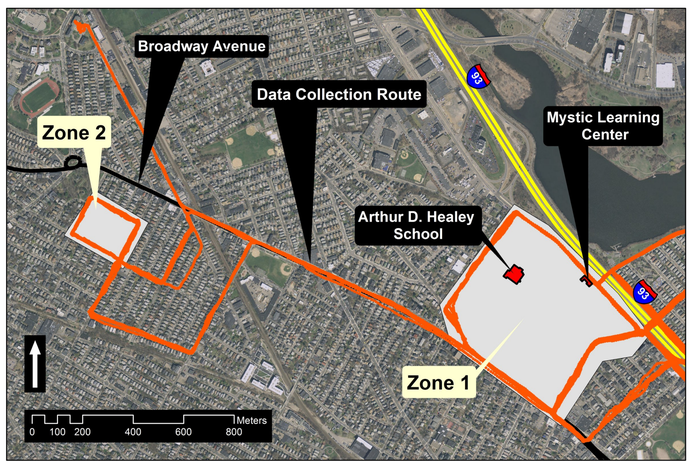
Particle Number Count (PNC) Trends in a Low and Moderate Income Somerville Neighborhood Adjacent to Interstate 93

Introduction

Particle Number Count (PNC) measured in number of particulates per cubic centimeter is an indicator of the degree of air pollution in a given area. The goal of this project is to use PNC data to evaluate the relative exposure in locations adjacent to Interstate 93 compared to locations further away. The following map shows the study area.

Study Area for Trend Analysis of Winter 2009-2010 PNC Data



Zone 1 is the low to moderate income area of interest. It includes federal and Somerville subsidized housing. Zone 1 also includes the Arthur D. Healey School and the Mystic Learning Center (MLC) which are places where children, a particularly sensitive population, spend a lot of their time in the neighborhood. Zone 2, is an area more removed from Interstate 93. It was used in this project as a background reference. All data examined in this project, were collected on five winter afternoons (between 2PM and 8 PM) in the winter of 2009-2010.

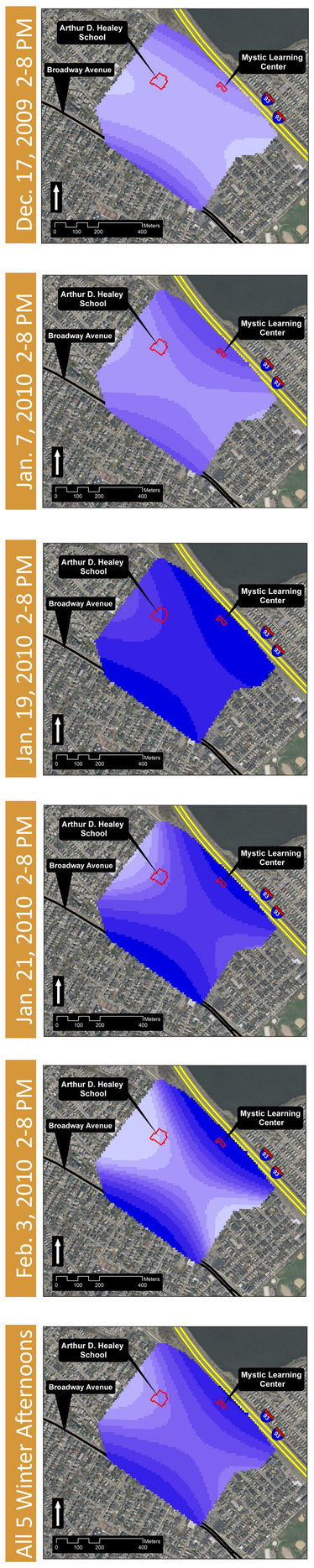
Methods

To evaluate the average concentrations expected in at the Arthur D. Healey School the following steps were taken. **Note that bold faced steps were carried out in Model Builder**:

- Step 1: Zones of interested where digitized into a polygon shapefile.
- Step 2: The resultant shapefile was then designated as the mask in GIS environments for raster analyses.
- **Step 3: The *Select Layer by Location* tool was used to select PNC data points that fell completely within Zone 1 and Zone 2 for all five winter afternoons.**
- **Step 4: The *Trend* tool was then used to evaluate a third degree linear trend on the selected data for each of the five winter afternoons. Trends were stored as raster files all with a cell size of 10.**
- **Step 5: The *Raster Calculator* was used to average the five produced raster files.**
- **Step 6: The *Select Layer by Location* tool was used to select Somerville buildings that fell completely within Zone 1 and Zone 2.**
- **Step 7: The *Zonal Statistics as Table* tool was then used to assign an average PNC value, based on the average trend produced, to each of the selected Somerville buildings. The results were output as a table.**
- Step 8: The resultant table and attribute table of the selected Somerville buildings layer were joined to input the average PNC values into the already drawn layer.
- Step 9: Average PNC of Somerville buildings in Zone 1 and Zone 2 were then displayed using the same graduated color scale as the one used for all the produced trends.

