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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "IASI-derived NH_3 enhancement ratios relative to CO for the tropical biomass burning regions" *by* Simon Whitburn et al.

Simon Whitburn et al.

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We would like to thank the referee for his/her positive feedback on the paper and useful comments. All have been addressed. The point-by-point responses to each of the comments are provided below. A 'tracked changes' version of the manuscript is also appended.

We would also like to draw the attention of the referee to the following. After the initial submission of the manuscript, a major update in the IASI-NH3 retrieval product was introduced. This update is of importance especially since we identified in the previous version of the NH3 dataset sharp discontinuities in the NH3 time series related

to inconsistencies between the different versions of the operational Eumetsat IASI L2 algorithms for temperature and clouds (which are used as input in the neural network). To tackle this issue, we have developed a version of the IASI-NH3 Neural Network which relies on the ERA-Interim ECMWF meteorological input data (along with built-in surface temperature) rather than on the Eumetsat IASI L2 data. This provides a reanalyzed dataset which is coherent in time over the whole period covered by IASI (2008-today) and can therefore be used to investigate interannual variability. The reanalyzed dataset has been described in a paper recently published in AMTD:

Van Damme, M., Whitburn, S., Clarisse, L., Clerbaux, C., Hurtmans, D., and Coheur, P.-F.: Version 2 of the IASI NH3 neural network retrieval algorithm; near-real time and reanalysed datasets, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2017-239, in review, 2017.

After careful analysis, we have judged that this new dataset should ideally be used also for the present manuscript. We have updated all the figures of the manuscript according to this new dataset. As you will see, the main conclusions of our paper remain unchanged, except for the comparison with the ERNH3/CO from the literature. The IASI derived ERNH3/CO are higher than in the manuscript initially submitted and this leads to a much better agreement with the values given in the literature. With these changes and the comments addressed, we are confident that the paper has been greatly improved.

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The relationship to NO2. Are the NH3 and NO2 columns related?

NO2 and NH3 emissions are anti-correlated during the different stages of a fire. During the flaming phase, which takes place first, emissions of oxidized species (including NO2) dominate. When all the easily accessible fuel has been consumed, smoldering combustion starts with increased emissions of reduced or incompletely oxidized species (NH3, CO, etc.) due to the lack of available atmospheric oxygen and/or the lower temperatures.

Flaming vs. smoldering fires might have quite different CO but similar NH3. Is anything known? The paper gives the impression that CO is more constant than NH3. I don't know if that is true, but I think the paper should comment on whether variability is driven more by CO changes or more by the N-content of fuels. For example, wood has zero N, a recent paper Coggon et al. Geophys. Res. Lett. 2016 pointed out that residential wood burning has near zero emissions of N-compounds.

Flaming and smoldering phases show very different proportions of NH3 emissions relative to the total Nr emissions. As mentioned above, emissions of oxidized Nr species (mainly NO2) dominate during the flaming phase while, during the smoldering phase, NH3 becomes the dominant Nr species emitted. CO also dominates during the smoldering phase.

This is indeed true (and well known) that flaming and smoldering phases will have very different ERNH3/CO. This is observed in particular in this study when looking at the differences between the ERNH3/CO for tropical forest and the savanna fires. Forest fires, which are characterized by a larger fraction of smoldering combustion than savannas (due to the higher biomass density) show higher ERNH3/CO than savannas. When studying enhancement ratios from satellite observations, we calculate an average ERNH3/CO (of generally an entire fire) over a certain time period and area which therefore include both smoldering and fire phases. Resulting average ERNH3/CO is therefore the result of many different factors acting together. It is however not possible to separate the contribution of each ones.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2017-331/acp-2017-331-AC2-supplement.pdf

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