

# Mapping Environmental Injustice

## GIS and Superfund Sites in South Carolina

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### Abstract

Environmental justice (or injustice) has recently been a topic of profound interest to scholars and policy-makers [see Bowen (2002) for an overview] at various scales. This project seeks to explore the dimensions of this particular phenomenon in the state of South Carolina. Using data from the U.S. Census Bureau, I employ Geographic Information System (GIS) software to analyze spatial trends in the location of EPA Superfund sites in the state relative to demographic measures of race and income. I conclude that instances of environmental injustice do exist in South Carolina, but that there are other, complex dimensions that need to be analyzed before a precise understanding of environmental injustice in South Carolina can be constructed.

### I. Introduction

Environmental justice is defined as an equal exposure to environmental goods and bads between and among people “no matter their race, ethnicity, or gender” (Robbins et al. 2010, p. 65). Environmental injustice, then, is the converse: an unequal exposure. I have chosen to explore this concept through an analysis of EPA Superfund sites in South Carolina. The Superfund program was established to identify and oversee the cleanup of hazardous waste sites in the United States. This program is administrated by the EPA. I hypothesize that the dispersion of Superfund sites in South Carolina will not be random in reference to measures of race and income, but rather, will tend towards areas of higher minority populations and lower wealth, and thus will represent an instance of environmental injustice.

### II. Literature Review

Robbins et al. (2010) argue that environmental injustice occurs wherever exposure to environmental goods (e.g., green space, clean air) and environmental bads (e.g., polluted water, airborne carcinogens) is not equal or proportional between different groups of people. Studies consistently show that people of color bear a disproportionate level of the burden of environmental hazards (Cutter, 1995; Elliot, Wang, Lowe, & Kleindorfer, 2005). Zimmerman (1993) finds that minority populations are especially over-represented in communities surrounding Superfund National Priority List sites located in urban areas. Cutter (1995) suggests income as another possible vehicle through which environmental injustice may present itself, though she contends that the empirical evidence supporting environmental injustice as realized through race is significantly stronger. Finally, Hird (1993) finds no demonstrable link between relative wealth at the county level and the incidence of Superfund National Priority List sites within a given county.

### III. Methodology

I obtained a list of EPA Superfund sites in South Carolina from the EPA website. The EPA provided addresses for almost all sites, though some sites were not associated with any address, nor could I accurately determine a precise geographic location remotely. Therefore, sites without available geographic data were omitted from my analysis. Using the 82 available addresses and other geographical data, I was able to geocode each Superfund site: I input the addresses of these Superfund sites into an online utility which located each point geographically, and assigned it latitude and longitude coordinates. I then collected data on race and income in South Carolina from the United States Census Bureau. Hird (1993) found no relationship between income and the location of Superfund sites at the county level. In order to determine if aggregation at the county level had a smoothing effect on racial and financial disparities, I specifically sought data on a more localized level. To that end, I retrieved data on race on a block-group level for all block groups in the state; I retrieved income data on a census tract level for all census tracts in the state. Though consistency in scale of data would have been preferable, I was forced to collect income data at the tract level as appropriate block-group level data was unavailable through the Census Bureau. In order to perform spatial analysis, I joined the census data to GIS shapefiles of South Carolina retrieved from the Census Bureau: I joined the race data to a shapefile of South Carolina block groups, and the income data to a shapefile of South Carolina census tracts. Over each shapefile I then overlaid the georeferenced Superfund site locations. I chose to represent wealth within a census tract with median household income. Three of the six classes fall above the median value of median income for each census tract in the state, and three fall below. I chose to represent race in a block group by calculating the percentage of minority residents relative to the total population of that block group. Of this data, one class falls below the median percentage of minorities for each block group in the state, and three fall above. Using GIS software, I performed spatial analysis to determine if evidence of environmental injustice exists in the locations of Superfund sites in South Carolina.

