

Review of “Measurement report: Evolution and distribution of NH₃ over Mexico City from ground-based and satellite infrared spectroscopic measurements”

General Comments

This study aims to constrain the spatial and temporal distribution of total ammonia columns in the Mexico City Metropolitan Area (MCMA) using ground-based FTIR spectrometers (from two sites) and satellite-based IASI observations. The study finds meaningful differences between the two surface sites (particularly in the diurnal cycle), illustrates the spatial heterogeneity in NH₃ column concentrations within the MCMA using IASI data, and highlights annual NH₃ trends across both datasets. The study also uses a back-trajectory cluster analysis to suggest a large portion of the measured NH₃ is local and urban in nature, with significant contributions from non-agricultural sources.

The study is well-written and highlights important conclusions, namely the need for a re-evaluation of NH₃ sources in the MCMA region. It is a useful contribution to the literature and provides a basis for more targeted work in this region. That said, the paper provides a somewhat limited discussion of a few key methods and conclusions that are central to its interpretation. With this in mind, I provide the following comments below and recommend that these issues be addressed prior to publication in ACP.

Specific Comments

Impact of Human Emissions

The authors allude to the importance of human emissions in the region (even providing a back-of-the-envelope estimate). However, based on this very estimate, human emissions appear to be 3 orders of magnitude lower than the total regional NH₃ flux. It thus seems unlikely that these sources are ‘meaningful’, but they are presented in this study as being an important underappreciated source. The authors also discuss the importance of local and urban sources multiple times in the study, citing human emissions as one of these sources. However, given the relatively small contribution of human emissions to the total flux, it stands to reason that there are other ‘main’ urban and local sources that should be prioritized over human emissions in order to develop accurate inventories. It would thus be a very useful contribution if the authors could quantitatively or qualitatively prioritize the relative importance of these underappreciated sources (fires, waste treatment, humans, pets, etc.) and discuss how their estimates differ from the current inventory estimates.

IASI retrieval and validation

Since the IASI retrieval scheme does not produce averaging kernels, could the authors expand the discussion in Section 2.2 to include a more in-depth overview of the underlying uncertainties and sensitivity constraints in the retrieval?

Could the authors also please provide a more detailed description of the ANNI that estimates NH₃ column concentrations based on the various input parameters (e.g., a list of all the parameters considered, the uncertainties associated with each parameter, the uncertainties associated with the ANNI transformation itself). A brief discussion in the main-text of the differences in the dynamic range of the data used to train the ANNI vs. the data inputs in this study would also be helpful.

Could the authors also please build on the above request to expand on potential reasons for the IASI column underestimation relative to the surface instruments? This is important in order to appropriately interpret the broader IASI spatial patterns.

Back-trajectory analysis

Please briefly expand Section 2.3 and Section 3.3 to provide more information on the specifics of the back-trajectory cluster analysis such that it can be reproducible by a third-party reader of this paper. Please also provide a brief discussion on how sensitive your results were based on the number of clusters assumed, clustering technique, etc.

Minor Comments

Line 71: 'come from'

Line 74: Suggest restructuring this sentence to – 'The inventory also attributes a meaningful NH₃ contribution (%) to a range of different population activities (e.g., X,Y,Z) and feces from domesticated animals'

Line 89: '.. , all classified as ..'

Line 178: 'The entire period ...' – Please restructure this sentence

Line 206: '.. conversion to ammonium, as was observed ...'

Line 314: 'Comparisons between the seasonal and temporal variability of NH₃ over ...'

Line 317: 'However, IASI-NH₃ shows a ...'

Line 318: 'The temporal evolution is represented using ..'

Line 320: 'even in Altzomoni, except for 2013 which was ...'

Line 321: 'averaged'

Line 322: 'molecules/cm²), yields a 62% increase in Mexico City over the course of a decade, in agreement with the trend of

Line 332: Please restructure for clarity