

*Comments by reviewer #2 are reproduced in the sans-serif font below. Our responses follow each comment in a blue, italicized, serif font. Text additions to the manuscript, for example, significantly modified sentences, appear in the manuscript in red color. Deletions from the manuscript are not explicitly shown but are described in the responses below. Minor editorial edits to the text are not explicitly shown to prevent a cluttered view.*

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The Fleming et al. manuscript reports on chemical speciation of fine particulate matter (PM<sub>2.5</sub>) emitted from cookstoves. Two types of stoves were evaluated, as well as two types of fuel (dung and brushwood). The stoves were operated under realistic conditions (e.g., traditional meals, local cook). Samples were collected onto PTFE filters and were analyzed off-line using advanced high-resolution mass spectrometry techniques. In addition to expanding the list of reported compounds in biomass burning PM<sub>2.5</sub> samples, brown carbon (BrC) chromophores were identified and mass absorption coefficients (MAC) were estimated. There are many strengths of this manuscript, including the effort to represent real world conditions, the application of advanced instrumentation, and the novelty of the reported results. This study likely represents the most comprehensive analysis of the chemical composition of brushwood- and dung- generated primary PM<sub>2.5</sub>. The manuscript is well written and should be of interest to biomass burning, air quality and climate communities. It is thus appropriate for publication in ACP. Minor technical and editorial comments are provided below.

Technical:

Sample collection: have particle losses through the aluminum tubing been characterized? Would any size dependent losses bias the results?

*We have not characterized particle losses in aluminum tubing, but we expect it to be similar to copper or stainless steel tubing. The length of tubing was minimized in the set up to reduce particle losses. However, since small particles tend to diffuse to the walls, this could be an issue for PM<sub>2.5</sub>.*

*There are practical limitations in sampling emissions from solid fuel use in households. Emissions tests in laboratories using controlled hoods and dilution systems etc. have the benefit of more controlled sampling, but the use of water boiling tests have systematically been shown to not reflect those during actual cooking, the subject of this paper. We anticipate that the discrepancies between field sampling during actual cooking and water boiling tests are much larger than one would expect from losses of small particles to the walls of the tubing. Thus, we chose to sample during actual cooking events with the associated constraints.*

MAC estimation: Can some uncertainty bounds be given for, 1. use of a separate filter for total mass and 2. range of estimated extraction efficiencies? Fig. 8 should include some uncertainty bounds/shading.

*Thank you for this suggestion. Uncertainties were added to Figure 8 and in the text that incorporate a 40% relative error for extraction efficiency, as well as flow rates (10% relative error).*

EF approximation: Is it reasonable to assume the peak abundances are proportional to mass concentrations? It would be useful to provide support for this assumption in either the manuscript or the supporting information. Given the uncertainties and required caveats, is there adequate justification for reporting emissions factors? Relative peak abundance may be more appropriate.

*We agree that the emission factors provided could be biased given different ionization and extraction efficiencies for different constituents. Therefore, we have changed the y-axis on Figure 2 to relative ion peak abundance (which is measured explicitly in the experiment).*

Nano-desi results (p. 7): The fractions of  $C_xH_yO_zN_w$  are relatively similar within and across fuel and stove types, with the exception of the brushwood sample RE007. That sample also appears to have a higher moisture content. Can any linkages between moisture content and PM<sub>2.5</sub> chemical composition be made? Does this also influence the presence of BrC chromophores and can the differences between the values reported in this paper and in prior work be attributed in part to difference in fuel moisture (e.g., p. 11, line 17-20)?

*We were hoping to see this connection as well. However, in the samples we collected, binned into wet and dry fuels, there was not a clear trend with moisture content and PM<sub>2.5</sub> composition.*

Levoglucosan: The suggestion that levoglucosan may be a “good” tracer for the two fuel types may be misleading in the context given (i.e., present in less than half of the dung and brushwood/chulha samples). It is suggested to revise this statement.

*We agree this was confusing. Levoglucosan should have been seen in all samples, however, the chemical constituents compete for charge in direct infusion ESI, and therefore we do not see it in all samples. We have added this explanation on P8, L22-26. We have amended the concluding statement on P8, L26-27, where we say levoglucosan serves as a marker rather than a tracer.*

Editorial:

The motivation for this work, as articulated in the introduction, is a bit unclear. There is quite a bit of discussion on the health implications of solid fuel use in cookstoves, and it is noted that the work was done as part of a larger study documenting the contribution of household combustion to ambient pollution (p. 4, line 4); however, the focus on MAC and BrC chromophores implies a greater relevance to climate. There is little to no discussion on the health implications of the identified compounds and no discussion of the local to regional implications of the findings (e.g., whether or not the MAC values and emissions factors are significant to suggest regional climatic influence).

*The health effects of particulate matter as they relate to chemical constituents from combustion are largely unknown. For example, cigarette smoke is now known to have 1000s of compounds that have various levels of toxicity. We always look for the usual suspects, for example PAHs, but the particle-phase is much more complex. It is essential to characterize this complexity before we can even start correlating the chemical composition to health effects. We are not in a position to evaluate the health effects of the smoke, but we recommend to future researchers to correlate newly observed organics with health effects (P15, L16). On the contrary, we do have access to methods that allow us to characterize the optical*

*properties of cookstove particles, and so we do this in the manuscript. Since local to regional implications of the findings involve many other factors, including the effects of cloud formation, secondary organic aerosol formation, as well as chemical aging of particles. These effects are the subject of more detailed atmospheric modeling which is not covered in this paper, but is forthcoming.*

p. 2, line 9-10: The clause “of pregnant women” after infants is a bit strange as written. Does this mean that exposure is through the mother? If so, one possible revision could be: “infants of women exposed while pregnant”.

*We took your suggestion on wording.*

p. 2, lines 25-28: The discussion of estimated EFs from the Stockwell et al. manuscript is awkward as written. Revision is recommended.

*The text was reworded for clarification purposes.*

p. 3, line 33: “prescribed” instead of “prescribing” ?

*The change was made.*

p. 5, line 50: “O”/oxygen does not need to be defined for DBE equation

*The change was made.*

p. 6, line 20: Remove “the” after “Since”

*The change was made.*

p. 13, line 3: SIC is undefined

*It is defined on P13, L24.*

Fig. 3: is confusing and provides little to no additional information beyond other figures and tables. Authors should consider removing it.

*Respectfully, we have elected to keep Figure 3. It may seem unnecessary to careful readers, however, it serves as a visual for the construction of the paper that readers can refer back to as they are reading the results and discussion.*

Fig. 5: “terpenes” is misspelled in figure legend

*Thank you for catching this. The change was made.*