### IV. Results and Discussion

Of the 82 Superfund sites included in my analysis, 45 (almost 55%) are located within block groups where the percentage of minorities is higher than the median of all block groups. Of these same 82 sites, 40 (almost 49%) are located within census tracts in which median household income is below the median of all census tracts. The results of the spatial analysis are fairly consistent with what the literature predicted. According to my analysis, the empirical evidence suggests some degree of environmental injustice, as, collectively, those block groups with higher-than-average percentages of non-whites also contain a plurality of the Superfund sites in the state. However, the same cannot be said of environmental injustice relative to income: the empirical data do not support the possibility of economically driven environmental injustice across the state. Several interesting phenomena can be observed by simple visual inspection. The most noticeable phenomenon is the difference between the Upstate and the rest of the state in terms of the distribution of Superfund sites. In the rest of the state, especially the Lowcountry, Superfund sites follow the hypothesized spatial pattern: they tend to be located in poorer areas and areas with higher minority populations. Yet, in the Upstate, the reverse is true. This unexpected result likely derives from the fact that the Upstate is relatively more wealthy and more white *as a whole*. Another trend to note in the data is the difference between urban and rural areas in terms of Superfund site distribution. In urban areas, higher minority populations correlate much more strongly with incidence of Superfund sites. A third phenomenon, related to the previous two, is that Charleston displays high levels of environmental injustice, both racially and economically, and that, more so than any other area in the state, the two (race and wealth), are themselves correlated. So, though environmental injustice may not be obvious when analyzing data across the state, the case for more localized instances of environmental injustice seems fairly strong, especially in the Lowcountry.

