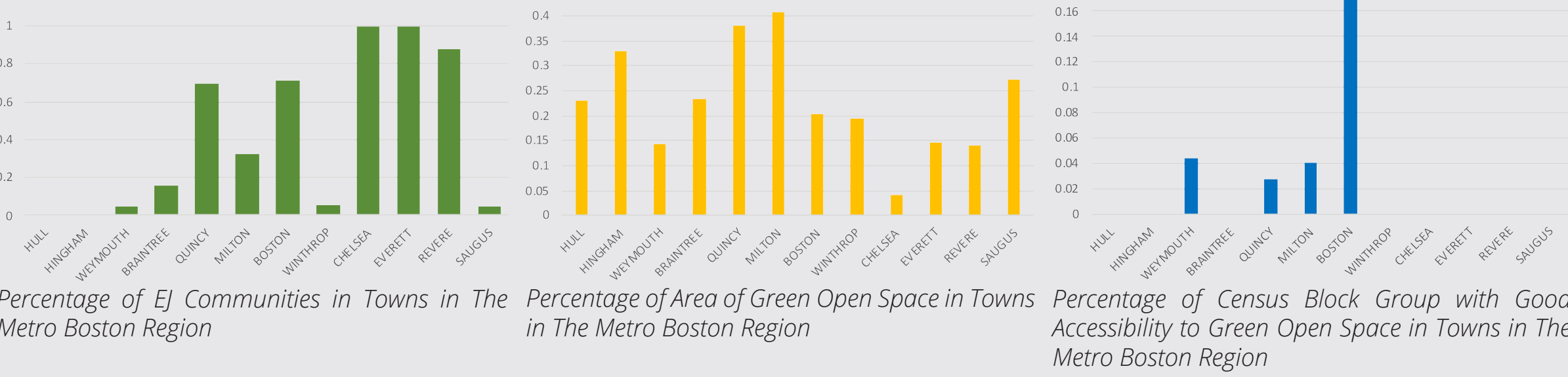
RESULTS & CONCLUSION

Environmental Justice

According to relevant maps, 62.7% of the census block groups in the Metro Boston region are belong to EJ communities. The following bar chart (left) showcases the proportion of EJ communities in each town. Additionally, the EJ clustering map displays that EJ communities with low score are relatively concentrated in Chelsea, Everett, and the center of Boston.

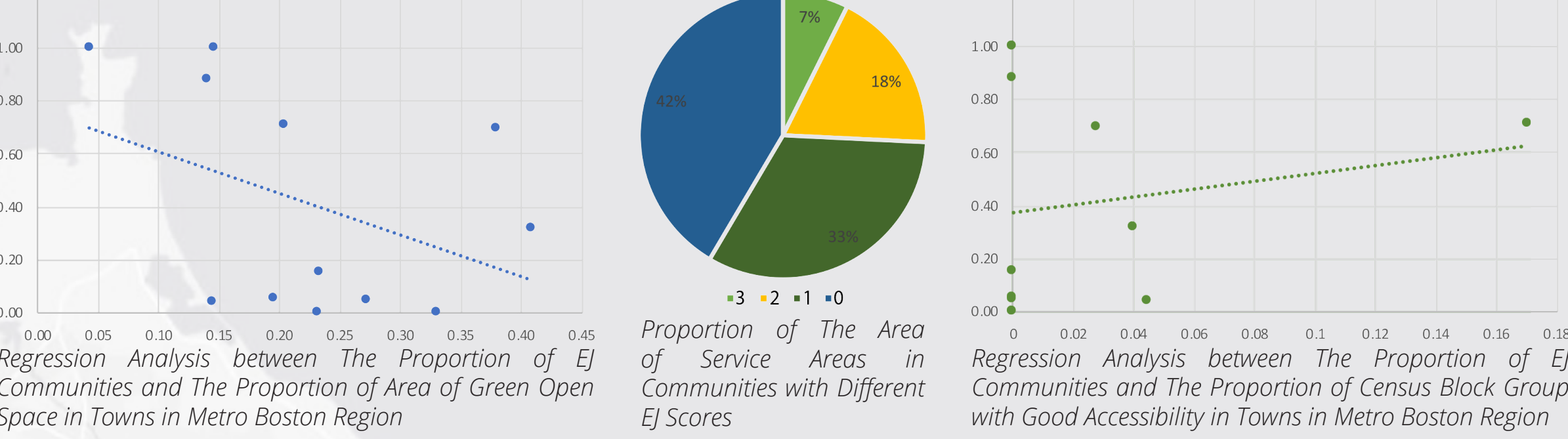
Green Open Space Access

Based on attribute tables of the green open space dataset, 25.7% of the Metro Boston region is covered by green open space. The proportion of the area of green open space in each town is shown in the bar chart below (middle). In terms of accessibility, census block groups with score above 0.1 are considered good in this analysis, the bar chart (right) exhibits the proportion of census block groups with good accessibility to green open space in each town.



Relationship

When it comes to the relationship between the EJ and accessibility to green open space, although one regression analysis (left) higher proportion of area of green open space is associated with the lower proportion of EJ communities, the other (right) indicates that higher proportion of census block group with good accessibility to green open space is associated with the higher proportion of EJ communities. Moreover, the pie chart shows that the lower the score, the higher the proportion of the area of service area, which is contrary to common sense.



LIMITATIONS

However, due to reasons as below, there is still plenty of room for improvement in this analysis in terms of process and data. Therefore, the conclusion also needs to be further tested.

- EJ data is outdated. The only available dataset for EJ communities in Massachusetts is from 2010. In addition, the EOEEA's definition of EJ does not include green space, which is a little bit questionable for me.
- The access points of green open space is incomplete. Since there is no ready-made addresses of green open space except Boston, I had to manually export other access points from Google Earth, which does not necessarily guarantee the precision and completeness of access points.
- There are more meticulous methods for analyzing accessibility. Due to the limitation of my personal GIS-related knowledge and skills, I did not take more complicated and time-consuming enhanced 2SFCA (E2SFCA) in this case.
- Some assumptions are not accord with reality. For example, the population of census block group is considered to be evenly distributed in this case.