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Reply on RC2

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Author comment on "Assessing the representativity of NH_3 measurements influenced by boundary-layer dynamics and the turbulent dispersion of a nearby emission source" by Ruben B. Schulte et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-907-AC2, 2022

We thank Referee #2 for their thorough reading and comments to our manuscript. The Referee raises a good point on the two assumptions regarding chemical conversion of ammonia and provides some interesting suggestions to improve the manuscript. Below, we would like to give an early response to several of the comments raised by the Referee. We will respond to all points raised in more detail alongside the revised manuscript.

- The Referee suggests to discuss the implications of the assumptions of a "typical" percentage chemical reaction rate, applied equally to the in-plume and background ammonia. Following the advice of the Referee, we will discuss the implications of these assumptions in the revised manuscript. Here, we will discuss the role of macromixing (plume meandering) and micromixing (in-plume mixing) in the dispersion of the emitted ammonia and its relation to the chemical reaction rate, following Vila et al. (1990).

- We agree with Referee #2 that it would be nice to have some representation of combined scenarios in addition to the sensitivity study presented in Section 3.3, where we identify the driving variables of the blending-distance. We aim to address this comment in the revised manuscript, either in a new subsection or as an Appendix. We are considering performing one or more new experiments where we vary a combination of at least 2 of the variables discussed in section 3.3.

- The Referee comments that it is misleading to refer to turbulent fluctuations as noise in an observations and we fully agree. That was one of the messages in Section 3.1, but it was not properly worded. We can imagine that the magnitude of these turbulent fluctuations and the impact entrainment can have close to the surface might come as a surprise for the ammonia measurement community. One of the advantages of an LES is the ability to visualize this turbulent mixing. In Section 3.1 (Fig. 2) we wanted to show that fluctuations as a result of turbulent mixing can have a large amplitude (>4 ppb) and be quite long lasting (up to 5 minutes), even in the background ammonia concentration. We will take a close look at the wording of this section and are considering removing the sentence mentioning instrumental noise to make sure our message cannot be misinterpreted.

- We are not sure if we correctly understand the comment of the Referee about Line 235. The fluctuation intensity (fI) is calculated for all concentrations, but we subtract a moving average concentration to remove the trend from the ammonia concentration. Next, we compare the fI of the total NH_3 (background + plume) to the fI of the background NH_3 by calculating the difference in percentages. The blending-distance is calculated by calculating the maximum distance at which the percentage changein fI (PC_{fI} in Fig. 4) reaches a fixed threshold, e.g. a 25 % increase in fI resulting from the emission plume. We interpret this comment as Referee #2 suggesting that it would be interesting to see how the change in fI and the blending-distance relate to the mean concentration of the emission plume. In other words, how much of an increase in the NH_3 concentration is found close to the emission source. We are considering to address this question with a new figure showing the concentration of the emitted NH_3 ($NH_{3,\ plume}$).

Reference:

Vila-Guerau de Arellano, J., Talmon, A.M., and Builtjes, P. J.: A chemically reactive plume model for the NO-NO2-O3 system, Atmospheric Environment. Part A. General Topics, 24, 2237–2246, https://doi.org/10.1016/0960-1686(90)90255-L, 1990.