

***Interactive comment on* “Field determination of biomass burning emission ratios and factors via open-path FTIR spectroscopy and fire radiative power assessment: headfire, backfire and residual smouldering combustion in African savannahs” by M. J. Wooster et al.**

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This paper describes field measurements of several trace gases in smoke from controlled savannah fires in Kruger National Park, S. Africa, using ground-based open path FTIR spectroscopy. The principal novelty in the measurements lies in the addition of airborne measurements of fire radiative power to help discriminate different stages of combustion in the fires. The paper is well written, suited and relevant to the readership

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of ACP, and I recommend it be published subject to the minor revisions listed below.

General comments:

The FTIR measurements are well described, largely following methods and previous work by this group and others. The results are compared with earlier measurements by several groups, but no comprehensive comparison is attempted.

Open path FTIR spectroscopy has many advantages, especially for simultaneous measurements of many species (and hence emission ratios), and for labile or reactive species such as formaldehyde. However the ability of measurements made 2 m above ground level to truly characterise representative or fire-averaged emissions from a fire is an important limitation, since most of the plume rises vertically and is not swept through the measurement path. This is particularly true of emissions from vigorous, flaming combustion which consumes most of the fuel. The authors really only first mention this limitation in the final conclusions, I would recommend it be dealt with earlier in the paper so that the relevance of the measurements to fire-average emissions could be better discussed along the way.

Specific/editorial comments and corrections:

Line 2 "... trace gas releases..." or "...trace gases released..."

Line 27: whilst is mis-spelt

P6 L15: The wording of the reference to Fernandez-Gomez 2010 here implies (incorrectly) that these authors were the first to suggest open path FTIR for biomass burning emissions studies – it would be more correct to also reference earlier work such as that by Yokelson, Griffith et al. (which is referenced elsewhere in the paper) in this place. A recent paper by Burling et al from the Yokelson lab is also a useful addition. (Burling, I. R., R. J. Yokelson, et al. (2010). "Laboratory measurements of trace gas emissions from biomass burning of fuel types from the southeastern and southwestern United States." Atmospheric Chemistry and Physics 10: 11115-11130.)

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P7 L19: fire's

P12 L10: "The retrieval algorithm is initialised. . . : (rather than "parameterised"..) and the column abundances are iteratively fitted.

P12 L22: Yokelson reference is 1997. Please re-check accuracy of all references.

P13 L18: How often was the ambient SB spectrum recorded and updated? This spectrum is not constant, and we would expect it to change with time and the temperature of the environment. What is the sensitivity to retrieved concentrations or column amounts due to typical changes in the ambient spectrum over the course of a day or a fire?

P16 L8: Ignoring  $Y_a$  and  $X_a$  relative to  $Y_p$  and  $X_p$  will become less valid as the smoke-filled proportion of the beam ( $f$ ) decreases. The simple statement that the error is  $<1\%$  is only valid above a particular value of  $f$ . What is this value, presumably different for each trace gas? The treatment is over-simplified and requires further discussion and quantification of the potential error. As a guide, referring to Figure 6., I suspect the effect of this approximation is evident at the lower end of the correlation plots, where the measured path-average amounts become more dominated by the background, not the smoke, and the points depart from the fire-dominated correlation. Using a pre-fire measurement of  $Y_a$  and  $X_a$  instead of simply assuming it is zero would be an improvement, and a better approximation than zero if these values do not change during the fire.

P16 L23: strictly FRE is proportional to fuel consumption RATE

P19 L8: fire's

P22 L9: This argument could be strengthened with an estimate of the fuel load of dung relative to the "normal" biomass burnt. Can the authors make such an estimate? Even an order of magnitude estimate (in the absence of field-measured data) could support or discount this conjecture.

P24 L8: may be should be 2 words. There are many instances of this – please find and

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replace. A comma between influences and the cause on the line above would make this sentence more readable.

P24 L22: Should this author be Juergen Lobert not Lobart?

P25 L15: Data from fire 3 confirm. . . (not confirms)

P26 L22: formaldehyde, CO<sub>2</sub> and CO/CH<sub>4</sub> are used as typical pyrolysis, flaming and smouldering emissions. Please provide a reference to this, esp. formaldehyde as a pyrolysis product (also earlier when this is first mentioned).

TABLE 1 fire 4 pressure surely cannot be 1095 hPa! Please proof read tables.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 3529, 2011.

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