#### Median Income by Census Tract in South Carolina

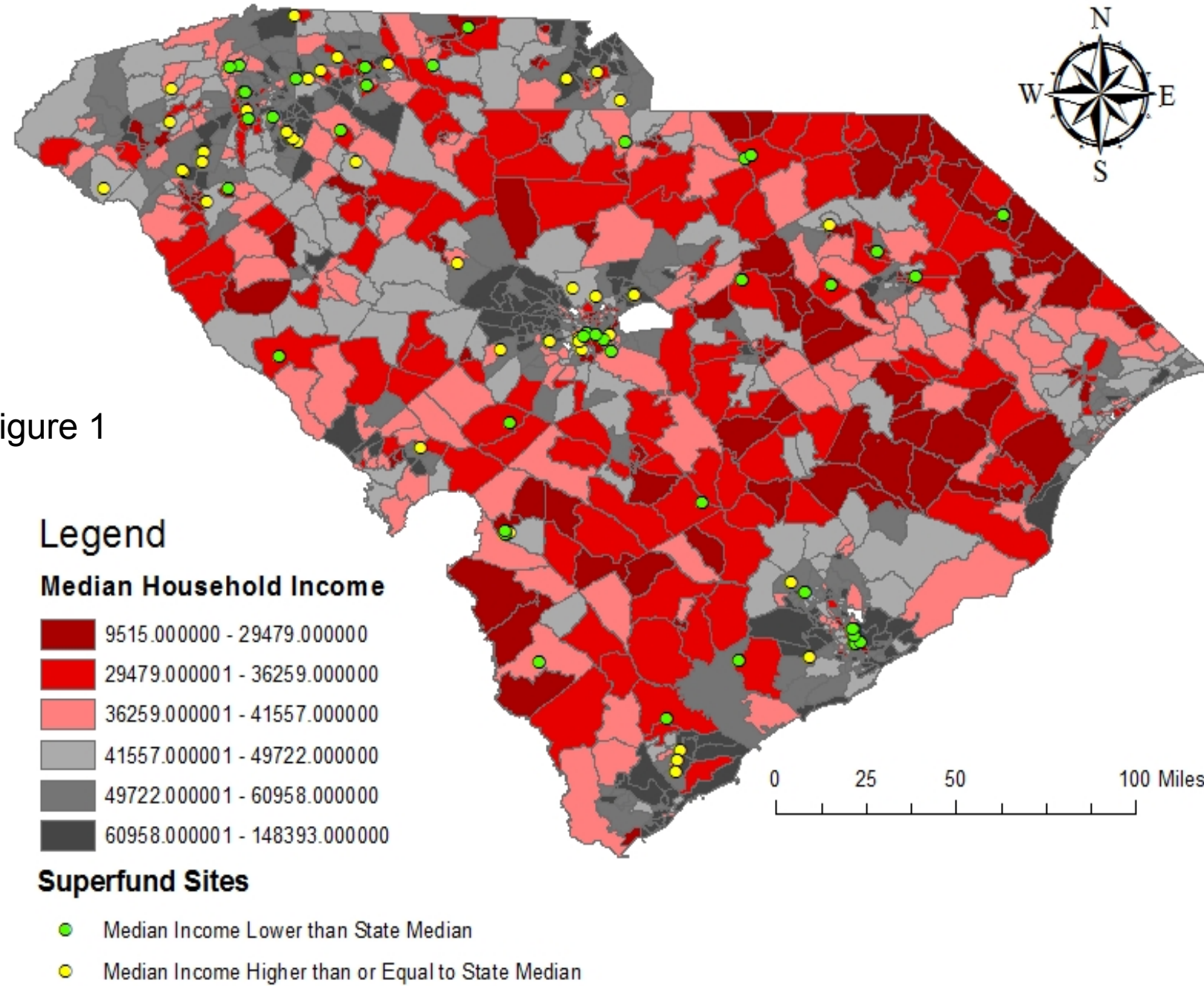


Figure 1

#### Percent Minority by Block Group in South Carolina

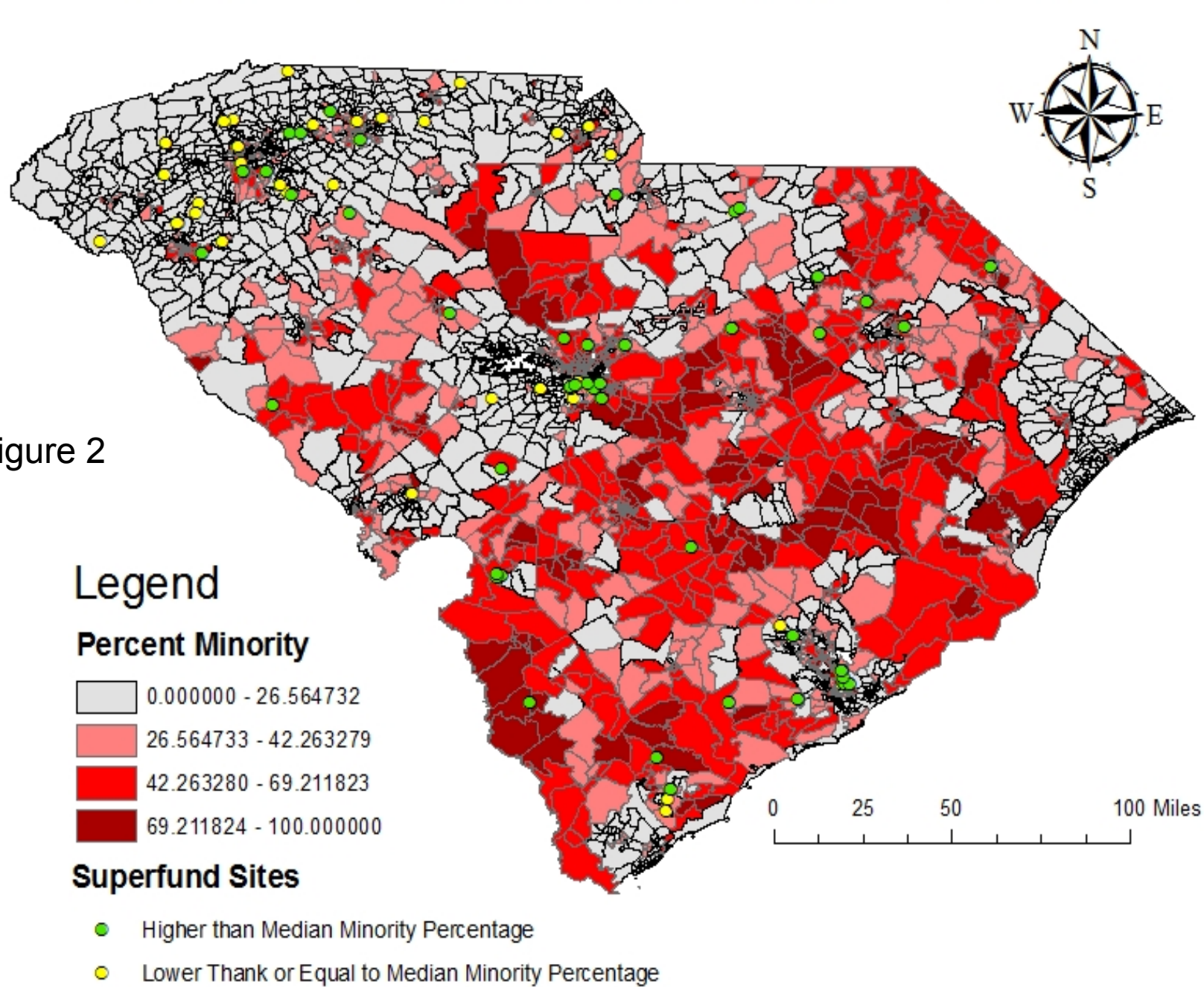
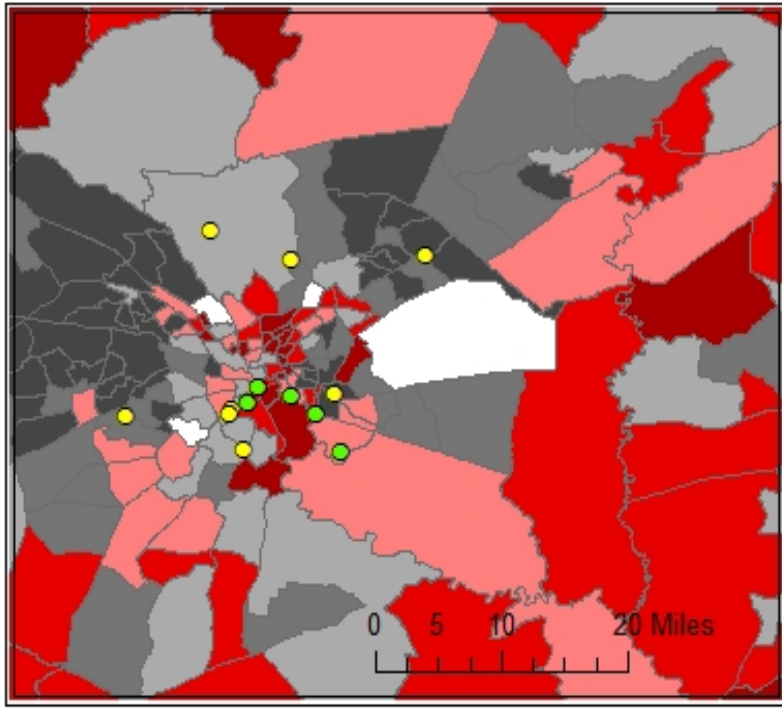