Results: PNC Trends

Zone 1



PNC (#/cm^3)

15,000 - 27,000	40,000 - 44,000	57,000 - 65,000
27,000 - 34,000	44,000 - 49,000	65,000 - 80,000
34,000 - 40,000	49,000 - 57,000	80,000 - 101,000

Zone 2

For all the five examined afternoons, trends in Zone 1 overall had higher PNC values than trends in Zone 2.

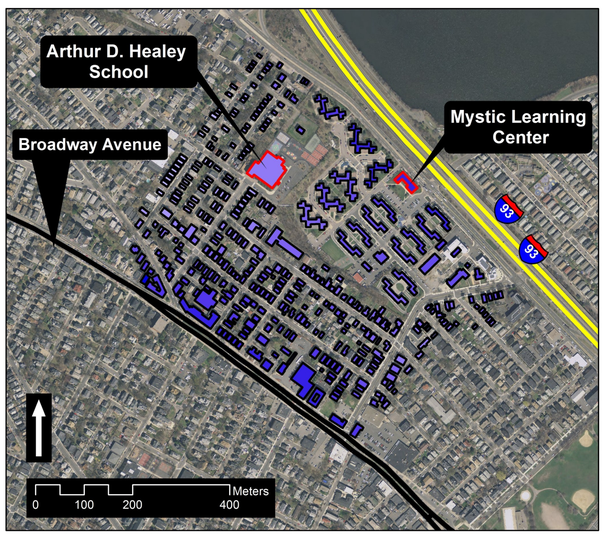
In Zone 1, the same pattern was observed for all five winter afternoons. Higher PNC concentrations were prevalent along Interstate 93 and Broadway Avenue. PNC Concentrations then continuously decreased the further away from Interstate 93 and Broadway avenue.

In Zone 2, there were no discernable patterns aside from the general observation that concentrations were lower in comparison to their counterparts in Zone 1 for the same day. January 7th and January 19th Zone 2 trends had unique PNC distribution patterns. December 17th, January 21st and February 3rd Zone 2 trends had somewhat similar trends in comparison.

Conclusion

As seen in the average trend produced, PNC trend averages in Zone 1 were much higher than PNC trend averages in Zone 2. In particular, the PNC trend average for the Arthur D. Healey school was 40,600 and the PNC trend average for the MLC was 71,100. On the other hand, the maximum PNC trend average in Zone 1 was 39,000. The following maps show the PNC trend average for all buildings in Zone 1 and Zone 2.

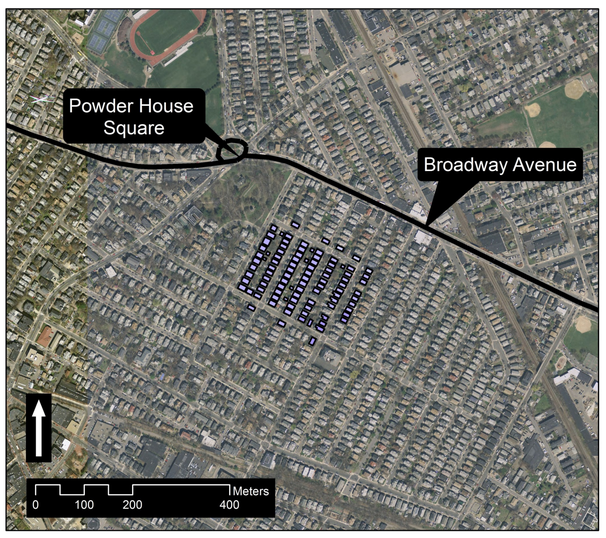
Average PNC by Building in Zone 1



PNC (#/cm^3)

27000 - 34000	44000 - 49000	65000 - 80000
34000 - 40000	49000 - 56000	80000 - 123000
40000- 44000	56000 - 65000	

Average PNC by Building in Zone 2



PNC (#/cm^3)

26200 - 27000
27000 - 34000
34000 - 40000

Next Steps

The following steps are suggested to gain a better understanding of PNC trends in the area:

- Study the effect of wind speed, wind direction and atmospheric stability on PNC trends.
- Conduct further analysis to understand the cause for the different trends observed in Zone 2.

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Projection: NAD 1983 State Plane Massachusetts FIPS 2001 (meters)
Data Sources:

PNC Data: Padró-Martínez, Luz T., Allison P. Patton, Jeffrey B. Trull, Wig Zamore, Doug Brugge, and John L. Durant. "Mobile Monitoring of Particle Number Concentration and Other Traffic-related Air Pollutants in a Near-highway Neighborhood over the Course of a Year." Atmospheric Environment 61 (2012): 253-64. Web.

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