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Interactive comment on “New emission factors for Australian vegetation fires measured using open-path Fourier transform infrared spectroscopy – Part 1: methods and Australian temperate forest fires” by C. Paton-Walsh et al.

Anonymous Referee #1

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The manuscript by Paton-Walsh et al. is a well-written and clearly articulated manuscript that provides emission factors for gases from fires in Australian temperate forests. The authors provide plenty of reasons for the necessity of these emission factors, not just because of the direct impact of fire emissions on atmospheric chemistry but also because of the paucity of available data for which to use in air quality modelling. This is surprising for a country as fire prone as Australia and the data presented in this manuscript is, therefore, sorely needed.

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The manuscript is very detailed in its methodology and I appreciate its honesty in describing potential caveats and how these were overcome. Although, I personally have not used FTIR as a measurement technique, the detailed description of the instruments used and how the spectral data were interpreted give me confidence in the measurement technique used and the emission ratios/factors that they have produced.

My main concern with the manuscript is based on the treatment of the uncertainties. The authors have treated the overall effect of many of the measurement uncertainties by summing in quadrature. However, no mention is made of whether they have accounted for the co-variance in some of the factors? For example, the authors mention that air temperature has an effect on both spectra and on air density. Therefore, the error in the spectra and density are not independent of each other and will exhibit co-variance. This needs to be accounted for in the error propagation calculations.

Indeed, there is considerable use of error propagation calculations throughout the manuscript that are then used to assign an error to the emission factors for the five sites. As the authors ask the reader to accept their mean emission factors as default emission factors for Australian temperate forests, even though they were measured from fires within one State (NSW), I would expect a more probabilistic approach to the uncertainties, such as a Monte Carlo type simulation. This would provide the reader with a probability distribution over which we could expect the emission factors to come from. It would also allow the readers to ascertain whether the mean emission factors reported are negatively or positively biased and whether median values need reporting instead.

The authors report the mean emission factors from the five sites and report the variability of the emission factors with a standard deviation. Normally, I would accept that as a method of reporting. However, these values are then compared against the measurement uncertainties (see p.4357 L1-10). The standard deviation is only informing me about 68% of the variability in the values from the mean of the sample population. The measurement uncertainties are reported as absolute limits so the comparison the

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authors make against the standard deviations is not valid. So the authors cannot state that “the variability of the fuel carbon in this ecosystem is less than the overall uncertainty assigned”. As a crude check, the error on the mean, using the quadrature method, gives an uncertainty of approximately 5%, which is the same as the uncertainty assigned to the carbon content. Alternatively, the 95% confidence interval of the mean value is approximately 3.9% of the mean and the 99% confidence interval is 8.8% of the mean value. Therefore, I feel that the authors need to reconsider what the data is telling us here. This also applies to the second paragraph on page 4358 with regards to the other trace gases and the second paragraph of the summary and conclusions.

Minor comments: 1. Some of the descriptive information about the sites in the method section (e.g. fuel loads) is replicated in Table 2. Include it in one or the other. 2. P. 4335 L8. Space needed between ‘it’ and ‘decreases’. 3. P. 4343 L26. Reference is made to a manuscript in preparation. I can’t check this manuscript out, therefore, include the details in the current paper or remove this paragraph. 4. P4351 L11. Volkova and Weston use the value of 0.47 for one fuel fraction (trees, I think) but actually measured C content for other fuel fractions. Unfortunately, they don’t report the measured values. 5. P4352 L20-21. This sentence repeats what was said at P4352 L4-5. 6. Figure 2. Units missing on axes (e.g. cm⁻¹ and arbitrary units). 7. Figure 2. In panels b and h I found some of the ‘red’ colours hard to distinguish.

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