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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Airborne and ground-based observations of ammonium nitrate dominated aerosols in a shallow boundary layer during intense winter pollution episodes in northern Utah" *by* Alessandro Franchin et al.

Anonymous Referee #1

Received and published: 27 September 2018

The manuscript by Franchin et al. reports on airborne and ground-based gas and particle measurements during pollution episodes in Utah. The measurements focus mainly on the particle chemical composition (using the Aerodyne Aerosol Mass Spectrometer); the particles in the boundary layer mostly consist of ammonium nitrate (ca. 75% of PM1.0) during persistent cold-air periods with limited vertical mixing. Comparison between ammonia/ammonium and nitric acid/nitrate in the gas and particle phase reveals that the formation of ammonium nitrate was generally limited by the nitric acid concentration in the gas phase. Comparison between measurements and the calcu-

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Discussion paper

lations with the ISORROPIA model show generally good agreement. Simulations with the ISORROPIA model further indicate that a reduction in nitric acid can lead to an approximately proportional reduction in the aerosol mass loading, whereas the same is true for ammonia at 2 of the 3 measurement sites. The manuscript is well written and clearly structured. It shows very interesting data and indicates what knobs need to be turned in order to reduce the aerosol burden under the specified conditions. The comments I have are only minor and should be considered before the manuscript is published in ACP.

Page 2, line 3: delete "also“

Page 2, line 26: delete "and“

Page 4, line 11: replace "and“ with "at“

Page 4, line 15: “laminar” instead of “linear” (see also page 5, line 16)

Page 5, line 29: Lee et al. (2017) is missing in the references

Page 5, line 30: “l min-1” instead of “liters per minute”

Page 6, line 5: please check the unit of the mass resolving power (usually expressed as Th/Th and not ppm)

Page 6, line 11: “measure”

Page 6, line 19/20: Do the authors mean by uncertainty the standard deviation of the signal at 1 Hz? Can you please also provide a value for the accuracy of the ammonia measurements?

Page 6, line 27: (i) If the offset at zero NO can be as high as 0.2 ppbv, is there a periodic zero measurement and correction performed? (ii) In this line the units used are pptv and ppbv; before the unit ppt was used, please use pptv consistently

Page 7, line 25: please check the use of the word “when”

Page 7, line 30: “It is . . .”

Page 7, line 30-32: since the AMS is not sensitive to particles < ∼70 nm, can the authors please also comment on the effects the exclusion of these small particles can have

Page 8, line 19: remove open bracket

Page 8, line 26: the green data points (Cache valley) show even higher values (up to 100 μg m-3)

Page 9, line 30: “C2H6”

Page 10, line 18: “Augsburg”?

Page 10, line 21: “compared with”

Page 11, line 11: delete “the”

Page 11, line 18: “emissions” instead of “concentrations”?

Page 12, line 5: “650 m AGL”

Page 12, line 24: “divided by”

Page 13, line 5: “than in Cache . . .”

Page 14, line 20: the 20% contour line seems to be rather yellow-greenish instead of orange

Page 14, line 26: I read the figure such that when a counter line intercepts with the maximum value on an axis, both ammonia and nitrate need to be reduced in order to decrease the aerosol loading further. This would be the case for > ∼60% regarding nitrate.

Figure 5: In most figures the unit μg m-3 is being used; it would be good not to switch between units (ppbv and μg m-3)

Figure 7: The agreement between UHSAS and AMS data is generally very good except for the bottom panel on the left. Is there any explanation why the concentrations differ in this profile?

SI (1st paragraph on page 1): Can the authors please specify what velocity they are referring to (particle velocity in the sampling line, velocity in the AMS flight chamber, . . .)?

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