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Atmospheric Chemistry and Physics Discussions

Interactive comment on "NH_3 emissions from large point sources derived from CrIS and IASI satellite observations" *by* Enrico Dammers et al.

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We would like to thank the referee for his/her time and insightful comments.

(1) Ref2: One comment is whether the satellite derived emission estimates can be influenced by the vertical sensitivities of the satellite measurements. For example, the CrIS-NH3 product is retrieved using the optimal estimation method. A priori profiles and averaging kernels matrices are then often required for comparing with other in-situ measurements. Satellite retrievals tend to have weak sensitivities in the boundary layer, and thus underestimate the true concentrations. Would it impact the results as presented in this study? Please discuss.

(1) Author: We agree with the review and that is one of the reasons why we use a

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2d plume model in combination with the total column densities, which reduces the dependency on the vertical sensitivity. The comparison of the CrIS-NH3 with FTIR-NH3 observations does not show any systematic under or over estimation in the total column; see page 4 lines 11-13. The most recent FTIR validation of the previous IASI product does show an underestimation. For reference in the text, see page 6 lines 31-34.

(2) Ref2: Page 1, Line 13 in the abstract: Please rewrite the sentence "which is equivalent to a factor of 2.5 between the CrIS estimated and HTAPv2 emissions". A factor of 2.5 compared with what values?

(2) Author: Page 1, Line 12-14: Change the sentence to "The CrIS emission estimates give a total of 5622 kt yr-1, for the sources analyzed in this study, which is around a factor 2.5 higher than the emissions reported in HTAPv2."

(3) Ref2: Page 6, Line 9: "only observations with a Quality Flag of 5". Please explain the meaning of "Quality Flag of 5" or list the reference.

(3) Author: Page 6, Line 10: added "(Shephard et al., 2019)". It reflects observations with a maximum NH3 concentration of 200 ppb for single layers in the profile. A DOF >0.1. Spectral signal-Noise-Ratio of >1. A thermal contrast above 0. In addition, a max CHI2 of the optimal estimation fit of 5.0. All the other flags are defined in Shephard et al., 2019.

(4) Ref2: Page 8, Line 10: "at a resolution of 0.75x0.75 resolution (40 x 40 km2)", 0.75 degree does not correspond to 40 km. Please check.

(4) Author: Page 8, Line 12: changed to"60x80 km2 at 45 degrees north"

(5) Ref2: Page 9, Line 13: Please define sigma here in the text. Sigma is also used in Page 8, Line 30 with a different meaning.

(5) Author: Changed the sigma on page 8, line 34 to "standard deviations". Added "the plume spread (σ) to line 9.

(6) Ref2: Page 10, Line 20: Please also define lambda in the main text.

(6) Author: Page 9, line 12-13: Added "(τ = 1/λ, with λ the decay rate)".

(7) Ref2: Page 17, Figure 6: For Figure 6, can you please explain why HTAP emission totals are integrated over 1 degree x 0.5 degree, rather than a finer resolution to compare with the point sources?

(7) Author: The HTAP emission totals include locations with agricultural emissions. Those locations are slightly less point source like and therefore we widened the integration area to capture the total source.

(8) Ref2: Page 22, Table 4: The Region total HTAPv2 value for China is too high due to the region define for China (Figure F1) also covers the main NH3 emitting areas in the northern India. I suggest add a table footnote to mention it.

(8) Author: Added a footnote to Table 4, "*The China region includes a large part of northern India, therefore the emissions may seem higher than expected."

(9) Ref2: Page 29, Appendix B Can you provide the range of fitted background concentrations (B)? Would high background NH3 concentrations over regions such as eastern China affect the applicability of the fitting approach to estimate point emissions?

(9) Author: The fitted background concentrations depend both on satellite and the region with higher background values for regions with other sources, and generally higher background values for CrIS compared to IASI-A and –B. As long as the background concentrations are homogeneous, there should be no effect to the emission estimate. This is where the SNR value comes in, which we use to determine if most of the "information" is coming from our intended source. We filter for an SNR>2, to ensure that the variations near the source are higher than those further upwind of the source. Sources very near (<10km) the source will however be included in the final emission estimate as it is not possible to discern these from the intended source, with the single source approach used in this paper. We marked the sites with nearby agricultural sources

in Fig 9 to show the potential interference. Furthermore, we added both the HTAPv2 emissions with and without agriculture in the supplementary tables.

References:

Shephard, M. W., Dammers, E., Kharol, S., and Cady-Pereira, K.: Ammonia measurements from space with the Cross-track Infrared Sounder (CrIS): characteristics and applications, in preparation for ACP, 2019

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