Review of “Airborne flux measurements of ammonia over the Southern Great Plains using chemical ionization mass spectrometry,” Schobesberger et al., AMT (2022)

Summary

This paper presents new airborne measurements of ammonia (NH3) using a benzene CIMS and shows the application of the data to eddy covariance flux calculations over agricultural land. It describes the measurement method, calibration and sampling challenges, and then provides a detailed description and some analysis of NH3 fluxes. English is generally good. The number of figures is appropriate, but some of them need tweaking for readability and comprehension.

Despite how many minor comments appear below, I think this is a good paper and suitable for publication in AMT.

Specific Comments

L14 – 20: The level of detail in the opening sentences of the abstract is more than needed. The first sentence would be sufficient, and the next four sentences could be removed.

L56: Critical load thresholds are also exceeded in North America (https://www.sciencedirect.com/science/article/abs/pii/S0048969719329109), but I’m not sure how much of that is attributable to NH3.

L64: This is a run-on sentence and may have some grammatical errors too.

L114: OPALS has not flown or been published. This sentence should be deleted and the following sentence adjusted.

L139 – 145: Recommend moving the sentences starting with “In this paper” and “The use of” to the next paragraph.

L229: Previous discussion has highlighted the high frequency of the TOF. Why is the sample frequency limited to 2Hz here?

L278: “would reduce the gap between the curves…” Is there a reason why you did not do this, if it would collapse the curves?

Sect. 3.1: I expected to find accuracy numbers at the end of this discussion. I know it is discussed later, but might also be appropriate to mention here.

Sect. 3.2: What is the time constant for the longer decay? Discussion mostly focuses on the first decay.

L309: Nguyen et al. (https://www.pnas.org/doi/abs/10.1073/pnas.1418702112) discuss a potential correction for this inlet hysteresis in their supplement (related to HNO3). Not suggesting that the authors implement that here, just wanted to make you aware of it.

Figure 3: I found it difficult to follow this figure and the caption. It has multiple legends and a lot of different experiments and assumptions. Not sure what the fix is. Maybe break into several panels, or replace the symbols with lines, or something else to simplify it?

L331: is this precision based purely on counting noise / background? Does this number change with humidity?

L363: If there is hysteresis as described, then ascending and descending profiles might have different shapes. It is hard to glean this from Fig. S3.

L382: It would be helpful for some readers to provide some references for this box budget technique.

Figure 5: This figure needs a little work. In Panels (a) and (b), coloring by altitude is unnecessary (and indeed confusing as the same color scale is used for a different parameter in (c)). Also, the colored text on the right hand side of (b) is hard to read. Also in (b), the arrows could be removed; a single arrow for average wind direction would suffice.

Figure 6: wrong caption. Also, the y axis in the top panel needs a better label, panels should be lettered, and it might be worthwhile to convert the x axis to distance.

Sect. 3.6: I think it would be helpful to show the power spectra for w', NH3' and T', along with cospectra, in the main text instead of the supplement, given the concerns about spectral attenuation.

L444: flux code is available on github (https://github.com/AirChem/FluxToolbox)

L450: "variety of interval lengths." Over what range?

L454: It is better to use distance than time for the independent variable in airborne fluxes. So instead of 1 minute, 6 km?

L469: It is still beneficial to detrend the data, especially if you are including larger scales in your calculated fluxes. Detrending is also necessary to get a clean lag-covariance plot.

L478: How long is the lag time?

L529: I am not a micrometeorologist, but I have come to understand "constant flux layer" as meaning "the altitude range over which changes due to divergence are smaller than our flux precision."

L534: Need to also mention the first term (storage).

L540: Wolfe et al. 2015 (https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015GL065839) show non-linear divergence for species with strong T-dependence, like PAN and HPALD. Could there be similar effects for NH3 fluxes due to gas-particle partitioning?

Figure 9: Blue-on-green is not a great contrast when printing this in color. Maybe switch to a different colorbar?

Figure 10: it is very hard to see the blue arrow on top of the blue background.

L623: effective spatial resolution is also limited by inherent random error related to turbulence. Errors in 1Hz (~100m) fluxes can exceed 100%.

L624: There may also be advantages to switching to a different mother wavelet; for example, some wavelets have better localization in space (at the expense of less frequency localization) and may be better suited for large point sources. This is certainly an area worthy of further research, especially if we had a way to validate which wavelet gave the "best" answer.

Figure 11: I find the use of the same color bar for 2 different quantities confusing.

L708: I expect other sources of uncertainty dominate over any locational noise in the footprint.

L711: Hannun et al. 2020 (https://iopscience.iop.org/article/10.1088/1748-9326/ab7391) have had success with 2-D footprint modeling.

Technical Comments

L53: delete "its"

L136: delete "And"

L166: delete ", specifically"

L211: delete "of our CIMS"

L398: replaced "transiting" with "transecting"

L595: might be worthwhile to mark these cities on the map.

L595: "emissions range from"

L617: It might be helpful to label the numbered plumes in Fig. 10.

L618: "series were widened"

L657: delete "in this paper"