Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-913-RC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Satellite-derived emissions of carbon monoxide, ammonia, and nitrogen dioxide from the 2016 Horse River wildfire in the Fort McMurray area" *by* Cristen Adams et al.

Anonymous Referee #2

Received and published: 23 October 2018

This is an interesting study that integrated multiple satellite observations to quantify lifetime and emissions of key species during the 2016 Horse River fire, based on fitting the Gaussian plume model. The results were interpreted in the context of an extensive suite of observations and fire models, as well as related publications. The topic is well within the scope of ACP, and the paper is in general well written and easy to follow. I found some technical details missing which I would list in the review. I recommend the manuscript to be accepted after the following concerns are addressed.

1. Page 5, Line 6-14: Please clarify the necessity and effect of increasing sampling. For example, would the number of available data be substantially reduced if the data

affected by row anomaly were not included? Would the uncertainties of NOx emission estimates in Table 1 be significantly stronger due to the reduced sampling?

2. Section 4: Apart from all the uncertainty tests, I am surprised that the authors did not do sensitivity calculations that account for the uncertainties in the satellite retrievals?

3. Section 4.1: Maybe the authors could list some uncertainties for NH3 and NOx in this section assuming the default lifetime they used later, just to provide a perspective if it could actually be larger or smaller than the 48% determined from CO?

4. Section 4.2: There is generally 1 or less than 1 piece of information in the NH3 retrieval from CrIS, and the average kernels of CrIS suggest the retrievals are most sensitive to 800-900 hpa (Shepard and Cady-Pereira, 2015). It is not surprising to me if CrIS resolves the variation of NH3 that are more reflective of winds at such altitude. Using MISR and CALIPSO plume height data is a good idea since the multi-angle capability of MISR and the LIDAR signals in CALIPSO do contain vertical information. I suggest the authors to reconsider (or further justify) the value of CrIS NH3 in determining the plume shape.

5. Page 12, Line 22-23: I am interested in the proportion of "accepted fitting", which gives a sense of the applicability of this fitting method in the data investigated. Also, for the cases with larger fitting errors, where are the errors from?

6. Page 16, Line 32-33: Instead of just omitting the MODIS data, could the authors comment on if the emission/FRP relationship might become non-linear at very strong burning conditions, and a good fit could still be achieved by deleting the two peaking records of FRP in Figure 8? The derived emission factors could still be meaningful, representing constant burning conditions.

7. Figure 10: I am interested to see if the correlation would be better or worse if the diurnal variation (e.g. in Figure 7) were corrected?

8. Since the authors made great efforts in quantifying and analyzing the uncertainties

which are insightful enough to be part of the main findings in the paper, I suggest adding a related discussion in the abstract and the conclusion. An example could be "The uncertainties of emission estimates are more sensitive to the plume shape for CO, and to the fitted lifetime for NH3 and NOx".

Technical suggestions:

1. Page 1, Line 30: "0.03" should be "0.003"?

2. Page 2, Line 21-22: Maybe change to "more than 10% of global CO emissions from wildfires are over mid- and high- latitude."

3. Page 8, Line 27-28: Please clarify how to determine if one day is with "sufficient" data, and how the "gap filling" was done?

4. Page 9, Line 15: I suppose the "VCD" here should actually be "dVCD"?

5. Page 12, Line 17: Again, how to define "sufficient"?

6. Page 16, Line 2 and Page 17, Line 3: Should add a reference to this estimation method.

7. Page 17, Line 7: Should add "for NOx" somewhere in this line to guide the presentation in the rest of this paragraph.

Shephard, M. W., and Cady-Pereira, K. E.: Cross-track Infrared Sounder (CrIS) satellite observations of tropospheric ammonia, Atmos. Meas. Tech., 8, 1323-1336, 2015.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-913, 2018.