

Spatial Analysis of Pollution Exposure and Health Outcomes in the cities of Long Beach and Wilmington

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Introduction

Health effects from living or going to school close to traffic related air pollution, are a main concern because they increase asthma incidence, have harmful effects on pregnant women and their offspring, and may cause heart attacks or other health conditions in the elderly (Figure 1). *Environmental justice* refers to the effort to correct a deep rooted practice of depositing harmful toxics around local communities regardless of race, color, national origin, education, and income. This research investigates residents that live around refineries, freeways, superfund sites, and the Ports of Los Angeles and Long Beach who are prone to asthma, because of all the pollution from industrial processes like trucks coming in an out of the ports, and yard equipment from the ports. Geographic information system (GIS) software was used to study the demographics and health data for census tracts close to the ports of Los Angeles and Long Beach, refineries, and local freeways to see how they may impact asthma risk in local census tracts.

Dasymetric mapping was used because it represents data by dividing each census tract enumeration unit into smaller zones based on local pollution exposure. Simple statistics estimate how to redistribute the tract's total number of asthma hospital admits to these zones.



Figure 1.
Examples of
pollution sources:
A: superfund site,
B: the local Tesoro
refinery in
Wilmington, C: the
710 freeway in
Long Beach, and
D: the Port of Los
Angeles

Methodology

The analysis approach (Figure 2) is summarized as follows:

- Located and mapped all the major sources of pollution in the City of Long Beach that emit toxic substances into the air, including refineries, local freeways, the Ports of Los Angeles and Long Beach, and local super fund sites (though these were found to be located far enough outside the study area and do not have a significant local impact).
- Created multiple ring buffers around the major sources of air pollution. The buffers delineate an estimation of the impact of pollution around each source of pollution. The buffer sizes are 0.25 mile, 0.50 mile, and 1 mile. At the end a combined ring buffer was created by unioning the ring buffers created for each different type of local pollution source (Figure 3).
- Clipping was applied to all the buffers to use only the information from the study area. After the clip was performed, the buffers were unioned with the census tracts to create individual polygons.
- A Python script was created to estimate how many of each census tract's total asthma hospital admits should be attributed to each polygon in that tract that was created during the union operation based on the polygon's pollution score and its area.