Figure 2

#### Columbia



#### Lowcountry & Charleston

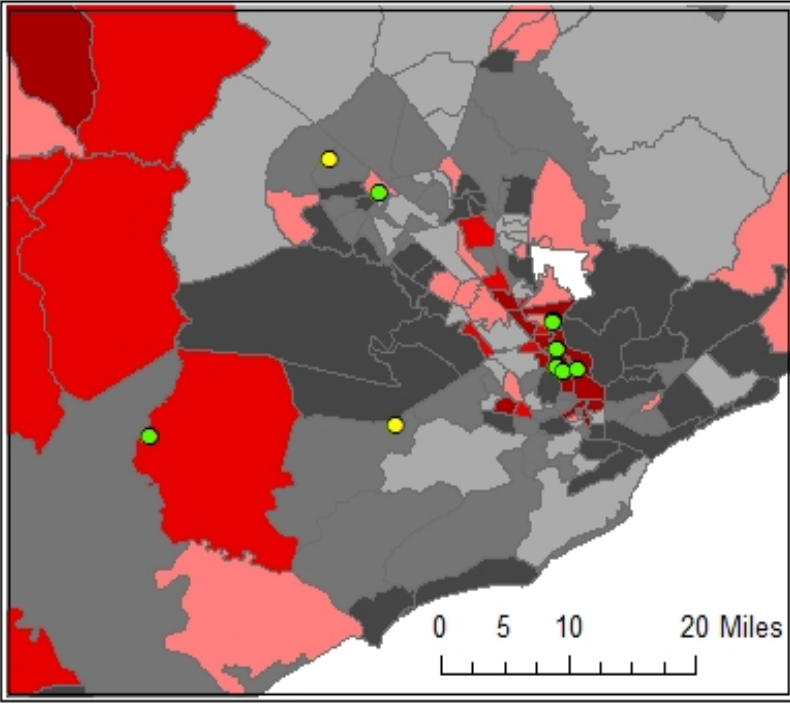
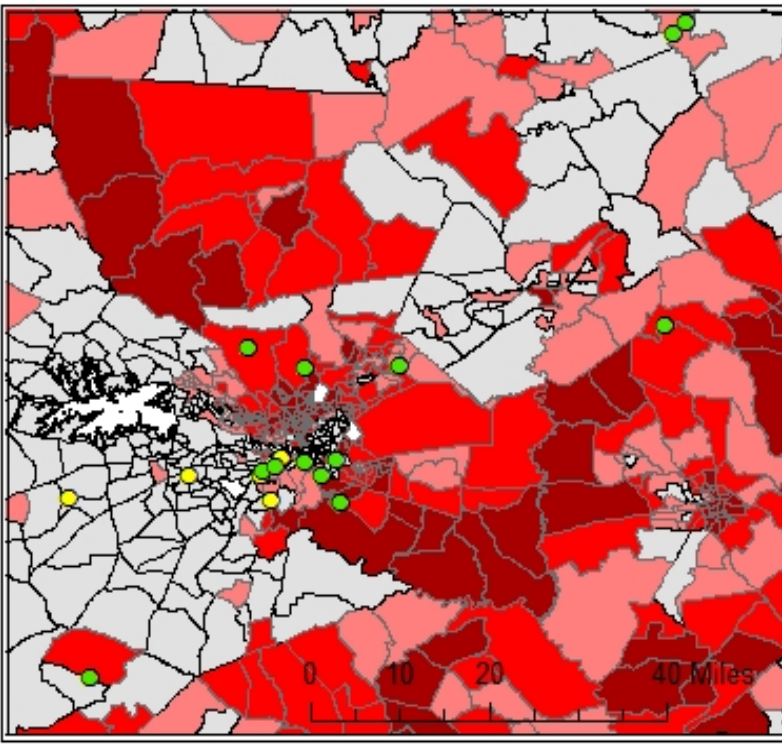


