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Spatio-Temporal Analysis of the Roadside Transportation Related Air Quality (STARTRAQ) and Neighborhood Characterization

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The San Joaquin Valley has some of the most polluted air in the nation. In particular, Fresno ranks at the top for worst air quality, with the highest levels of particulate matter that exceed federal and state clean air standards according to the Environmental Protection Agency (EPA). Particulate matter 2.5 ($PM_{2.5}$), fine inhalable particles with diameters that are generally 2.5 micrometers and smaller, have been known to pose a risk to human health. While many $PM_{2.5}$ particles vary in compositions, black carbon (BC) which occurs due to incomplete combustion from gas and diesel engines and other sources, makes up a majority of particulate matter emitted worldwide. As toxic components of particulate matter are emitted from the fossil fuel combustion, mainly from transportation mobile sources, increased health risks associated with asthma, cardiovascular disease, and premature death are inevitable.

A previous analysis, the Childrens' Health and Air Pollution Study (CHAPS), focused on the exposure to traffic emitted air pollutants on different populations in the Fresno area by assessing effects on birth outcomes, development, immune health, and inflammation. In this study, we provide the data-driven transportation information on transportation-related particle pollution data, spatial analyses of geocoded vehicle emissions, and neighborhood characterization for the built environment. The goal is to provide a clear understanding of air pollution in the Fresno area by informing the public and decision makers; this information can help to establish public policy, planning for sustainable growth, and promoting public health in the region.

Study Methods

Transportation-emitted particle pollutants in the air are measured by air particle monitors in the Fresno neighborhoods for the CHAPS. These pollutants include particulate matter (PM), black carbon (BC), and polycyclic aromatic hydrocarbons (PAH). PM, depending on the particulate size, can be further categorized as PM_{10}, $PM_{2.5}$, and PM_{1}, whose numbers refer to the size of particles

in the unit of micrometers. Various particle monitors (DustTrack DRX, microAeth, PAS2200CE) sampled roadside air on walking routes, along with GPS loggers for CHAPS. Next, coordinate information was added to this pollution data using time stamps. The pollution data acquired from the sites were organized so that trajectories of each pollutant could be displayed in digital maps. In this study, the low-cost air sensors (Dylos and Atmotube) were tested side-by-side with particle monitors for the potential use of future study.

This study also utilizes Geographic Information System (GIS), a computer system that organizes, analyzes, and displays map-referenced information. GIS not only enables the visualization of spatial variations and patterns of pollutants but also allows for the spatial analysis of data (such as proximity, buffer, interaction, union, etc). GIS is further applied to observe the impact on zip code and consensus tract level analysis using the CalEnviromentScreen data.

Geo-coded particle data enhanced the ability to examine spatial variations of pollutants by surrounding built environments of neighborhoods.

Findings

To evaluate spatio-temporal characteristics, the air pollutant concentrations near roadways in Fresno neighborhoods from the community monitoring project (CHAPS) were geocoded and examined the relationship among environmental and health indicators from CalEnviroScreen by zip codes. Geo-coded pollution data enhanced the ability to observe spatial variations of pollutants across different built environments in surrounding neighborhoods. The roadside concentrations of $PM_{2.5}$, black carbons, and PAHs were significantly elevated compared to the concentrations at the ambient monitoring stations. The increased overall $PM_{2.5}$ concentrations occurred near roadways with a higher volume of traffic and in regions with more unpaved areas. The proportions of black carbon and PAHs as components of $PM_{2.5}$ were persistently elevated in the neighborhoods near the highways and areas with high diesel traffic and industries based on the parallel monitoring data. The results indicate component speciation of $PM_{2.5}$ would improve the public health of the community and further an understanding of built environmental impacts.

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To Learn More

For more details about the study, download the full report at **transweb.sjsu.edu/research/2010**

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