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Characterization of particulate matter emissions from on-road gasoline and diesel vehicles using a soot particle aerosol mass spectrometer

T. R. Dallmann et al.

Correspondence to: R. A. Harley (harley@ce.berkeley.edu)

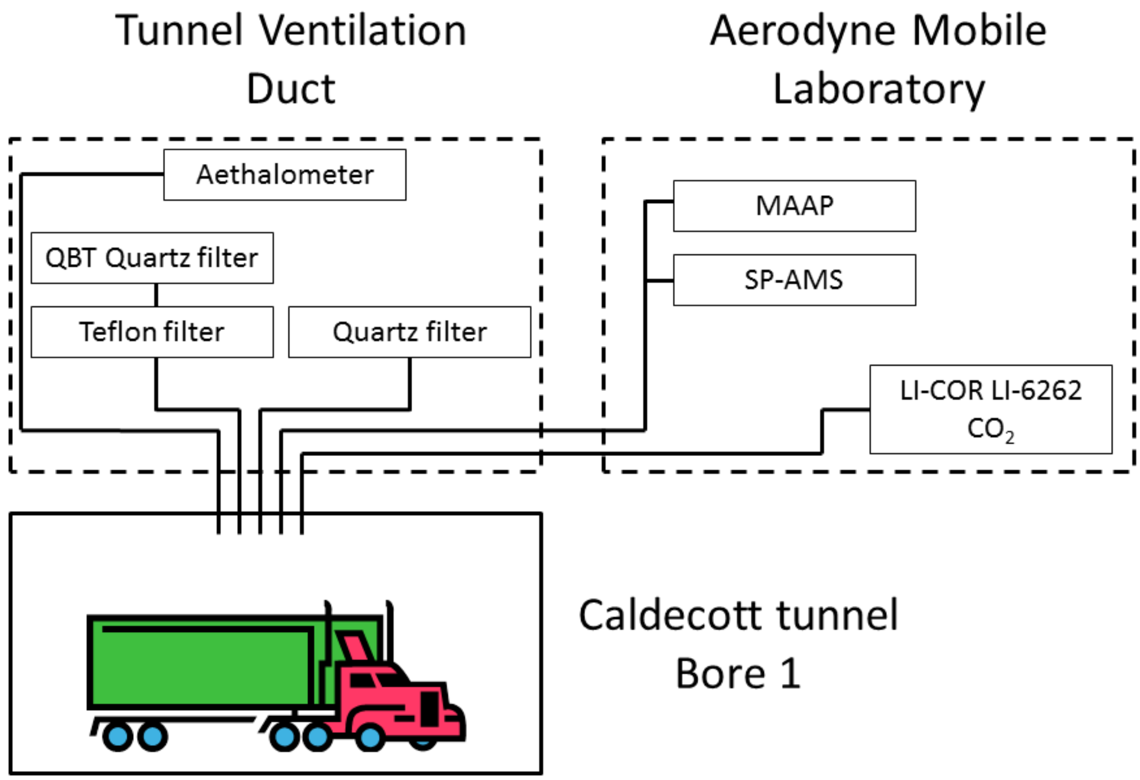

Figure S1. Extractive sampling schematic.

Particle Transmission Efficiency Testing

The sampling line was tested for particle losses prior to sampling inside the Caldecott tunnel by generating a polydisperse ammonium sulfate aerosol and sampling the distribution prior to and after passing through the copper sampling tubing. Particle losses, due to surface impaction and gravitational settling, were determined as a function of particle size by taking the ratio of the two size distributions. It was not feasible to test the full 35 m length of tubing. We tested 17 m of the external 5/8" OD copper sampling line tubing in addition to the split sampling lines inside the Aerodyne mobile laboratory (AML). Finally, we used theoretical calculations (Baron and Willeke, 2001) to estimate particle losses due to the additional 18 m of copper sampling line.

Figure S2 shows the generated ammonium sulfate distribution before and after transiting the sampling line and the measured size-dependent particle loss (i.e. transmission efficiency) for 17 m of 5/8" copper tubing and the AML lines, theoretical calculations for additional 18 m of 5/8" copper tubing, and the combined particle transmission efficiency. The theoretical calculations assume a straight smooth bore tube without bends (reasonable approximation for the 5/8" sampling line).

The results show that the particle number distributions and total number concentrations will be dramatically affected by the extractive sampling technique used for this study. The 50% transmission point for the sampling line is 50 nm in diameter. The volume/mass of the particle size distributions will not be as significantly affected. For example, the polydisperse ammonium sulfate test distributions shown in Figure S2a peaks at 38 nm in number and 150 nm in volume distributions. Whereas the total particle number (area under solid curves) is dramatically different, the total volume (area under dashed curves) is much less so.