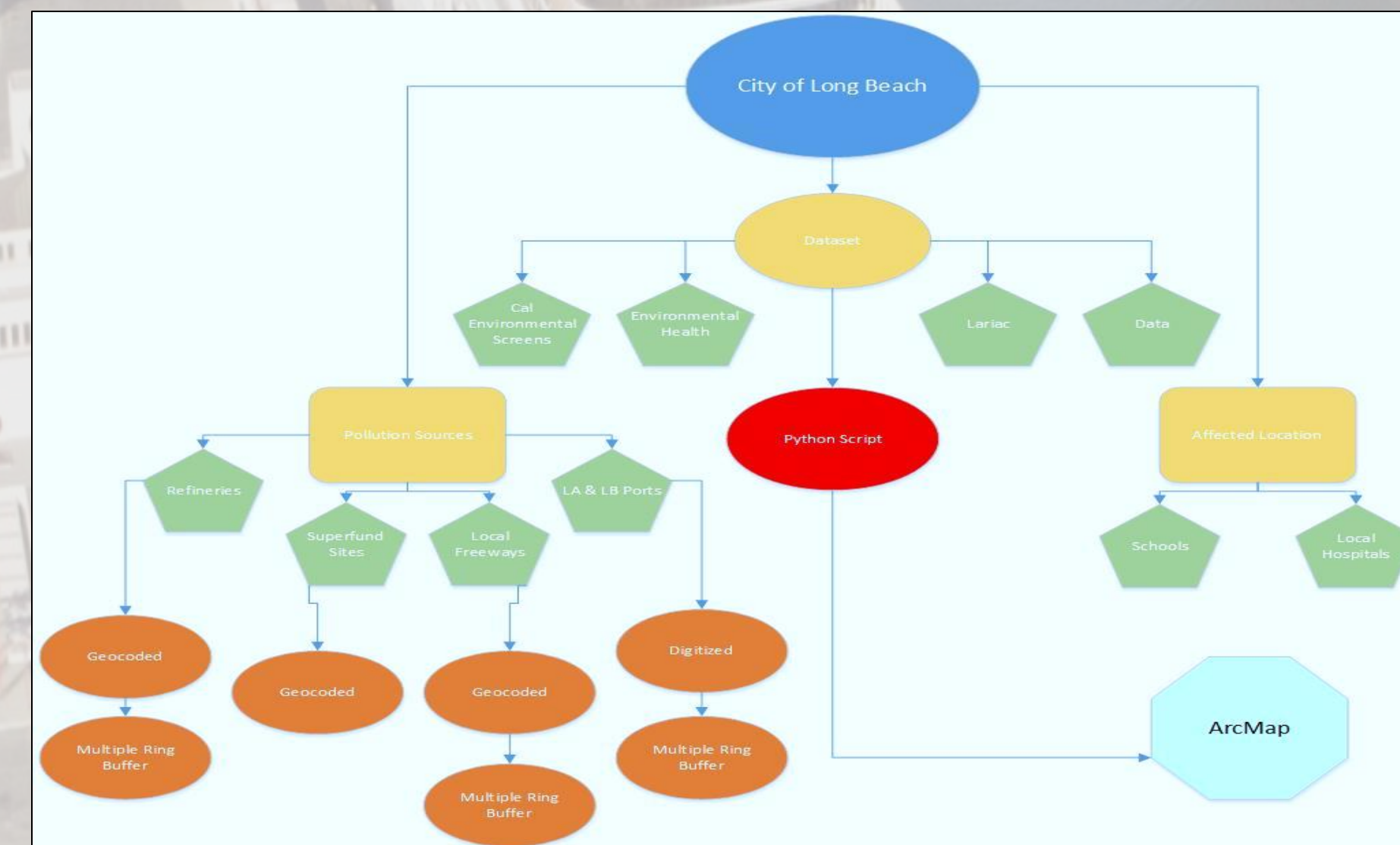


Figure 2. Spatial model of the steps taken for the project.

