Source apportionment of ambient particle number concentrations in central Los Angeles using positive matrix factorization (PMF)

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In this study, the Positive Matrix Factorization (PMF) receptor model (version 5.0) was used to identify and quantify major sources contributing to particulate matter (PM) number concentrations, using PM number size distributions in the range of 13 nm to 10 µm combined with several auxiliary variables, including black carbon (BC), elemental and organic carbon (EC/OC), PM mass concentrations, gaseous pollutants, meteorological, and traffic counts data, collected for about 9 months between August 2014 and 2015 in central Los Angeles, CA.

Several parameters, including particle number and volume size distribution profiles, profiles of auxiliary variables, contributions of different factors in different seasons to the total number concentrations, diurnal variations of each of the resolved factors in the cold and warm phases, weekday/weekend analysis for each of the resolved factors, and correlation between auxiliary variables and the relative contribution of each of the resolved factors, were used to identify PM sources.

A six-factor solution was identified as the optimum for the aforementioned input data. The resolved factors comprised nucleation, traffic 1, traffic 2 (having a larger mode diameter than traffic 1 factor), urban background aerosol, secondary aerosol, and soil/road dust. The contributions of each of the resolved sources in different phases are illustrated in Figure 1.

As can be seen from the figure, traffic sources (1 and 2) were the major contributor to PM number concentrations, collectively making up to above 60% (60.8-68.4%) of the total number concentrations during the study period. Their contribution was also significantly higher in the cold phase compared to the warm phase. Nucleation was another major factor significantly contributing to the total number concentrations (an overall contribution of 17%, ranging from 11.7% to 24%), having a larger contribution during the warm phase than in the cold phase. The other identified factors were urban background aerosol, secondary aerosol, and soil/road dust, with relative contributions of approximately 12% (7.4-17.1), 2.1% (1.5-2.5%), and 1.1% (0.2-6.3%), respectively, overall accounting for about 15% (15.2-19.8%) of PM number concentrations. Brines *et al* (2015) reported that traffic and nucleation were the main sources contributing to PM number concentrations in five high-insolation cities, including Los Angeles, using a different method, namely, the k-means clustering method.

As expected, PM number concentrations were dominated by factors with smaller mode diameters, such as traffic and nucleation. On the other hand, PM volume and mass concentrations in the study area were mostly affected by sources having larger mode diameters, including secondary aerosols and soil/road dust (Vu *et al,* 2015). Results from the present study can be used as input parameters in future epidemiological studies to link PM sources to adverse health effects as well as by policy makers to set targeted and more protective emission standards for PM.

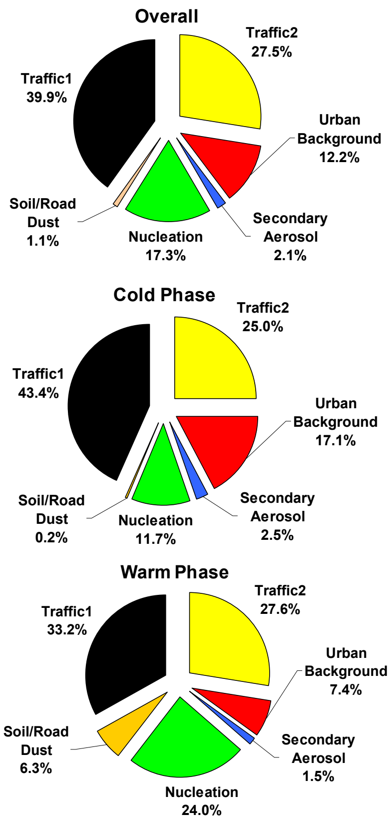

Figure 1. Relative contribution of each factor to the total number concentrations: a) overall phases; b) cold phase; and c) warm phase.

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