

Interactive comment on “Trace gas and particle emissions from domestic and industrial biofuel use and garbage burning in central Mexico” by T. J. Christian et al.

Anonymous Referee #1

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This paper presents the results of multiple measurements of trace gas and particulates emitted from various types of fires (cooking, brick- and charcoal-making kilns, garbage, and crop residue) in Mexico. The authors present Emission Ratios (ER) and emission factors (EF) for several gaseous species, as well as for specific particulate components. These data are particularly important because it will enable the estimation of emissions from these biomass burning sources and provide information useful for identifying these sources in future measurement campaigns. The results of this study show that these sources have significant emissions and could potentially have important influences in the atmosphere.

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This paper is well-written and the material included is relevant for Atmospheric Chemistry & Physics. I do suggest that some edits be made to the paper, and some points clarified before publication. I provide these comments here.

Overall, this paper contains a lot of information and is quite long. I understand the desire to keep everything in one manuscript; I am wondering if it would be possible to shorten the overall length by removing some more descriptive components in the paper. I will try to include suggestions for editing within this review.

Specific Comments

In addition to Table 1, A map of the site/study locations would be useful (perhaps in supporting material)?

Just to clarify, the authors present total NMOC emissions (e.g., Table 5). I am assuming that the NMOC is the sum of all of those compounds measured with the FTIR?

Page 10106, line 24-25: Does this mean that people only cook every few days?

The detailed descriptions of the kilns studied could be removed from the main text and provided in supporting material.

Page 10108, line 20-23: What is a typical size of these kind of kilns? It seems like there is a fairly large range in potential sizes.

Page 10108, line 26: How do these “exemptions” work? Are they commonly allocated?

Page 10110, line 23: The detection limit of the FTIR is ~ 50 -200ppb for most gases. What concentrations are typically observed in fire plumes?

Page 10111, line 1-4: At what point did the HCl and ammonia losses occur? By adjusting the results upward, doesn't that assume that the loss of detection occurred at the beginning of the study? Is this realistic?

Page 10111, lines 5-14: Was the impactor homemade? For the analysis of the sugars-

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how were the samples extracted?

Page 10112, line 4-5: How was this uncertainty determined?

Page 10112, lines 6-14: Just a question- would one expect the composition of the trash burning PM emissions to be different than what was observed from other forest and vegetation fires? Is it reasonable to expect that sulfate and ammonium is only a few percent?

Page 10114, line 18: The authors state that the measurements agree "reasonably well." With what?

Page 10115, line 1 and Figures 2 & 3: How was the MCE determined from the Andreae and Merlet (2001) paper? And which EF CH₄ was used in this Figure? For Biofuel Use (EF CH₄ = 6.1 +/- 2.2)? The point on Figure 1 looks higher? Along those lines, which EF was taken for Figure 3? EF PM_{2.5}? EF TPM? It would be useful to be clear if all studies were measuring PM_{2.5}, PM₁₀, TPM? I realize that there may not be too much difference in these, since the bulk of the mass emitted is typically PM_{2.5}, but it would still be useful.

Page 10115, line 27; Page 10116, line 5: Could examples of "smoldering compounds" be provided when this phrase is first mentioned?

Page 10116, line 19: Why were Particle EFs not measured from the Patsari chimney?

Page 10118, line 12: The authors state the results imply a 3:1 flaming/smoldering fuel consumption in the trash-burning fires, which "does not seem unreasonable." Based on what?

Page 10118, lines 16-18: It is not clear why, just because 3 out of the 4 fires had filter data, that the average of the filter results is "equivalent to 1/3 of the fuel being consumed by smoldering." This sentence should be reworded to more clearly state a point here. Also, the authors already state that there is an assumed 3:1 flaming/smoldering ratio in these fires. Is this all consistent?

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Page 10119, line 14: how much of the total Cl is expected to be soluble Cl-? What else besides PVC could contain Cl?

Page 10119, lines 28-29: is it still assumed here that 10-30% of the PM_{2.5} mass is not measured? How did the authors determine this percentage for the garbage? (e.g., how did they come up with EF PM_{2.5} of 10 +/- 5 g/kg?)

Page 10120, lines 1-7: The authors compare EF PM to EF PM_{2.5}. It may be worth mentioning how much of the EFPM_{2.5} is expected to contribute to the total EFPM. And why mention EF SO₂ and EF NO_x when they weren't measured here, and aren't discussed?

Page 10124: What fuels were used in the Zambian charcoal-making kiln? Is there a reference about the Tannins in Oak compared to other woody species?

Page 10124, line 10: In Table 1 of Andreae and Merlet (2001), the for EF for charcoal making is for EF TPM, not PM_{2.5}

Page 10127: This analysis is a bit confusing. Why are the MCMA emissions multiplied by 75/20 to get the emissions for Mexico? I understand that 75 million people are living in urban areas. (am I missing something?) There are urban emissions inventories for all of Mexico developed for the MILAGRO campaign. Are these available for the analysis? I think it's worth noting here that the Emissions Inventories are highly uncertain, and the results from this analysis can be skewed depending on which EI is used. Also, is it worth noting the difference in the species associated with the NMOC emissions from cooking fires versus anthropogenic emissions?

Page 10127, line 22-23: garbage burning could still be an important source here, since it sounds like there are still a lot of modern sources of C being burned in the landfills (page 10109).

Page 10128, lines 15-21: While I think this discussion of HCl sources and chemistry is interesting, I do not think it's necessary for this paper and is one section I recommend

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removing. (And again, page 10129, lines 7-12).

Page 10128, lines 25-26: What are “typical” levels of Cl⁻ in particles?

Conclusions: How much were these emissions relative to other fires burning in the region during that time?

Table 4: The measurements of K⁺ from IC and K from ICP are given. However, the results from either methods are pretty different. Could you comment on this? (Also with Ca).

Figure 5 (and Page 10126): Why is it that dry season cooking fires that contribute at least 33% to the total dry season burning emissions have larger annual emissions? Wouldn't it be 50%? Could this be explained with a bit more detail?

Technical Comments Page 10111, line 28: Change comma to period after (0.267)

Page 10116, line 27: I recommend changing “significant” to “noticeable”

Page 10119, line 9: Define PVC when first used.

Page 10125, line 12: I suggest replacing “they were probably” with “they could have been”.

Table 3: the text is very small and difficult to read.

Figs. 2 and 3: The symbol used for the Andreae and Merlet (2001) point is pretty similar to the symbol for Johnson et al. (2008) results. Could these be changed?

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