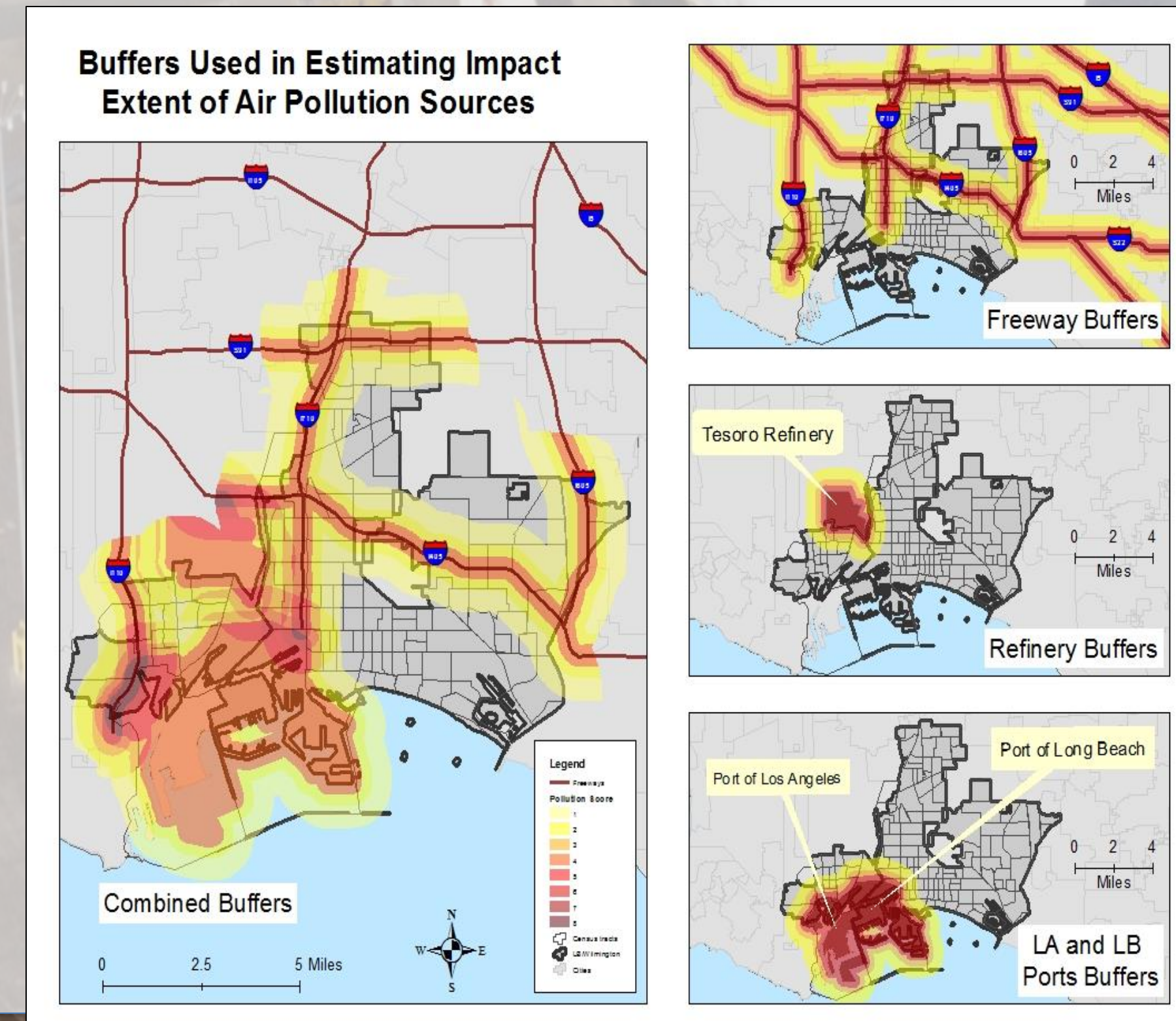


Figure 3. Buffers created from each local source of pollution.

Results

To determine the damage of pollution placed upon the cities of Long Beach and Wilmington, different maps were created with ArcGIS software. Figure 4 shows the schools in the study area along with areas that have been predicted to have high pollution exposure. Table 2 shows the estimated pollution exposure of schools based on the unioned ring buffers created around the local sources of pollution. Most schools were located far from pollution sources, but there were many schools in close proximity to more than one local pollution source. Figure 5 shows the dasymetric map that was created to better estimate asthma risk within census tracts based on exposure to local pollution sources.

