RC1 of "Measurement report: Evolution and distribution of NH3 over Mexico City from ground-based and satellite infrared spectroscopic measurements"

Reviewer 1

Summary

This paper describes a study of the changes in NH3 over Mexico City as observed by FTIR instruments at two ground stations, one in an urban area and one in a more remote location, and from the IASI instrument. The FTIR and IASI data both showed similar seasonal variability, peaking in April and May, and a significant increase in NH3 amounts over the observing period. Interestingly the largest NH3 amounts are measured in the northeastern corner of the MCMA and appear to have local sources, as predicted rom an emissions inventory and confirmed by a back trajectory analysis. The paper is well laid out and clearly written. The plots are very high quality and easily understood. It requires only some minor edits and additions to be acceptable for publication.

Response: The authors would like to thank the reviewer for this positive review and all the suggestions to improve this work. We addressed each comment below and in the revised manuscript.

Technical comments

Line 132: Please provide a little more detail on the a priori profiles. Are there more than one? If yes, how are they chosen?

Response: The a priori profiles were derived from five years of averaged NH_3 simulations from the global chemical transport model GEOS-Chem v11. We include this information in the revised manuscript as follows: "scaled *a priori* profiles derived from 5-years of averaged NH_3 simulations from the global chemical transport model GEOS-Chem v11 were used instead".

Line 279: Could the authors propose some possible explanations for the column underestimation by IASI?

Response: The underestimation could be attributed to a combination of more randomly distributed error sources and large systematic errors, as was attributed in Dammers et al., (2017), using an older version of the IASI ANNI-NH_3 product. We include this information in the revised manuscript as follows: "Dammers et al. (2017), using an older version of the IASI ANNI-NH_3 product, attributed these differences to a combination of more randomly distributed error sources and large systematic errors, however, these reasons need to be investigated further."

Minor edits

Line 71: come from

Response: Done

Line 74: "The inventory also strongly attributes the NH3 sources to a range of population activities and feces from domesticated animals". This sentence is not clear.

Response: We have modified this sentence in the revised manuscript as: "The inventory strongly attributes domestic emissions of NH_3 to feces from domesticated animals."

Line 89: …all of which are classified as …

Response: Done

Line 152: …when the thermal contrast is large

Response: Done

Line 171: Please clarify this sentence: “The 8-hour back-trajectory was selected to capture only air masses traversing the MCMA”.

Response: We have modified this sentence in the revised manuscript as: “Eight-hour back-trajectories were selected to capture the air masses passing over the MCMA.”

Line 174: …NH3 is mostly concentrated near the surface

Response: Done

Line 177: The average NH3 total columns for the entire period (1.46x1016 ± 0.64 molecules/cm2 at UNAM and 1.87x1015 ± 2.40 molecules/cm2 at Altzomoni) are listed and …

Response: Done

Line 207: …attributed to the conversion to ammonium, as was observed by Moya et al. (2004) when describing the evolution of the surface gas phase NH3 and PM NH4+ evolution at an urban site in Mexico City.

Response: Done

Line 314: the evolution with time…

Response: We have modified this sentence to also complement RC3 in the revised manuscript as “Comparisons between the seasonal and temporal variability of NH_3 over the ...”

Line 316: … in Figure 9a

Response: Done

Line 317: However, IASI-NH3 shows a consistent negative bias. The evolution with time is is represented by the IASI-NH3 and FTIR-NH3 annual averages in Figure 9b.

Response: Done

Line 320: even in Altzomoni,

Response: Done

Line 322: … there is an increase of 62 % over a decade for Mexico City, in agreement with the trend ….

Response: Done and complemented with response to RC3

Line 329: … at this station

Response: Done

Line 334: from a variety of local sources and does not show only the transport of NH3-enriched air masses from the enhancement region to the northeast observed in Figures 7a to 7c. This is in agreement with Viatte et al. (2022).

Response: Done

Line 339: This sentence is not clear or does not follow: this agrees with Figure 8 where the main NH3 sources in MCMA are seen to be urban

Response: We have modified this sentence in the revised manuscript as: "this agrees with Figure 8 which shows that the main NH_3 sources in MCMA seem to be urban."

Extra:

Line 116: We added a line and a reference

"The first study presenting and validating the combined usage of trace gas products obtained from dedicated retrievals with FTIR spectra measured at UNAM and ALTZ was that of Plaza-Medina et al. (2017)."

Reference:

Plaza-Medina, E. F., Stremme, W., Bezanilla, A., Grutter, M., Schneider, M., Hase, F., and Blumenstock, T.: Ground-based remote sensing of O_3 by high- and medium-resolution FTIR spectrometers over the Mexico City basin, Atmos. Meas. Tech., 10, 2703-2725, https://doi.org/10.5194/amt-10-2703-2017, 2017.

We update the Viatte et al. (2022) reference as:

Viatte, C., Abeed, R., Yamanouchi, S., Porter, W., Safieddine, S., Van Damme, M., Clarisse, L., Herrera, B., Grutter, M., Coheur, P.-F., Strong, K., and Clerbaux, C.: NH3 spatio-temporal variability over Paris, Mexico and Toronto and its link to PM2.5 during pollution events, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2022-413, 2022.