

Response to the Anonymous Referee #2 (comments in italic)

In this manuscript, the authors investigated PM_{2.5} mass concentration and chemical speciation in Truckee Meadows, an urban valley of Nevada during winter 2009/2010.

The authors found that the high PM_{2.5} concentrations were associated with specific meteorological conditions, such as intense and multi-day temperature inversions, snow on the ground and low wind speeds. PM_{2.5} exceedances of NAAQS were associated with elevated ammonium nitrate (NH₄NO₃) and water concentrations due to low temperature and high RH. The manuscripts also discussed the results from an effective-variance chemical mass balance (EV-CMB) receptor model, and identified major contributors to PM_{2.5} in this region as secondary NH₄NO₃, residential wood combustion and diesel engine exhausts. Secondary NH₄NO₃ was mainly formed from engine NO_x emissions, which provides a possible reason between snow cover and elevated NH₄NO₃ and PM_{2.5} concentrations. The findings from this manuscript can also be applied to similar situations in other urban valleys. The manuscript was generally well written and the results were clearly discussed, although some details need to be improved. I recommend the publication of this manuscript in ACP after consideration of the specific comments as listed below.

Thanks for the comments.

1. *Page 15804, although the sampling period can be realized later in the manuscript, it is better to state the sampling period clearly either in the introduction or in the monitoring description part.*

The sampling has been ongoing since 2001. We now point out the period of study in the revised manuscript.

(Line 96-100) "For this study, data for the December 2008–January 2009 and December 2009–January 2010 were retrieved from USEPA's Air Quality System database (AQS; <http://www.epa.gov/ttn/airs/airsaqs/index.htm>). Concurrent meteorological observations were obtained from stations on the valley floor and at higher elevations, as shown in Fig. 1."

2. *Page 15804, line 20, need to specify the instruments used for continuous measurements. PM₁₀, CO and ozone don't have to be mentioned here because they were not discussed through the manuscript.*

This is now addressed in the revised manuscript:

(Line 93-95) "Hourly average PM_{2.5} and oxides of nitrogen (NO_x) are also measured by a beta attenuation monitor (BAM; MetOne E-BAM; Grants Pass, OR) and a chemiluminescent analyzer (42C, Thermo Environmental Instruments, Franklin, MA), respectively."

3. *Page 15807, Eqs (1) - (3), references are needed for these calculations.*

Chen et al. (2002) and Malm et al. (1994) are cited.

4. *Page 15810, line 7, this is related to Figure 6. The four points for episode days are associated not only with low AAE, but also high OC concentration. If the OC fraction is high, it may not be safe to say that PM_{2.5} was contributed by flaming RWC and motor vehicles. Can the authors provide information on EC/OC fraction not just the concentration to justify this statement?*

We would like to emphasize that AAE is low during the episodes and therefore is "consistent" with situations where b_{abs} is dominated by mobile and/or flaming wood burning emissions. AAE should be higher if b_{abs} is mainly from smoldering combustion. It should be noted that mobile (diesel and gasoline), flaming, and smoldering emissions all generate OC and EC of various proportions and OC/EC ratio is usually not a definite indicator for their contributions (Chow et al., 2010). The sentence is revised to:

(Line 233-235) "In this study AAE appears to be lowest during the PM_{2.5} episodes (Fig. 6), consistent with b_{abs} contributions from flaming RWC and/or engine exhaust."

5. Page 15814, line 14, EC1, EC2 and OP were not defined in the manuscript. Furthermore, based on Table S1, these carbon fractions were not selected for EV-CMB modeling. How could their calculated concentrations be plotted in Figure 7?

Although these species are not included in the fitting, they can still be calculated by CMB from the SCEs determined using other species. This sentence is revised for clarification.

(Line 338) "EC1, EC2, and OP, not included in the fitting but calculated from SCEs"

6. Page 15816, Section 3.4, this is a very interesting finding. I noticed that continuous NO_x concentration was also measured in the study. Have the authors investigated the relationship between secondary NH₄NO₃ and measured NO_x concentration? Will the result provide some hints about the origins of secondary NH₄NO₃?

We analyzed the NO_x data and find a good correlation between NO_x and NH₄NO₃. This supports most of our statements and justifies our source apportionment of NH₄NO₃ by multiple linear regression against primary sources.

(Line 393-395) "A good correlation of 24-hr NO_x and AMNIT ($r^2 = 0.82$) was found for winter 2009/2010. Most wintertime NO_x is generated from local sources, particularly mobile and RWC emissions, and so is NO₃⁻."

7. Page 15828, the plot of snow cover may require a separate part in the figures. Sharing the axis with deltaT makes it confusing.

The figures have been revised to have a separate panel for snow cover.

8. Page 15831, Figure 5, I suggest also put total PM_{2.5} concentrations in this figure for better illustration.

PM_{2.5} concentrations have been added.

9. Page 15833, Figure 7, the labels of the species are too small and some of them overlap with each other.

The labels have been enlarged and adjusted.

10. Page 15834, Figure 8, the font size of the legend is too small and very difficult to recognize in a normal scale. Also I suggest change "salting" to "de-icing" in order to be consistent with the discussion in the main text and Table S2.

The figure has been corrected.

References

- Chen, L.-W. A., Doddridge, B. G., Dickerson, R. R., Chow, J. C., and Henry, R. C.: Origins of fine aerosol mass in the Baltimore-Washington corridor: Implications from observation, factor analysis, and ensemble air parcel back trajectories, *Atmos. Environ.*, 36, 4541-4554, 2002.
- Chow, J. C., Watson, J. G., Lowenthal, D. H., Chen, L.-W. A., and Motallebi, N.: Black and organic carbon emission inventories: Review and application to California, *J. Air Waste Manage. Assoc.*, 60, 497-507, 2010.

Malm, W. C., Sisler, J. F., Huffman, D., Eldred, R. A., and Cahill, T. A.: Spatial and seasonal trends in particle concentration and optical extinction in the United States, J. Geophys. Res., 99, 1347-1370, 1994.