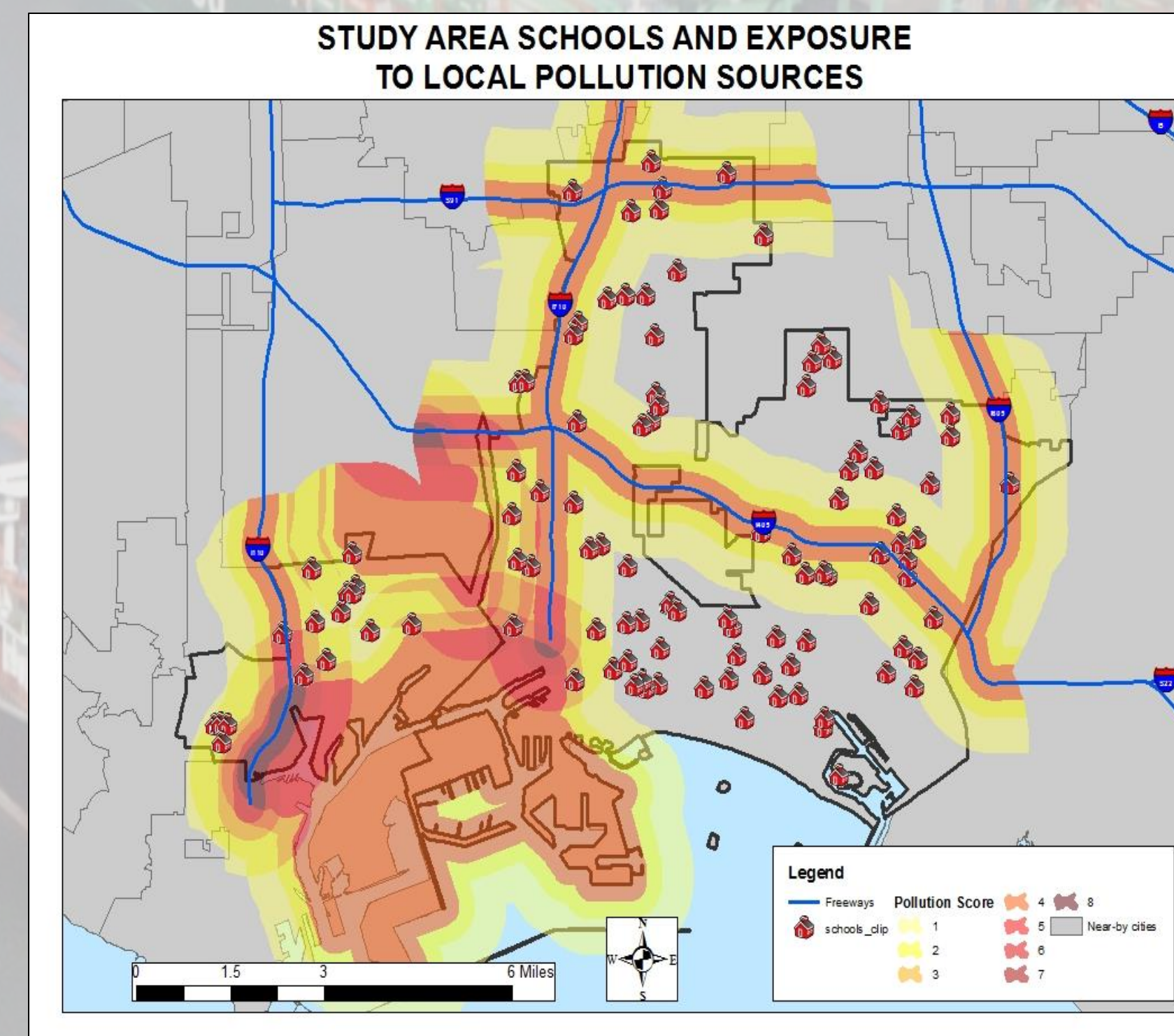
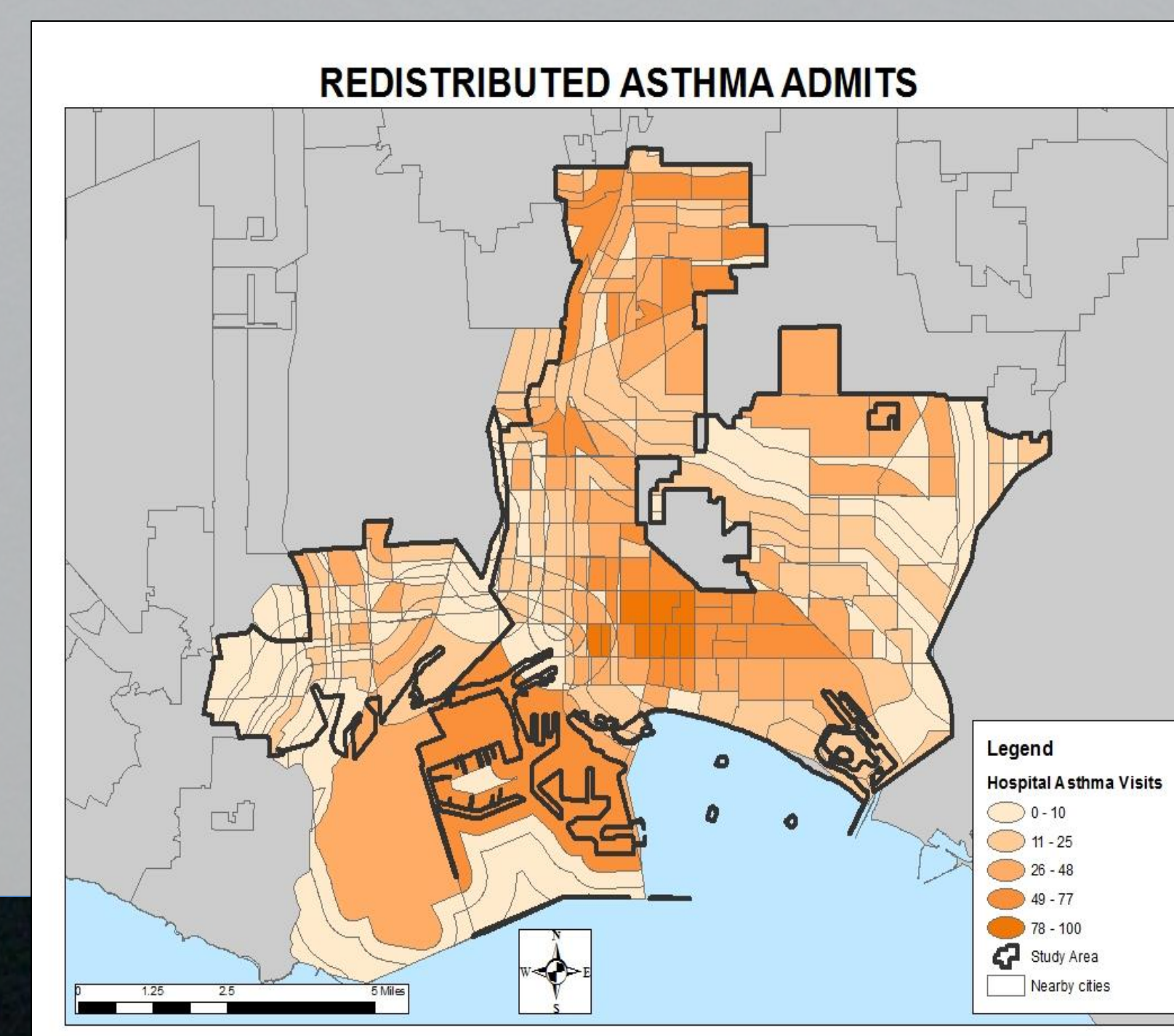