Kittelson et al. (2004) reviewed typical diesel truck exhaust and notes that >90% of the emitted particle mass, mainly "carbonaceous agglomerates and adsorbed materials", exists in accumulation and coarse modes above ~50 nm in diameter. Thus, while long extractive sampling line effectively limits characterization of the particle number concentrations and the nuclei mode (i.e. nanoparticles <50 nm in diameter), we can confidently characterize the mass and chemical composition of the emitted particles.

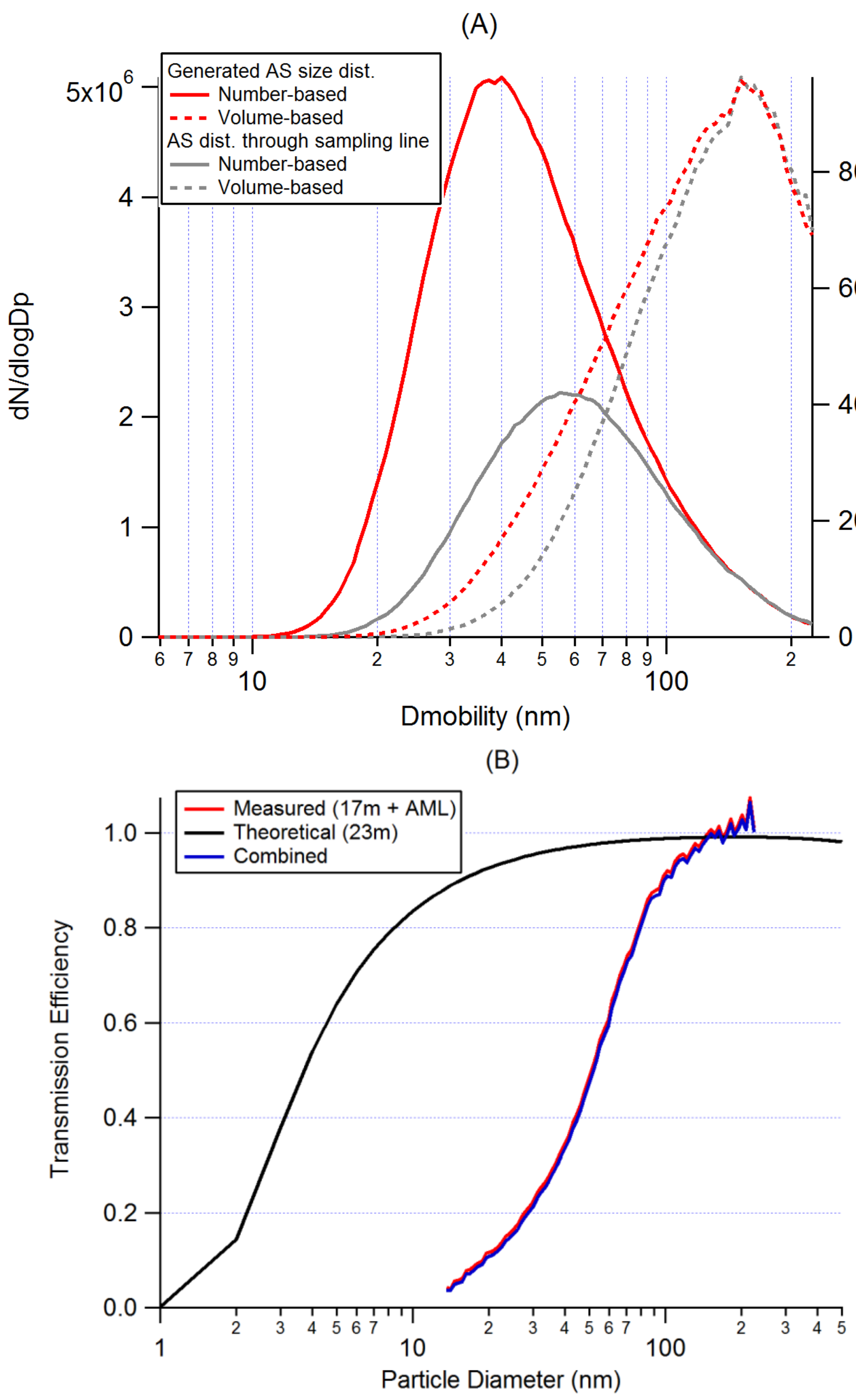

Figure S2. (A) Ammonium sulfate polydisperse size distribution before and after transiting through the sampling line. (B) Transmission efficiency of particles through the sampling line as a function of particle size.

References

Baron, P. A. and Willeke, K. (Eds.): Aerosol Measurement: Principles, Techniques, and Applications 2nd Edition, Wiley, New York, 2001.

Kittelson, D., W. F. Watts, and J. P. Johnson (2004), Nanoparticle emissions on Minnesota highways, *Atmospheric Environment*, *38*(1), 9-19.