

## General comments

The manuscript provides a comprehensive analysis of air pollutant emissions resulting from the open burning of various types of household or municipal solid waste. The authors have conducted laboratory combustion experiments and presented detailed chemical speciation data for PM<sub>2.5</sub>, acidic and alkali gases, as well as non-polar organic compounds such as PAHs, nitro-PAHs, alkanes, alkenes, and phthalates. The manuscript's strengths lie in the extensive data collection and thorough analysis. It offers localized emission factors for a variety of waste materials specific to South Africa, which is a notable advancement for air quality management and research in the region. The manuscript addresses a critical knowledge gap in emission inventories, particularly in the context of developing countries where open burning of waste is frequent. If the authors address the following comments sufficiently, the manuscript has the potential to make a significant contribution to the field and would be a valuable addition to the ACP journal.

## Specific comments

The authors are encouraged to provide additional details and clarifications on the methodology, particularly regarding the selection of waste materials for combustion and the conditions under which the experiments were conducted; see my comments below. This will enhance the reproducibility of the study and improve readability without the need to extensively refer the readers to the companion paper by Wang et al.

- Regarding the collection of food discards and vegetation samples in Nevada to avoid potential degradation during transportation (Line 84), I am curious as to whether these samples accurately represent the conditions in South Africa.
- Could you please provide more details on the method used to determine moisture content (Line 89)?
- In the section describing the preparation of waste materials for testing, it is not entirely clear why each specific step (drying, rehydrating, and re-equilibrating) is necessary. Could you please elaborate on the purpose of these procedures (Lines 89-91)?
- I noticed that there is a considerable range in the fuel mass used in the experiments, varying from 0.5 to 20 g (Line 97). I am concerned that this variability could potentially influence the emission factors, particularly if the surface area or geometry of the samples plays a significant role in combustion. Could you please address this issue?
- It would be helpful if you could provide the burn duration in minutes (Line 97), as this unit of measurement may be more intuitive for readers.
- I am interested in understanding whether the temperature of 450 °C used in the experiments (Line 97) is indicative of smoldering combustion; does your setup allow control over combustion efficiency, which seems to depend on fuel type? Was the modified combustion efficiency calculated based on measurements from gas analyzers, and were these measurements consistent across different materials, especially those that were subjected to repeated testing (Lines 103-104)? How do emission factors and PM abundances depend on ignition temperature?

- When you mention that some materials exhibited both flaming and smoldering phases (Line 99), does this mean that the average fire condition was a mix of both? