1UA.6
Factors and Particle Dynamics Controlling Pollutant Plume Length Downwind of Major Roadways in Nocturnal Surface Inversions. WONSIK CHOI, Meilu He, Vincent Barbesant, Kathleen Kozawa, Steve Mara, Arthur Winer, Suzanne Paulson,*University of California Los Angeles*

Recent epidemiological and toxicological studies have shown evidence for significant impacts on human health from exposure to fresh vehicular emissions. The pollutant plumes from major roadways generally can impact near roadway neighborhoods over a much wider area under stable atmospheric conditions (> 2 km) than unstable convective boundary layers (< 300 – 500 m). However, factors controlling pollutant plume length downwind of line sources still need to be quantitatively understood for the precise prediction of plume impacts. This study focuses on understanding (1) what are the major contributors to the extent of freeway plumes for the pre-sunrise periods, and (2) how freshly-emitted ultrafine particles (UFP) evolve in their characteristics during downwind transport periods.

We have measured spatial concentration profiles of pollutants emitted from major roadways for stable pre-sunrise periods (4:00 – 6:30 A.M.) using an electric vehicle mobile monitoring platform with no emissions of its own in the California's South Coast Air Basin (SoCAB). Curve fits using a Gaussian dispersion model solution were successfully applied to obtain both the dispersion coefficients and particle number emission factor (PNEF) directly from the observed UFP concentration profiles. The dispersion coefficients ranged more widely than conventionally used Briggs' values with strong correlations with meteorological parameters as well as with differences between the background and plume peak concentrations. These relationships were applied to predict freeway plume transport using a multivariate regression method. The mean PNEF for a mixed vehicle fleet on the four freeways studied here was estimated as 1.2×10^{14} particles·mi^{-1}·vehicle^{-1}, which is 15% of a previously estimated value for the I-405 freeway in 2001, implying significant reductions in UFP emissions over the past decade in the SoCAB.

Preliminary results of observed particle dynamics from size-segregated UFP concentration profiles, including dilution, evaporation/condensation, coagulation, and production rates with distance downwind of the freeways, are also presented.

1UA.7
Ultrafine Particle Infiltration to Passenger Vehicle Cabins: the Effects of Driving Speed and Ventilation Setting. EON LEE, Yifang Zhu, *University of California, Los Angeles*

Previous studies have found motor vehicle emissions leaking into vehicle cabins. However, few studies characterized location-specific infiltration and its contributions to in-cabin air quality. The present study examined ultrafine particle (UFP) infiltration in five passenger vehicles including a minivan and four sedans under different ventilation modes (i.e., off, outside air intake (OA), and recirculation (RC)) on both local and freeway routes. We observed high variability in mechanical ventilation fan settings among tested vehicles (i.e., 4 to 12 steps) and applied an equal measure of quartile fan settings to all the vehicles. This study first distinguished in-cabin UFP penetration by incursion routes: mechanical ventilation and infiltration through leakages. The primary leakage locations were identified at side-doors and rear-trunk by measuring UFP concentration gradients and differential pressure between in-cabin and across potential leakage areas. We found the infiltration amount through the leaks were different by leakage location, driving speed, ventilation modes, and fan settings. Increases in driving speed created differential pressure up to 300 Pa for passenger cars and 100 Pa for the minivan primarily because of aerodynamic changes on the moving vehicle. In contrast, the differential pressure between in-cabin and rear-trunk remained positive in the range of 10 to 60 Pa with respect to driving speeds. It suggests that no leakage would occur through side-doors and rear-trunk as a result of cabin pressurization driven by mechanical ventilation under OA mode. Under RC mode, however, we consistently observed a negative differential pressure between in-cabin and rear-trunk suggesting that on-road pollutants could infiltrate through rear-trunk in RC mode regardless of vehicle type or driving speed. Under RC mode, depending upon vehicle envelope aerodynamics, infiltration through side-doors was inconsistent in terms of leakage flow direction (i.e., into or out of the cabin) and the amount of infiltration.

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