Response to Anonymous Referee #1 (comments in italic)

1. ***The manuscript describes wintertime measurements of particulate matter including chemical composition in the vicinity of Reno, Nevada. The primary objective of the study was to investigate conditions that lead to exceedances or potential exceedances of air quality standards and the composition and sources of PM during these times. The methods are adequately described and appropriate for the study and the manuscript is organized and extremely well written. In its present form, however, it is quite specific to the study region and would benefit from a minor revision in the form of additional background information and discussion of other regions where the processes investigated here may be important. There is brief mention of the results being useful for developing control strategies in other urban valleys, but this section could be expanded to include examples of other studies in similar regions and a brief comparison of the major findings from this study to those presented for other regions.***

Thanks for the suggestion. We believe the relationship between pollution episodes and inversion/snow cover is not unique in the Truckee Meadows valley but common for urban areas with similar topography and emitting sources (particularly for NO_x). Such urban valleys are common, at least, in the northwestern U.S. and southwestern Canada. In the revised manuscript, we added descriptions in the introduction and conclusion to emphasize this:

(Line 54-59) "Similar urban valleys are common in the Western Cordillera area, including Salt Lake City, Utah, Boise-Nampa, Idaho, Missoula, Montana, and Kelowna, British Columbia (Canada). Air quality in such valleys is determined by the interaction between synoptic winds and local thermal circulation (Fernando, 2010). Under stable conditions, pollutants released from the valley floor tend to be confined by surrounding mountain ranges leading to elevated pollution episodes."

(Line 423-438) "The formation of $PM_{2.5}$ episodes shows meteorological and chemical characteristics that are likely common for many urban valleys in the Western Cordillera–

First, the highest $PM_{2.5}$ concentrations are accompanied by intense and prolonged (multi-day) temperature inversions, snow on the ground, and low wind speeds. These variables are inter-related, as snow cover increases the reflectance of sunlight, thereby decreasing heating at the surface that would break up the inversion. Most of the surface heating that remains is absorbed as latent heat, melting the snow rather than raising the surface temperature. The prolonged inversion creates a stagnant condition that inhibits ventilation by wind.

Second, OC and EC dominate the $PM_{2.5}$ mass, but during episodes much elevated NH_4NO_3 and unidentified mass concentrations drive $PM_{2.5}$ levels over the 35 µg m^{-3} threshold. The low temperatures and higher RH associated with snow cover and melting snow encourage a shift in equilibrium for gaseous HNO_3 and NH_3 to form particulate NH_4NO_3, thereby increasing its contribution to $PM_{2.5}$ mass. Liquid water associated with NH_4NO_3 explains most unidentified mass in the samples. The water may not completely leave these particles until RH decreases below 30%."

The conclusions warrant further investigations. It is expected that this study will initiate a broader examination to support our findings. Nitrate dominance in $PM_{2.5}$ has been documented by others for the San Joaquin Valley, California (Chow et al., 2006, cited in the paper). So far discussions of a direct correlation between inversion and $PM_{2.5}$ episodes in isolated urban valleys and the role of snow cover are rare in the literature. We did cite a recent study by Silcox et al. in the revised manuscript:

(Line 131-133) "Inversions were also found by Silcox et al. (2012) to strongly influence $PM_{2.5}$ concentration in the Salt Lake City valley, though in that study inversion (or stability) is measured through heat deficit, the energy required to dry adiabatically mix a layer."

2. ***Several figures would also benefit from minor modifications. Figures 3 and 6 need more information regarding the sizing of the data points. Are they scaled by area or diameter (should be area)? The scale also needs an example of the concentration represented by the smaller points as well as the largest one that is given in the caption. The data point labels in Figure 7 are difficult to read.***

Figures 3, 6, and 7 have been revised according to the reviewers' suggestions. The size of bubbles is now defined in the figures. Data labels in Figure 7 have been enlarged.

References

Chow, J. C., Chen, L.-W. A., Watson, J. G., Lowenthal, D. H., Magliano, K. L., Turkiewicz, K., and Lehrman, D. E.: PM2.5 chemical composition and spatiotemporal variability during the California Regional PM10/PM2.5 Air Quality Study (CRPAQS), Journal of Geophysical Research-Atmospheres, 111, 1-17, 2006.

Fernando, H. J. S.: Fluid dynamics of urban atmospheres in complex terrain, Annu. Rev. Fluid Mechanics, 365-389, 2010.

Silcox, G. D., Kelly, K. E., Crosman, E. T., Whiteman, C. D., and Allen, B. L.: Wintertime PM(2.5) concentrations during persistent, multi-day cold-air pools in a mountain valley, Atmos. Environ., 46, 17-24, 2012.