

Interactive comment on “Multiscale observations of NH₃ around Toronto, Canada” by Shoma Yamanouchi et al.

Anonymous Referee #1

Received and published: 29 September 2020

In this investigation, three independent observational data sets are used to characterize the variability and trends of ammonia over the Toronto area. The results present a positive trend in the NH₃ concentration over the region with larger values in the Spring, confirming what has been published in previous studies. The large amount of data analyzed in this contribution and the comparisons performed among these rich data sets (in situ, column and satellite) provide, however, the most precise and confident results on NH₃ in the Toronto area so far. The comparisons of the column and satellite observations with CTM simulations on a coarse grid indicate, as expected, that the model is not properly capturing local sources responsible for the high frequency variability.

MAYOR

The approach to determine the observational footprint of the FTIR column measure-
C1

ments seems to be oversimplified. It is only based in correlating the data with the satellite observations at different spatial and temporal scales. The best correlation and slope is obtained with the most strict criteria (25km/20 min). A proper footprint analysis would require to take the wind fields within the considered time period in consideration, which is not done. Although this simple analysis gives some indication of the representativeness of ground-based measurement, it should not be claimed in the text that a proper observational footprint assessment has been performed.

A bias would be expected to be observed between the FTIR and in situ data just because the FTIR only measures during sunny conditions. NAPS data is collected regularly every third day. Moreover, NH₃ has a strong diurnal pattern that is not reported in this paper. While in situ data represents the average concentration within a 24 h period, FTIR data is available only during the day. The authors contrast the trends from the linear regressions from both data sets (TAO and NAPS) when outliers are and are not considered (L204). However, no mention or explanation is given for this source of bias given that NH₃ concentrations are probably expected to peak during warmer days and warmer hours. It would be interesting to compare both data sets only for coincident measurement days and give a more comprehensive explanation of this additional source of bias.

It seems that the comparison of both TAO and IASI data sets with GEOS-Chem is challenging due to the coarse resolution of the model. It is shown from the comparison of the ground-based data with the satellite observations that NH₃ presents high frequency variability in the region. It would then seem logical that the authors filter out the enhancements from the FTIR data, as done in the trend analysis, before correlating to the model data. The same could apply to IASI data since the enhancements observed within the large model domain are probably due to local emissions that are not well represented by the model. Figures 9a and b could then show the correlation and regression results as is, as well as from the filtered data sets.

MINOR

L28. The sentence is not accurate. The health impact of PM2.5 is strongly dependent on the chemical composition and the cited study does not take composition into account. In the context of this contribution, the PM containing ammonium salts are not the most hazardous and also those that contribute to smog are rather organic in nature. Please rephrase.

L41. Referring to NH3 being injected to the free troposphere, you may want to cite Hoepfner et al 2016 (www.atmos-chem-phys.net/16/14357/2016/)

L86. A citation or description for the camera and solar disk-fitting system of the solar tracker is missing.

L90 Should say "... microwindows in the ... and ... spectral regions."

L76. Was there any quality control and data filtering performed? Please describe. Same for the in situ data.

L110. No need to repeat (National Air Pollution Surveillance Program)

L117. Define the IASI acronym.

L121. May not be clear to the reader what a 2 x 2 circular pixel is. Maybe a matrix of 2 x 2 pixels?

L126. Indicate the overpass times of each satellite instrument

L155 What do "longer time series" refer to? The length considered in this contribution? Please specify.

L165. If mirroring a value is the same as taking its absolute value, the readers might be more familiar with the second terminology. It may also be wise to mention that the average of the mirrored residuals include the positive ones.

Fig4. Figure 4 b) seems redundant since no additional information is provided with respect to a).

C3

Fig5. It would seem sufficient to show the correlation plots a) and e) in this figure, while keeping the results of the different resampling periods in the text (L219-223)

L300. A larger trend with outliers with respect to that obtained without them may not be conclusive when looking at the data availability of the TOA data series. Measurements seem to be performed more regular in recent years so to me the increase in seasonal variability is more evident when comparing for example the standard deviations year to year.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-319, 2020.

C4