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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "The Tropical Forest and fire emissions experiment: overview and airborne fire emission factor measurements" *by* R. J. Yokelson et al.

**Anonymous Referee #2**

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Review of Yokelson et al., 2007

The manuscript by Yokelson et al., presents an overview of the measurements conduced within the TROFFEE field experiment in Brazil 2004. This paper presents the motivation for this airborne and ground-based field effort and presents background information on fire activity in Brazil. The main results obtained in this field experiment, i.e., emission factors for numerous, mainly organic, compounds from deforestation fires mainly obtained within individual smoke plumes, are presented. On one flight a highly polluted air mass was chemically characterized and the location of the responsible fires was determined.

The manuscript is in general well written and contains a good description of the motivation, the experimental concept and observational strategy, and the main results. Some parts, however, should be more focused and maybe restructured as suggested in the specific comments below. The data analysis and interpretation of the results is sound and clear. The currently available data for emission factors from deforestation fires is very limited (especially for the oxygenated VOC presented in this study), thus the present work presents a significant contribution to our knowledge of tropical fires and will help to establish a better representation of these types of fires in larger-scale models. Hence, the manuscript is well suited for publication in ACP.

Enclosed are my specific comments that should be considered before publication of the manuscript in ACP.

Specific Comments:

- Introduction: Presently the introduction is written rather unconventional in the sense, that first (after only one paragraph of general introduction) details of the field experiment are presented (page 6905 to 6908) before some more motivation for the field experiment is given (page 6908/6909). I suggest to reorganize the introduction in the more conventional way, starting with the more general motivation and then presenting the details of the field experiments.

In addition, more general information that is included in the later sections of the manuscript should be moved into the introduction. Section 3.3, for example, contains interesting information about Brazilian deforestation fires that should be included in the introduction. Section 3.4 deals with the description of the fires sampled within TROFFEE and should be included into the 'Experimental Details' section.

- Page 6911, Section 2.1.2: This section contains the description of the IR spectral analysis for the different compounds accessible with FTIR. While for some compounds, mixing ratios can be determined, for most of the compounds excess mixing ratios are determined by the spectral subtraction routine. I suggest to make this point



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more clearer, e.g., by dividing the first paragraph on page 6911 into two, the second paragraph possible starting on line 11 ('Excess mixing ratios of NO....').

- Page 6911, line 11: Please expand a little bit on the determination of the NO and NO2 excess mixing ratios. Are those determined 'directly from the smoke-plume absorbance spectra'? If so, why is this excess mixing ratio (as opposed to mixing ratio)? Or do you subtract background air mixing ratios to derive excess mixing ratios?

- Page 6912, line 21: Please give some more detail (e.g., a reference) on the mass-calibrated nephelometer. In particular I am wondering how the aerosol mass is determined based on measurements of the aerosol scattering (I assume that aerosol scattering is the quantity that is measured by the nephelometer). Do you make an assumption about the aerosol mass scattering efficiency to convert aerosol scattering into aerosol mass? If so, please motivate the choice of the value you are using.

- Page 6913, line 3: 'Septemmber' should read 'September'

- Page 6913, line 9: Maybe add another sentence to give some more details about the ZF-14 Tower (who is running this tower, what kind of instrumentation: aerosol vs gas phase). This information could instead be included in the introduction, page 6907, line 21 (in fact, it might be better placed in the introduction).

- Page 6913, line 14: It is not clear if in total 21 canisters were sampled, or if this number relates to the canisters sampled in Manaus. Please specify.

- Page 6913, line 15: I suggest to start a new paragraph before 'To measure....' to increase readability.

- Page 6913, line 25: What is meant by '..profiles on an emission source...'? Please specify.

- Figure 2: The axis labels should read $\Delta$CO and $\Delta$CO2 (for 2a, and accordingly for 2b, 2c, and 2d). I suggest to include error bars on the measurements.



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- Figure 2: There seems to be a misprint in Figure 2c, since CH3CO is a radical, which almost certainly has not been measured with the employed instrumentation.

- Page 6915, line 4: Please motivate the use of the integrated excess mixing ratio to determine the ER from PTR-MS measurements. From my perspective it seems that using the continuous plume measurements from the PTR-MS would be the natural way to determine ER. Please specify, how the integrated excess mixing ratios are calculated from PTR-MS measurements (e.g., how do you define the plume, how do you derive the unit of ppbv s?)

