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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Possibility for an infrared sounder as IASI to document the HCOOH chemistry in biomass burning plumes" *by* Matthieu Pommier et al.

Anonymous Referee #2

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General Comments

This manuscript presents IASI measurements of formic acid between 2008 and 2014, and uses these data to determine enhancement ratios from biomass burning emissions over seven regions. HCOOH and CO total columns, MODIS fire counts, and ECMWF surface wind speeds are combined to identify enhancements due to biomass burning. Correlations between HCOOH and CO total columns are used to calculate the enhancement ratio in each region. These results suggest that production of HCOOH by Siberian forest fires may be underestimated by 60%, and provide some insights into sources and sinks of HCOOH in other regions studied.

The manuscript provides a useful contribution to the field, but is somewhat qualitative

and speculative in places, as noted by the other reviewer. It also has many distracting grammatical errors and should be carefully reviewed and revised to correct these and to improve the clarity of the writing. I recommend publication in ACP after the comments below are addressed.

Specific Comments

Page 1, line 1 – The title is awkwardly phrased. Why just a "Possibility" for IASI to detect HCOOH in biomass burning plumes? "document" should be replaced by "measure" or "detect". A better title might be something like: "Detection of HCOOH from biomass burning plumes by the Infrared Atmospheric Sounding Interferometer"

Page 1, lines 25-27 – Make clear whether this underestimation for Siberian forest fires is in the IASI HCOOH or other studies or both. This seems rather speculative based on the results presented in the paper.

Page 1, lines 27-29 – Rewrite this last sentence for clarity.

Page 5, line 185 – Why is 1.44 m/s used as a threshold?

Page 6, lines 210-212 – Please clarify this discussion. It is not clear how a better detection limit "minimizes the bias with the lowest columns", nor what suggests "a negligible effect of the low column biases".

Page 6, para 3 – This is a long paragraph, written in a way that is hard to follow. Please revise for clarity. e.g., lines 224-228 – Explanations are also not clear here. Please explain why the results suggest that the plume "encountered a limited secondary production or a low sink as deposition or reaction with OH" and why the faster decay of HCOOH relative to CO, suggests rapid advection of the plumes. And line 237 – How would the impact of the difference in the geometry of sampling be accounted for in a proper comparison between ACE-FTS and IASI? Line 239 – Where were the plumes sampled by Yokelson et al.?

Page 7, lines 243-244 – What was the approach developed by Chaliyakunnel et al.

(2016) to determine pyrogenic ER(HCOOH/CO)? It is not clear what is meant "by reducing the impact of the mix with the ambient air".

Page 7, lines 269-271 – Revise this poorly written paragraph. It is not clear what is meant by either sentence.

Page 7, lines 275-279 – Why can't the decay be taken into account by considering the exponential decrease between emission and detection using relative lifetimes, e.g., Viatte et al. (2015) and references therein?

Sections 5.1 and 5.2 – Both sections discuss enhancement ratios and emission ratios, including comparisons with other studies, e.g., on page 8, there is additional discussion of ER although the title suggests that Section 5.2 is about EmR. These sections could be more clearly differentiated.

Page 9, lines 358-359 – Arguably, such an intercomparison could have been included in this study.

Technical Corrections

Page 1, line 19 – add comma after "(MODIS)"

Page 1, line 26 – add comma after "forest fires"

Page 1, line 34 – delete "for"

Page 2, line 46 – Rewrite this sentence. Not clear what is meant by "as on the oxidizing power. . ."

Page 2, line 55 – "hence depend on"

Page 2, line 67 – change "as with" to "including" or "such as"

Page 2, line 69 – delete "with the"

Page 2, line 70 – "Atmospheric Chemistry Experiment – Fourier Transform Spectrometer (ACE-FTS)"

Page 2, line 72 – I think this means "(MIPAS) limb instrument, which is sensitive to altitudes down to $\sim$10 km" (rather than only sensitive at 10 km)

Page 2, line 74 – "compared to ground-based and airborne"

Page 2, line 75 – "allows observation of remote regions"

Page 2, line 77 – "ratios of HCOOH relative to CO over"

Page 3, lines 93-94 – add space before K, as done for other units like km, cm-1, etc.

