Diesel Exhaust Exposure in the Duwamish Study (DEEDS)

Technical Report
Executive Summary

University of Washington
Department of Environmental & Occupational Health Sciences
Seattle, WA

September 13, 2013

Suggested Citation:

Schulte, J.K., Magzamen, S., Oron, A.P., Beaudet, N., Kaufman, J.D., Larson, T.V., & Fox, J.R. (2013). Diesel Exhaust Exposure in the Duwamish Study: Technical Report. Seattle, WA: University of Washington School of Public Health, Department of Environmental Health Sciences. Retrieved [date], from http://www.duwamishdiesel.org/home/technical-report

For more information about this report, please contact Julie Fox or Sheryl Magzamen at:

Julie Fox
University of Washington
Dept of Environmental Health & Occupational Health Sciences
richmanj@uw.edu

Sheryl Magzamen
Colorado State University
Dept of Environmental and Radiological Health Sciences
sheryl.magzamen@colostate.edu

SCHOOL OF PUBLIC HEALTH
UNIVERSITY of WASHINGTON

EXECUTIVE SUMMARY

The Diesel Exhaust Exposure in the Duwamish Study (DEEDS) is a community-academic partnership between the Department of Environmental and Occupational Health Sciences (DEOHS) in the School of Public Health at the University of Washington and Puget Sound Sage. This study sought to characterize the gradient of diesel exhaust in the south Seattle neighborhoods of South Park and Georgetown. With guidance from community members and the program partner, DEOHS researchers measured levels of diesel exhaust markers in a high-density air sampling campaign, built statistical models to identify spatial features predictive of diesel exhaust, and created maps of the gradient of diesel pollution across the neighborhoods.

Two 2-week sampling campaigns were conducted in the study neighborhoods during summer 2012 and winter 2012-2013. The time periods for these campaigns were selected to capture seasonal variation in diesel pollution, other air pollution sources, and weather. Data were collected on four pollutants as markers of traffic-related air pollution: 1-nitropyrene (1-NP), a polycyclic aromatic hydrocarbon that is a by-product of combustion from diesel engines; black carbon (BC); oxides of nitrogen (NO_x); and particulate matter less than 2.5 μm in diameter ($PM_{2.5}$). Measurements of these pollutants were collected at 20 active sampling sites in South Park and Georgetown as well as 4 comparison sites in other neighborhoods. In addition, the campaign included passive sampling for NO_x and NO_2 at 99 sites and measurements of on-road carbon emissions from a mobile monitoring instrument. Active and passive samplers were co-located at the Puget Sound Clean Air Agency and Washington State Department of Ecology's Air Quality Monitoring Stations. Secondary data included traffic forecasts and meteorological information.

To determine the predictive spatial features, statistical models were derived using a hybrid land-use regression/dispersion modeling approach. Diesel gradient maps were generated by calculating pollution predictions at gridded points 50m apart, which were smoothed using universal kriging.

Results generally indicated a wide degree of variation in pollution levels across the study area. Average BC, 1-NP, NO_2 and NO_x levels were higher in December than August, though August measurements showed a greater degree of variability. Prediction models were successfully built for all pollutants except $PM_{2.5}$ and December 1-NP. These models were able to explain a very large amount of the community variation in pollutant exposure by factoring in distance to developed areas, railroads, truck traffic, and information from mobile monitoring efforts, especially for August 1-nitropyrene (cross-validated R^2 of 0.73). The modeled gradient of August 1-NP predictions is shown in Figure 1.

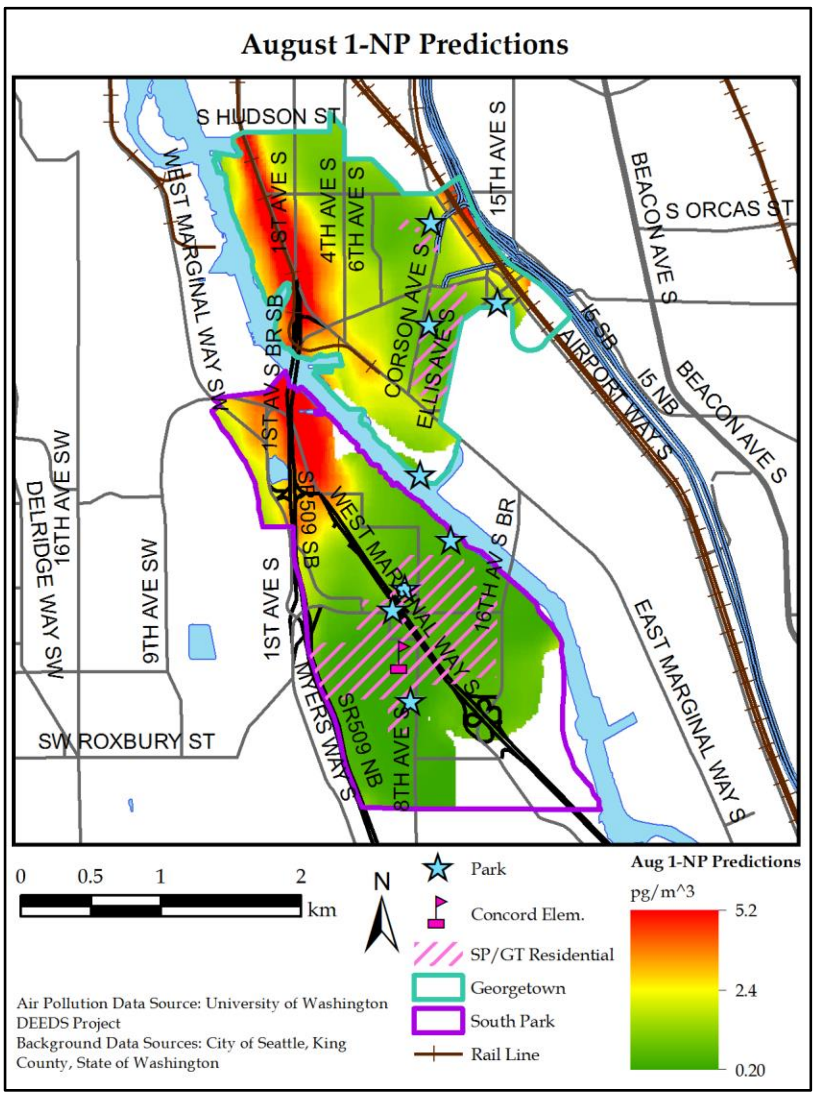

Figure 1. Map of August 1-NP prediction gradient

In addition to models of individual pollutants, models were also generated for a continuous pollution score, which represents a linear combination of standardized levels of 1-NP, BC and NO_x. The August pollution score model had the highest cross-validated R^2 of the prediction models (0.89).

By combining community-based monitoring and advanced modeling approaches, this study was able to identify and display predictors of fine-scale differences in concentrations of diesel exhaust pollution in the communities of South Park and Georgetown. Pollution levels were generally higher in South Park and Georgetown than comparison sites in other residential neighborhoods (Queen Anne and Beacon Hill). Within South Park and Georgetown, levels were highest in areas of heavy traffic and industrial activity.