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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Wintertime Spatial Distribution of Ammonia and its Emission Sources in the Great Salt Lake Region" *by* Alexander Moravek et al.

Anonymous Referee #1

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The manuscript "Wintertime Spatial Distribution of Ammonia and its Emission Sources in the Great Salt Lake Region" investigates the driving forces behind wintertime formation of ammonium nitrate during the Utah Winter Fine Particulate Study (UWFPS) in January and February 2017. Observations of gas-phase ammonia (NH3) and particulate ammonium (NH4+) are used to compare measured NHx (NH3 + NH4+) with NHx calculated using the Stochastic Time-Inverted Lagrangian Transport (STILT) model and NH3 emission inventories. Modeled NHx enhancements were found to be a factor of 1.6 to 4.4 lower than observed in the region with the largest underestimation found for Cache Valley, an area with intensive agricultural activities. The underestimation of the NHx is likely due to underestimation of NH3 emissions from livestock not transport

of NH3 into the Cache Valley, though transport of NOx in the Cache Valley may be transforming the local NH3 into ammonium nitrate.

This paper is well written and appropriate for Atmospheric Chemistry and Physics. It makes a reasonable argument that NH3 emitted from agricultural activity is driving the wintertime ammonium nitrate formation. Underestimation of the NH3 emissions from the agricultural activity prevents models from accurately predicting the amount of ammonium nitrate formed. A large uncertainty in the modeled NHx is the determination of the background NH3 in the region. The authors do a reasonable job addressing this issue. However, due to the sampling strategies and limitations, all interpretations and applications of these results will need to be cognizant of this fact. That said, I recommend publication after addressing a few minor comments listed below.

Specific comments: Page 4, line 10 – What is the instrument time response and what makes it suitable for aircraft measurements? The reference Hacker at al. 2016 is incomplete in the reference list making it impossible for the reader to verify these claims.

Page 5, line 5 – How fast does the Twin Otter fly? Is a 30 s averaged from that that platform or is it just smearing multiple point sources?

Page 4, lines 14-15 – It is not clear how using a smaller pump has any influence on the measurement or analysis presented here. It is the pumping curve, i.e. pumping speed as a function of pressure, which is important to the measurement, not the weight of the pump. How has the pump change affected the measurement?

Page 5, line 6 – Vibrations and g-force accelerations during extreme events made the observations unreliable. What criteria are used to evaluate the level flying segments to ensure there are no vibrational effects? This is not addressed here or in the supplemental.

Page 6, line 15 - Why does it take 24 hrs of over-flowing zero air to determine the AIM-IC background, if it reports hourly data? Is that a relevant background?

Page 13, line 12 - This statement seems to contradict Page 5, line 4, which states that the 30 s precision is 90 pptv. The precision should decrease for a 1 minute average, unless the precision is not limited by counting statistics, which has not been discussed.

Page 15, line 26 – These two sentences are not a separate paragraph.

Page 19 – The Hacker reference is incomplete. The complete reference list should be checked.

Page 24, Figure 3 – The top panel is difficult to differentiate between the gray and purple traces. The symbols and their error bars are very hard to read.

Page 25, Figure 5 – In the caption the units of the flux sensitivity footprint are given as (in ppmv/(μmol m-2 s-1) but in the test on Page 8, line 17 the units are given as (in pptv/(μmol m-2 s-1)). This appears to be an inconsistency.

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