Figure 4. Schools affected by local sources of pollution.

Table 2. Number of schools within a local pollution score zone.

Exposure to Local Pollution Sources Score	Number of schools in score area
0	46
1	17
2	28
3	3
4	14
5	1
6	1
7	0
8	0

Figure 5. Redistributed hospital visits with asthma symptoms based on census tract hospital admit data and proximity to local pollution sources.



Discussion

Children living in west Long Beach are more likely to be exposed to local pollution than children in east Long Beach, but interestingly the downtown area has a greater density of asthma hospital admits than areas close to local pollution sources.

A benefit of using dasymetric mapping is that they have lower errors than maps created with different methods. The limitations of using dasymetric mapping was that when it came to represent small polygons, the data were not portrayed correctly because larger polygons have higher values than smaller polygons with similar characteristics.

This project only provided an example of how dasymetric mapping could be used to research health issues. It is unlikely that the redistributed asthma hospital admit map is a good predictor of where asthma may be more common among residents, because residential zones data were not factored in to determine where people are likely to live within each census tract. When using dasymetric mapping to predict where disease cases may be occurring, it is important to consider people's right to privacy and ensure that maps do not reveal any personal information.

Wind pattern data was going to be used to determine the level of pollution, but due to a lack of time the research project was completed without the wind direction using only the distance from pollution source to calculate estimated local pollution exposure.

Conclusion

Environmental justice issues in the Long Beach and Wilmington area are an important topic of study because of the vulnerable low-income communities around these areas. The mapping methods explored in this research project could be used in other studies that incorporate other important factors such as race, age, income level, education level, and sex that could be added into the mix to further explore issues of environmental justice.

Assessing the potential impacts of pollution reduction efforts would be another interesting way to expand this project. If closing a refinery provides cleaner air but causes job losses, does this have an overall positive impact or negative impact on the local community?

The only way that changes are likely to be made is by making the local public more aware of environmental justice issues and the pollution that they are exposed to.

Acknowledgments

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Image Sources:
[1] <http://blogs.kcrw.com/whichwayla/wp-content/uploads/2015/03/DELAMORUBBER.png>
[2] <http://www3.nd.edu/~drucio/Carson.jpeg>
[3] <http://www.psr-la.org/wp-content/uploads/2012/08/freeway.jpg>
[4] <http://www.burnsmcdblog.com/wp-content/uploads/2014/11/PortofLA.jpg>

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Data and Data Sources

Table 1. List of data and data sources used in the project.

Dataset	Source
Cal Environmental Screens	Office of Environmental Health Hazard Assessment
Environmental Health Imagery	Environmental Protection Agency
Schools data	Los Angeles Region Imagery Acquisition Consortium (LARIAC) Program
LA County data	Los Angeles County GIS Data Portal