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Atmospheric Chemistry and Physics Discussions

Interactive comment on "New emission factors for Australian vegetation fires measured using open-path Fourier transform infrared spectroscopy – Part 2: Australian tropical savanna fires" *by* T. E. L. Smith et al.

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We would like to thank anonymous referee #1 for the positive comments and suggestions. Below we address the referee's specific comments:

Specific comments

Comment (1) Introduction. I suggest adding a note in the introduction (e.g. at the

end of Page 6316 Line 16) to explain that the paper is part 2 of a companion paper (Paton-Walsh et al., 2014), and briefly comment what part 1 and part 2 cover.

Reply (1) A explanation that this is Part 2 of a companion paper will be included in the revised introduction as suggested, with a brief description of what Parts 1 & 2 cover.

Comment (2) Page 6316 Line 24. mercury-cadmium-telluride (MCT) detector

Reply (2) This will be corrected as suggested in the revised manuscript.

Comment (3) Page 6320 Lines 5-9. It is not clear to me how different are the retrieval parameters from part 1 and part 2 of the work. Please clarify.

Reply (3) There are three differences: the spectral resolution (0.5 cm^{-1} here, 0.96 cm^{-1} in Part 1); the field-of-view (20 mrads here, 22 mrads in Part 1); and the apodisation function (triangle here, Hamming in Part 1). The comparison with Part 1 is not included in lines 5-9 and will be included in the revised manuscript for clarification of the differences between Part 1 and Part 2.

Comment (4) Page 6322 Line 2. Figure 4d is mentioned before Figures 4a-c. The Authors should rearrange Figure 4 to cite the images sequentially.

Reply (4) The text in the revised manuscript will be edited so that the sub figures in Figure 4 are referred to sequentially.

Comment (5) Page 6323 Line 11. “Figure 4c”, same comment as above.

Reply (5) As for Reply (4)

Comment (6) Page 6324 Line 22. It is not clear what “this moves slowly” refers to.

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Please clarify.

Reply (6) The revised manuscript will be edited to state “the fire moves slowly”.

Comment (7) Page 6325 Lines 25-26. Why did Paton-Walsh et al (2014) (part 1 of the paper) find C2H4 better correlated to CO2, whereas this paper finds C2H4 better correlated to CO? My understanding is that both papers use the same (or very similar) dataset.

Reply (7) Parts 1 and 2 use the same analysis techniques, but on two very different datasets. Part 1 is an analysis of data collected at Australian temperate forest fires, whilst Part 2 is an analysis of data collected at Australian tropical savanna fires. C2H4 is a product of the pyrolysis stage of combustion (Lobert & Warnatz, 1993). This occurs close in space and time to the CO2-emissions-dominated flaming stage of combustion, which explains high correlation with CO2. C2H4 is also a product of incomplete combustion during the smouldering stage of combustion (Lobert & Warnatz, 1993), which explains why it might also be highly correlated with CO. There was very little difference in the correlation between C2H4 and CO, and C2H4 and CO2 for the fires measured in this paper. Across all 21 fires C2H4 was found to have a better mean correlation with CO. This was not the case in Part 1, where C2H4 was found to have a better mean correlation with CO2. We suggest that this difference is real and due to differences in the vegetation (fuel) types and combustion efficiency of the fires.

Comment (8) Page 6328 Line 2. Missing parenthesis? (based on MCE<90

Reply (8) This will be corrected in the revised manuscript

Comment (9) Page 6328 Line 14. Drivers of variations in emission ratios *and* emission factors

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Reply (9) This will be corrected as suggested, in the revised manuscript.

Comment (10) Page 6333 Line 14. I think it is Paton-Walsh et al (201*4*)

Reply (10) This will be corrected as suggested, in the revised manuscript.

Comment (11) Summary and Conclusions. I feel this section is mostly a summary of their work and lacks some conclusions...

Reply (11) The revised manuscript will address this comment by separating the summary from the concluding comments, these are currently intermixed.

Figures and Tables

Comment (12) Table 2. Table refers to *Y * compounds, whereas the text refers to *X * compounds. Please be consistent. What are the units of the emission ratios, ppm/ppm? Also, the caption of the table is long. The table would be much clearer is some of the text is moved to footnotes below the table.

Reply (12) The manuscript will be corrected so that all references to emission ratios use *Y*. Emission ratios are not usually referred to using units. To be consistent with Part 1 (Paton-Walsh et al. 2014) and other emissions literature, we will keep this as unit-less. The text beginning with "*The standar deviation...*" may be better suited to footnotes rather than in the figure caption. We will see how this looks in the typeset version of the revised manuscript.

Comment (13) Table 3. Table refers to *Y * compounds, whereas the text refers to *X * compounds. Please be consistent. What are the units of the emission ratios, ppm/ppm?

Reply (13) As for Reply (12)

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Comment (14) Table 5. The caption of the table is very long. I think the table would be much clearer if most of the text is moved to a few footnotes.

Reply (14) The text beginning "*The emission factor reported by...*" may be better suited to footnotes rather than in the figure caption. We will see how this looks in the typeset version of the revised manuscript.

Comment (15) Figures 4a-b are not used in the text. The Authors should remove them or at least cite them in the text, for example with Figure 3 (page 6321 line 14)

Reply (15) The text in the revised manuscript will be edited so that all of the sub figures in Figure 4 are referred to sequentially.

Comment (16) Figure 7. "Only the first 60 s following ignition are dominated by smoke from purely flaming combustion, with increasing contribution from the smouldering phase combustion zone towards the end of this time series (as reflected by the decreasing MCE throughout)." This information is already in the text. I would omit it here.

Reply (17) This section of the figure caption will be removed as suggested, in the revised manuscript.

Comment (18) Figure 7. Figure 9. "Notice the higher correlation (R2) between each of the trace gases and carbon monoxide, than between each of the trace gases and carbon dioxide (Fig. 8).". This is already explained in the text. I would omit it here.

Reply (18) This section of the figure caption will be removed as suggested, in the revised manuscript.

Comment (19) Figures 11a, 12 and 13. I think the MCE observations should be presented consistently. Figure 11a presents MCE ranging from 80% to 100%, whereas it

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ranges from 78% to 100% in Figure 12 and from 84% to 98% in Figure 13.

Reply (19) The scale bar in Figure 11a is incorrect, and will be corrected to range from 78% to 100%, consistent with the scale bar in Figure 12. The range of MCE values in Figure 13 is dependent on having enough data for each vegetation type in each MCE bin for meaningful comparison between different vegetation types. Only one vegetation type (SOW) has enough data to extend this figure lower than the 84%-86% bin (as is evident when you compare Figure 11c with Figure 12), and no single vegetation type has enough data to extend this figure higher than the 98%-100% bin. Therefore, given that this figure is for an intercomparison of emission factors between different vegetation types, the existing MCE range will be kept for clarity. A short explanation for this will be appended to the Figure 13 caption.

References

Lobert, J. M. and Warnatz, J.: Emissions from the combustion process in vegetation, In: Fire in the Environment: the Ecological, Atmospheric, and Climatic Importance of Vegetation Fires, edited by: Crutzen, P. J. and Goldammer, J. G., John Wiley, New York, 15-37, 1993.

Paton-Walsh, C., Smith, T. E. L., Young, E. L., Griffith, D. W. T., and Guérette, É.-A.: New emission factors for Australian vegetation fires measured using open-path Fourier transform infrared spectroscopy - Part 1: methods and Australian temperate forest fires, Atmos. Chem. Phys. Discuss., 14, 4327-4381, doi:10.5194/acpd-14-4327-2014, 2014.

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