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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Receptor modeling of near-roadway aerosol mass spectrometer data in Las Vegas, Nevada, with EPA PMF" *by* S. G. Brown et al.

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This is an interesting work on the application of PMF and ME2 to data obtained by AMS for the source apportionment of OM. This is research topic of great interest in the last years, and the investigation of the present paper on the applicability of the PMF model may be an interesting contribution. We appreciate the reviewers excellent comments and have strived to provide sufficient details in response.

There are some minor aspects which could be clarified. 1. Recent publications identified the contribution of cooking organic aerosol (COA). This is not commented in the introduction section. Have the authors check the possibility of indentifying this source in the study area? COA is certainly a likely source in the area. The SV-OOA profile here has only modest similarities to the one reported in Lanz et al., 2007 (r2=0.71), with a fair amount of scatter for the high concentration fragments like m/z 41 and 43. However the SV-OOA profile and temporal behavior is in general similar to the COA factor found by Allen et al., 2010. Similar to the COA profile, the largest peaks in the SV-OOA profile are at m/z 41 and m/z 55, plus in both profiles m/z 41 is greater than m/z 43 and m/z 55 is more than twice m/z 57; this is in contrast to HOA, where m/z 43 is greater than m/z 41, and m/z 55 is only slightly higher than m/z 57. Similar to the COA factor, our SV-OOA factor has a peak in the evening, again different than HOA which peaks in the morning and evening, associated with rush hour. We have added discussion along these lines, suggesting that this factor is likely a combination of COA and SV-OOA.

2. Levels of sulphate and nitrate are extremely low; sometimes levels of nitrate are below the detection limit (Figure 3). This is partially explained by the authors by the low SO2 and NH3 emissions in the area. Is there any reference showing similar low value of sulphate and nitrate in the study area? Please could you add these cites if available.

There are very limited previous studies in Las Vegas regarding PM composition. The 2000-2001 Las Vegas Valley Visibility/PM2.5 study may be the most thorough, even though it was 10 years ago. In wintertime, sulfate concentrations were on average less than 0.5 μg/m3, similar to our study (available from http://www.clarkcountynv.gov/Depts/daqem/Pages/ResearchProjects.aspx) ; including summer as well, the average annual concentrations were between 1.3 and 0.98 μg/m3 at three sites. Nitrate on average was between 0.2 and 0.6 μg/m3. There has also been some speciated PM2.5 data collected as part of EPA's CSN network, from 2002 to 2007. Using the data from this 5 year period, average sulfate is 1 μg/m3, and average nitrate is 0.89, though sulfate is lower and nitrate is higher in the winter. Concentrations are indeed low for an urban environment, but this is part of why Las Vegas is somewhat unique. There are very few sources upwind, so the amount of transported secondary organic carbon and ammonium sulfate is low. Unlike most of the U.S. or much of Europe, there is very little coal-fired power production upwind of Las Vegas, so SO2 (and sulfate) levels are low. See map below from http://vista.cira.colostate.edu/improve/publications/Reports/2011/PDF/Chapter2.pdf, which shows ammonium sulfate (not just sulfate only) concentrations are on average during 2005-2008 <1.5 μg/m3 in the area. In addition, there is little ammonia generated in the region, as it is entirely desert (e.g., http://nadp.sws.uiuc.edu/nh3net/). Since we are ammonia-limited, ammonium nitrate levels may be lower than expected for an urban environment; a map below of 2005-2008 ammonium nitrate concentrations in the U.S. suggests ammonium nitrate concentrations are on average < 1 μg/m3 in the area. This issue has come up in another reviewer's comments, so we've added more text referencing the earlier work and IMPROVE publications to the manuscript.

Figure 1. IMPROVE and CSN 2005–2008 PM2.5 ammonium sulfate (AS) annual mean mass concentrations (μg m-3); from http://vista.cira.colostate.edu/improve/publications/Reports/2011/PDF/Chapter2.pdf

Figure 2. IMPROVE and CSN 2005–2008 PM2.5 ammonium nitrate (AN) annual mean mass concentrations (μg m-3); from http://vista.cira.colostate.edu/improve/publications/Reports/2011/PDF/Chapter2.pdf.

3. Do you have PMx (PM1 better) measurements during the field campaign? It could be useful to show in a figure the temporal evolution of inorganic and organic compounds measured by AMS, and BC (as stacked time series figures) and the time series of PM1, in order to see the approximate percentage of determination.

The only PMx measurements are the total PM measured from the AMS plus the aethalometer, so non-refractory PM + BC. Since we don't have any direct measure of total PMx, we have not included such a plot.

4. Sulphate and nitrate show a very low correlation with other pollutants. What is the origin of the peaks of these compounds observed in Figure 3? Are they attributed to

regional transport?

As we discuss above in item #2, it does appear that sulfate and nitrate are regional in nature. Sulfate is extremely low (the maximum for sulfate in Figure 3 is < 1 μg/m3). Leading up to the NO3 peak on 1/9 there was a period of extended relatively high RH, i.e., there was not the usual midday decrease. Instead RH stayed > 55 % for more than 24 hours, and temperature remained < 8 degrees F throughout this 24 hr period. This may have been conducive to NO3 formation, and was a very unusual pattern; typically RH was < 40 % during midday. Once the winds picked up on 1/13 concentrations plummeted to around zero.

5. Time series of wind direction could help for interpretation. Please add it in Figures 3 and 6.

We've added wind direction to Figure 3, and removed NO and NO2, as these are not as helpful for factor interpretation as having more space for other parameters, including wind direction. Figure 6 is a figure of factor profiles, so we suspect the reviewer means Figure 7; however, this is a graph of average diurnal values for parameters, so wind direction may not be as useful here.

6. Please, add a wind rose diagram in Figure 1. Done 7. First two paragraphs of section 3.1 seem s repetitive. We agree, and have streamlined these paragraphs.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 22909, 2011.

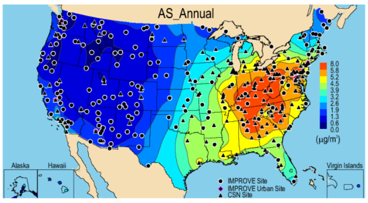

Fig. 1. Figure 1. IMPROVE and CSN 2005–2008 PM2.5 ammonium sulfate (AS) annual mean mass concentrations (μg m-3); from http://vista.cira.colostate.edu/improve/publications/Reports/2011/PDF/Chapter2.pdf

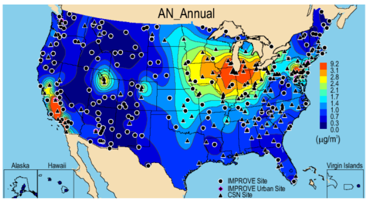

Fig. 2. Figure 2. IMPROVE and CSN 2005–2008 PM2.5 ammonium nitrate (AN) annual mean mass concentrations (μg m-3); from http://vista.cira.colostate.edu/improve/publications/Reports/2011/PDF/Chapter2.pdf.