- Page 6916, line 7: I suggest to refer to Table 2 only in the 'Results and Discussion' Section, and not already in the Section on 'Experimental Details'.

- Page 6916, line 11: How is the emission factor for 'NOx as NO' calculated?

- Figures 3 and 4: The use of 'percent' as the unit for water vapor is rather uncommon, maybe this value can be converted to more common ways to report atmospheric humidity, like dew point, specific or relative humidity. At least it should be stated somewhere, how this unit can be transferred to more common units.

- Page 6919, line 15: 'Christian07b' should read 'Christian et al., 2007b' (I guess)

- Section 3.2: The comparison of the measured pollutant concentrations with previous work is very valuable. Maybe there is some additional information available from the SMOCC experiment in 2002, e.g., Guyon et al. in the ACP Special issue.

- Section 3.3: As mentioned previously I suggest moving this section on the Deforestation fires forward in the introduction section. In addition, it should be shortened, streamlined, and more focused on the information relevant for the present work.

- page 6921/6922: The summary of fire types in Brazil (savanna, pasture and deforestation, if I understand correctly) is very interesting and helpful to evaluate the relevance of the obtained measurements. However, it is rather hard to read and therefore should be streamlined and the most relevant points (e.g., what is the contribution of the



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different fire types to the Brazil biomass burning emissions?) should be highlightened more clearly.

- Page 6921, line 18ff: The presentation of the results from different studies on the biomass loading of deforestation fires should be shortened, maybe give a range of burned fuel derived in these studies that can be compared to the value of 5 - 10 t/ha from savanna fires.

- Section 3.4: This section describes fires sampled within TROFFEE and their relevance. I suggest to move this section into Section 2 'Experimental Details', potentially as Section 2.3, and present only results in Section 3.

- Page 6925, line 2: To motivate the statement of 'well above-average years' please include the average annual area of deforestation fires?

- Section 3.5: Here, a reference to Table 2 should be included.

- Table 2: Please specify what is meant by 'nm'.

- Table 2: I suggest presenting the data from the Mega-Plume in a separate table. Only the AFTIR conducted measurements listed in Table 2 for the Mega-Plume so the additional table should be much shorter than Table 2. This would make Table 2 more readable and would give more attention to the very nice results obtained from the Mega-Plume measurements. Especially the comparison of the effective emission factors from the Mega-Plume measurements with the emission factors determined from the plume measurements, and the calculation of the difference between the mega-plume emission factor and the emission factors expressed using number of standard deviations in the study-average emission factor is very innovative and useful.

- Section 3.5.1/Figure 5: For selected compounds their emission factors as function of MCE are determined. What is the selection criterium for the selected six compounds? For the use in models and for the broader understanding of fire emissions it could be valuable to determine the dependence of the emission ratios from the MCE for all



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measured compounds. If the authors find this relevant, maybe a Table that includes the parameters of the linear correlation between the MCE and the emission factor for each compound can be included.

- Page 6929, second paragraph: Is the difference in acetonitrile emission factor for the different fuel types consistent with the different N-content of the fuel, e.g., high emission factors for fuel with high N-content.

- Page 6929, Line 18: Please mention the particle emission factor measured during TROFFEE here.

- Page 6930, line 18: Can you speculate, why aerosol mass emission is related to fire size / intensity (and not MCE)?

- Page 6930, line 20: maybe mention the three main types of burning you are referring to in this paragraph already in the beginning.

- Page 6930, line 29ff: Are the higher emission factors for deforestation fires compared to savanna fires related to the difference in MCE between these two fire types. Or is the statement valid even when you include the MCE dependency of the emissions?

- Page 6933, line 6ff: You mention that 'only the AFTIR and the GPS acquired data on this flight', but present PM10 mass mixing ratio. It seems that also the nephelometer was measuring during this flight.

- Page 6933, main paragraph: How do you determine the effective emission ratios? How do you determine the background mixing ratios to calculate the excess mixing ratio in the situation of the mega-plume?

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 6903, 2007.



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Interactive Comment