Figure 1: Census tract shapefiles retrieved from Census Bureau. Data retrieved from Census Bureau: 2011 ACS 5-year estimates.

#### Columbia



#### Lowcountry & Charleston

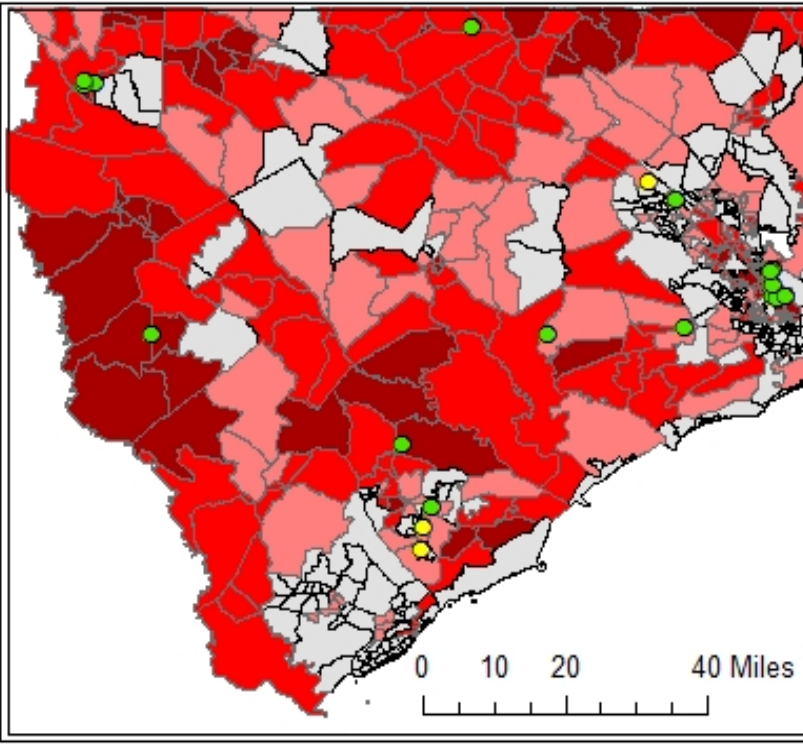


Figure 2: Block group shapefiles retrieved from Census Bureau. Data retrieved from Census Bureau: 2010 SF1 100% Data.

### V.I. Conclusion & Future Research

My initial hypothesis proved correct to an extent: following the definition of Robbins et al. (2010), environmental injustice, especially racial environmental injustice, does exist in South Carolina, at least with respect to the dispersion of EPA Superfund sites. Though we in the Upstate may be isolated from it by virtue of our demographic makeup, it is more noticeable in the rest of the state, and especially so in Charleston and surrounding areas, as well as in other urban areas. Ultimately, my analysis may have been impacted by the forced omission of several Superfund sites. I would like to geocode those in the future and include them in my analysis. Perhaps the fact that geographic data does not seem to be available for several specific sites is itself a non-random occurrence. Also, I would like to explore alternative measures of environmental injustice beyond race and income. Additionally, an historical study of demographic data in the areas surrounding Superfund sites would be interesting, as it would give context to the results of this particular project. Finally, given the relative wealth and homogeneity of the Upstate, I would like to repeat this analysis on only the middle and lower portions of the state.

### VIII. Acknowledgements

Many thanks to Mike Winiski for his invaluable assistance and encouragement throughout.

### VII. References

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