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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling the optical properties of fresh biomass burning aerosol produced in a smoke chamber: results from the EFEU campaign" *by* K. Hungershöfer et al.

Anonymous Referee #1

Received and published: 9 October 2007

General comments:

This manuscript presents measurements of aerosol optical properties and size distributions collected during two laboratory biomass combustion experiments. The authors retrieve the aerosol bulk and, to some degree, species specific complex refractive indices by fitting scattering and absorption coefficients determined using Mie theory from size distribution measurements to those measured with a nephelometer and photoacoustic spectrometer. The best fit between modeled and measured optical properties yielded real parts of the complex refractive index on the upper end of the range reported previously, and imaginary parts on the lower end of values given in the literature. They

hypothesize that the presence of weakly absorbing 'brown carbon' as opposed to more fully graphitized carbon may be responsible for the lower imaginary component of the refractive index they retrieve.

Overall, the manuscript describes the combustion conditions of the burns, and the optical and physical properties of the emitted particles in good detail. The values for refractive index they provide are a useful addition to the growing body of literature describing biomass burning aerosol properties, and may be of some use in predicting climate forcing. In particular, the authors do a good job attempting to confirm their retrieved values for refractive index, given their relative extremity compared to previous work. The manuscript could benefit from some streamlining, via the removal of some redundant and extraneous information. The subject matter is appropriate for publication in ACP with some minor revisions.

Specific comments:

12660, lines 3-10 It would be helpful if the authors could provide more information regarding the two fuels they focus on, such as their proper taxonomical names, specific location of their origin, and components of the plant that were burned. For example, was the 'African savannah grass' a single species, or a mixture of several, and if so, which ones?

Also regarding fuels, the manuscript also discusses several other fuels besides the two that the majority of the results concern. Either additional results/figures/information should be provided for these other fuels, or the discussion in this manuscript should be strictly limited to the two African fuels. If the authors wish to retain these additional fuels, they should explicitly give the reasons why the optical closure method they describe could not be attempted (or did not work?) for those fuels, rather then simply stating that they are limiting their discussion to those experiments with a 'maximum of information'.

Finally, please clarify what is meant by the phrase 'largest source of biomass burning' in

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line 9 of the same page. Is this based on mass of carbon emitted?...area burned?...etc.

12661, line 19 The term biofuel may be a bit misleading as it tends to be applied to biomass burned for specific heating or cooking purposes. Using the term 'fuel' would be consistent with the language used elsewhere in the manuscript.

12661-12663 The description of the experimental setup would be greatly aided by including a figure or schematic. Also, section 2.1.1 could be combined with the introductory paragraph that begins section 2.1 to eliminate the need for the sub-subsection and shorten the manuscript.

12662, line 8 How were the SMPS and APS data merged? (chop off the APS below 0.81? or was some standard or reference method used?)

12662, line 20 Were nephelometer non-ideality corrections made based on an assumed distribution or measured size distributions?

12664, line 17 The justification for assertion that the sample contained 'compact particles' is given much later in the manuscript (use of SEM images) and should at least be mentioned here.

12665, line 4 Please provide some quantification width of the distribution (such as geometric standard deviation) to put the term 'very broad' in context.

12665, line 9 Could these coarse particles possibly originate from dust or dirt present on the fuels? Were they cleaned or rinsed prior to combustion?

12665, lines 16-18 I was confused by this section. The Rissler et al. (2006) data shown in Fig. 1 extend to about 2 um, not 0.85 as stated in the text? Is this a fit based on data measured up to a smaller value? If this is the case the Rissler data do not necessarily prove that these coarse mode particles were not present in Brazil.

12665, line 3 What is the motivation for using the 11 percent $\Delta CO/\Delta CO2$ value to discriminate between smoldering and flaming combustion phases? Was this based on

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observations from this experiment or previous work?

12666 general comment Please give the standard error of the mean when presenting the properties averaged over the course of the two experiments, as is done for the mass scattering efficiencies.

12666, lines 23-25 and 28-30 As mentioned earlier, data from other EEFU burns should not be presented unless the authors provide as complete a description of the fuels, locations, and combustion conditions as is done for the SAVA20a and MUSA23a samples.

12667 general comment It would probably be easier on the reader to convert all the times from time of day to the time elapsed since the start of the burn as that is the more relevant time reference

12667, line 26-27 Please provide some quantification of the agreement (statistics of the fit, or at least a percent error between modeled and measured optical properties). How sensitive was the fitting procedure used?

12667, general comment Are the values of 1.60 - 0.01i and 1.56 - 0.01i means of the retrieved refractive indices, or the refractive indices retrieved using the mean values of the relevant optical properties? Lines 24-26 make it sound like the later, but the use of the term 'mean effective refractive index' makes it sound more like the former method is used.

12669, lines 25-26 Please provide more information regarding the uncertainties (or a reference discussing the uncertainties) of the nephelometer used in the experiments.

12669, lines 8-10 The fact that TEOM and impactor masses agree does not necessarily prove that there was no loss of semi-volatile material, but points 2 and 3 are strong. The SMPS/APS system may also confirm the validity of the mass measurement. What density was needed to make SMPS/APS volume agree with either of the mass measurements?

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12672 , line 24-29 Please provide some evidence of this either from this study or previous work

12673, line 13-16 Is it possible that ECa is overestimated by the thermal optical technique? Some discussion of the uncertainty in ECa values is needed to strengthen the case the authors are making.

12674, line 11 If possible, replace the term 'brownish' with just 'brown', or, more ideally, with a more quantitative measure of the filter color, such as the absorption exponent.

Technical corrections:

12662, line 19: data were corrected, not was 12662, line 26: in the case of the not in case of the 12663, line 24: change of OC to 0 to of the OC refractive index to 0 12663, line 26: might be more clear if 'various BC volume fractions' was replaced with 'various assumed BC volume fractions' 12663, line 27: also change 'the refractive index' to 'the effective refractive index' to be consistent with terms given earlier

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 12657, 2007.