Page 3, line 97 – Isn't the lifetime of CO closer to two months than several weeks?

Page 3, line 113 – "in more detail"

Page 3, lines 117-118 – "which is less than 35% for total columns smaller than . . ."

Page 4, line 123 – "hotspots"

Page 4, line 123 – MODIS has already been defined

Page 4, line 129 – "which, for each detected fire pixel, includes the . . ."

Page 4, line 132 – Last sentence doesn't need to be a separate paragraph.

Page 4, line 141 – "most active in terms of actual fires but are still of interest. The first . . ." These four sentences about importance of biomass burning in India and Siberia could also be rewritten for clarity.

Page 4, line 144 – "over some years, such as during summer 2010"

Page 4, line 154 – "(correlation coefficient, r, from"

Page 4, line 155 – "the impact of sources other than biomass burning"

Page 4, line 156 – "also have"

Page 4, line 160 – "The large region selected over Siberia"

Page 4, line 161 – “other regions, such as polluted”

Page 5, line 170 – add comma after “criteria”

Page 5, line 171 – “in Table 1. The smaller correlation coefficients, i.e., less than 0.7, are found”

Page 5, line 172 – “the HCOOH and CO columns”

Page 5, line 178 – “assign” rather than “attribute” ?

Page 5, line 179 – ECMWF has already been defined

Page 5, line 182 – “(r close to 0.8)”

Page 5, line 183 – Clarify that the low mean and median refer to surface wind speed. Also rewrite the sentence on line 184 for clarity.

Page 5, line 186 and elsewhere through the manscript– “in Table 2” ? Does ACP accept Tab. as an abbreviation for Table?

Page 5, line 197 – “than using only the columns”

Page 5, line 198 – “for each measurement pair”

Page 6, line 201 – “so comparison with previous work is . . . over another”

Page 6, line 203 – should globally be generally?

Page 6, line 206 – “The effects of both biases are, however, limited”

Page 6, line 211 – “an improved [or a lower?] detection limit”

Page 6, line 222 – “same plume as”

Page 6, line 231 – trajectories

Page 6, line 235 – “reasons for the agreement”

Page 6, lines 241-242 – “Conversely, the . . . from IASI is twice that of Chaliyakunnel”

Page 7, line 247 – No need for a new paragraph here.

Page 7, line 248 – “worth noting”

Page 7, line 251 – “and that of Paton-Walsh (2005) may be explained”

Page 7, line 254 – quantify “quite uncertain”

Page 7, line 280 – “For both the IND”

Page 8, line 287 – Equation

Page 8, line 289 – “composed of tropical”

Page 8, line 292 – “composed of cropland”

Page 8, line 293 – “characterized by an”

Page 8, line 300 – “(2004) both used the same”

Page 8, line 307 – “twice the value” [also specify whether ER or EmR from Akagi]

Page 8, line 308 – “It is highly”

Page 8, line 314 – “forest fire plumes”

Page 9, line 336 – “difficulties . . . are”

Page 9, line 338 – “using satellite, airborne, or FTIR measurements”

Page 9, line 346 – “A very good agreement was found” in what? Specify.

Page 9, line 349 – Replace “delicate” with a better description.

Page 9, line 355 – “a modelling study could be”

Page 9, line 357 – times

Page 9, line 358 – “instruments such as”

Page 10, line 367 – Isn't IASI an instrument, not a mission?

Page 10, line 372 – "for free access"

Page 10, lines 385 and 387 – Inconsistent formatting of references for the same journal.

Page 17, caption line 2 – "over the 7 [seven] regions studied. IASI data are"

Page 17 – Tab. or Table ?

Pages 18 and 19, table headings – "HCOOH/CO Enhancement/Emission Ratio ..." would be a better title

Page 18, Table 3 – Left justify all the table entries

Page 19, caption line 2 – "in the literature". Also, rewrite the full caption for conciseness and clarity, e.g., HCOOH/CO enhancement ratio, etc.

Page 20, caption line 3 – "column distribution ... column distribution"

Page 21, Figure 2 and page 22, Figure 4– Preferable to have units on the y-axis labels, rather than just in the caption.

Page 22, Figure 3, caption line 4 – Clarify text describing the percentiles.

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