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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.

K. Hungershöfer et al.

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We thank the reviewer for the comments. We modified the revised version of the manuscript to address these comments.

Comment 1: First, the paper is rather long for relatively straightforward results. The authors seem to feel the need to over turn every stone to explain why their results are less absorbing than other results, but I don't feel they need to go into quite as much detail.

Response: Since our results deviate in some aspects from literature values and since this is the first study on operating the laboratory combustion facility of the Max-Planck Institute with a continuous flow mixing chamber, we believe that a discussion of possi-

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ble sources of systematic errors with some attention to detail should be included here. However, we have tried to shorten this section where possible.

Comment 2: Second, the authors spent a fair amount of effort trying to establish the effective refractive indices of the aerosol mixture. They found that the both had about the same value (the grass was 1.60-0.010i and the hardwood was 1.56-0.010i at 550 nm). However, the usefulness of the effective refractive indices is limited and they might have well just used the scattering and absorption per mass instead. The fact that their "model" calculations could not match the results at the beginning and ending of the combustion run is exactly why effective refractive indices are of limited value.

Response: Performing Mie calculations with a constant effective refractive index allows to discriminate between size- or chemistry-related changes in the mass scattering/absorption coefficient, since choosing a constant effective refractive index implies that all modelled changes are due to changes in particle size only (not chemistry). The fact, that the temporal evolution of the scattering/absorption properties of our samples are reasonably well described by the model for varying burning conditions, except for the very beginning of the combustion, suggests that much of the observed variation in scattering/absorption properties is due to changes in particle size only. This important information can not be obtained from simply providing mass-specific scattering/absorption efficiencies, since changes in these parameters can be due to both size and chemistry. Furthermore, since the contribution of the initial burning phase to the overall combustion time is small, we argue that the effective refractive index concept has its merit even for atmospheric conditions.

Comment 3: Third, as the authors noted because they only measured the absorption at one wavelength, they were unable to determine if the absorption observed was due to a very small amount of highly absorbing carbon particles (BC or LAC) or a larger amount of weakly absorbing organic particles. This limits the understanding of the results.

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Response: We agree with the Referee that wavelength dependent absorption measurements would have provided useful additional information for the interpretation of the results. We acknowledge this limitation of our study at the end of Section 4.

Comment 4: Finally, like the authors I don't understand why the CO/CO2 ratio indicates that the combustion is flaming but the absorption results are more in agreement with smoldering combustion. I'm not an expert in combustion chemistry, but is it possible that these terms are too broad so that they are not determinative of the resulting aerosol products?

Response: We have reconsidered this issue more carefully and we would like to offer two possible explanations for the apparent inconsistency between dCO/dCO2 ratio and aerosol absorption:

1.The CO emission ratio is only a rough guide for the determination of the combustion phase. The video recording of the two combustion experiments clearly shows that mixed phase combustion (simultaneous occurrence of flaming and smouldering phase) occurred during extended periods of the combustion experiment. Since the aerosol emission factor is larger for smouldering combustion (e.g. Ferek et al., J. Geophys. Res., 103(D24), 32,107-32,118, 1998), one would expect that for mixed phase combustion, the smouldering phase has a more pronounced impact on the average aerosol properties. This is consistent with our observation of more smouldering aerosol properties for dCO/dCO2 ratio characteristic for more flaming conditions.

2.The larger absorption coefficients given in the literature could be in part due to measurement artifacts. As stated in the manuscript (p.12,662 L.24-26) the commonly used filter based methods consistently overestimate absorption (Bond et al., Aerosol Sci. Technol., 30, 582-600), whereas the photoacoustic spectrometer used during the EFEU experiments has shown to be accurate to within about 5

These arguments were included in the discussion of Section 4.1.

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Technical corrections pg 4 line 110 deposited not deposit pg 12 line 387 Schkolnik et al (2007) is missing

Response: Done.

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

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Interactive Comment