Name(s)
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Project Number
J1202

Project Title
Particulate Matter Spatial Analysis in Micro-Environments: Decreasing Childhood Microfine PM Exposure

Abstract

Objectives/Goals
Children are unwillingly and needlessly exposed to excessive amounts of microfine particulate matter (PM). This poses many health hazards, especially for children, the elderly, and those with pulmonary & cardiovascular health concerns by penetrating deep into the respiratory system and can potentially damage the gas-exchange surfaces (alveolar region) of the lung. The goal is to measure and spatially analyze the accumulation/dispersion rate of PM over distance from vehicle sources in a parent pick-up lane or roadway in order to understand PM accumulation and thereby minimize childhood exposure. My hypothesis is that the microfine PM concentrations would decrease exponentially over distance.

Methods/Materials
I generated a 1-meter grid over a satellite image of the area behind the parent pickup line at Krystal School (34.379011, -117.288474) using Google Earth and placed 2 Purple Air PA-II sensors each day for three weeks. I wrote a shell script to upload data to my google drive and then calculated the average of all of the data per sensor per location. I generated graphs and analyzed the data.

Results
The data trend shows that the smaller the particle, the greater decrease (linear, not exponential) in the concentration of PM. Microfine PM (0.3 microns)decreased 88.04% while fine PM (2.5 microns) decreased 79.23% and course PM (PM10) decreased just 14.86% over 15 meters from source. Conversely, larger particles trend less decrease over distance.
The data indicates that the smaller particles accumulate through chemical bonds (I found PM bonded with H2O molecules last year due to their weak electron bond) over distance and time. Kids should be moved back at least 5 meters from PM sources to minimize microfine PM exposure.

Conclusions/Discussion
I found that the larger the size of the particles, the less of a decrease there was in the concentration of PM over distance and time from sources, but not an exponential decrease as predicted in my hypothesis. This is due to the smaller PM accumulating through homogeneous nucleation, condensation, and then coagulation/agglomeration forming larger particles.

The results show that children should be moved at least five meters back from cars/PM sources to minimize their exposure to microfine PM and decrease the health risks.

Summary Statement
This project measured microfine, fine, and coarse particulate matter accumulation trends over distance from sources in order to create a risk assessment for children displayed in a spatial analysis of a microenvironment.

Help Received
I purchased the sensors and ran the experiments by myself, but Dr. Vaselios Papapostalou at the Southern California AQMD provided a resource to select sensors.