Size characterization of sidewalk particulate matter due to vehicular emissions.

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Abstract

Measuring instruments were mounted on a controlled electro-mechanical device near to a road to obtain the vertical and horizontal location of concentration, number distribution and size of particulate matter coming from vehicular emissions. By applying a digital filtering technique, background and local concentration signals were separated, allowing the isolation of particulate matter preferred at near road locations.

Largest Aitken and accumulation ranges of fine particles (diameter: 0.22 um - 2.5 um) were found near to the road at heights between 1.14 m to 1.43 m mainly placing children at risks.

Results provide a guideline to mitigate children exposure to vehicular emissions of particulate matter.

Ecological barriers and green urban design can reduce this risk. Methodology, graphic results and future experiments regarding ecological barrier design will be presented.

Methodology

Measuring instruments were mounted on a controlled electro-mechanical device near to a road to obtain the vertical and horizontal location of concentration, number distribution and size of particulate matter coming from vehicular emissions. Instruments are listed:

- Sidewalk Atmospheric Profiler, UNAM-CCA's original invention, to scan following environment near to sidewalk by using mechanic moving devise which measurement instruments were attached to.
- Portable Aerosol Spectrometer Grimm 11C to measure aerosol diameter, RH and temperature. Data measurement every 6 seconds.
- Portable Spectrometer Thermo PDR-1500 to measure PM-2.5 Data measurement every 1 seconds.
- Ultrasonic Anemometer Young 81000V to measure wind and temperature. Data measurement every 0.1 seconds.
- Datalogger Campbell CR1000 to synchronize and collect experimental data.

By applying a digital filtering technique, background and local concentration signals were separated, allowing the isolation of particulate matter preferred at near road locations.

Due to its cold dry weather, winter and fall are classified as "the particle season" in Mexico City and Metropolitan Area. The experiment was carried on a wide open three-laned street surrounded by green areas at UNAM's Campus Ciudad Universitaria, on Monday, February 17, 2020, a month before COVID19 quarantine began, so measured data and results represent car traffic due to ordinary activities.

Results

Sidewalk profiles of particulated matter

Particulated matter local signal due to vehicular emissions was filtered from background, classified by diameter and was plotted by its position near to road.
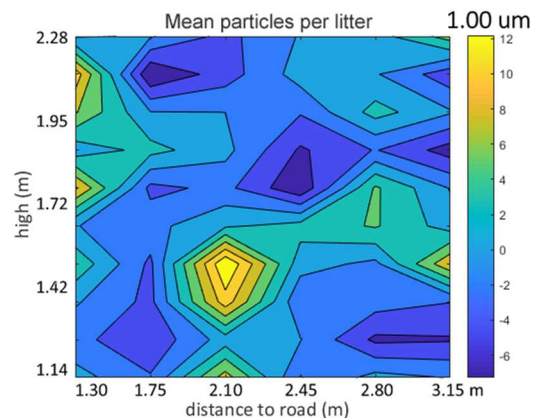

Figure 1. Atmospheric profiles near to sidewalk. X-axis: distance to road. Y-axis: high. Color scale axis: mean counting particles per litter. 1.0 um particles concentrate mainly at 2.1 m from the road.

Conclusions

Largest Aitken and accumulation ranges of fine particles (diameter: 0.22 um - 2.5 um) were found near to the road at heights between 1.14 m to 1.43 m mainly placing children at risks.

This method identifies specific zones where pollutants are mainly concentered and can be used to study personal exposure to pollutants in urban cannons.

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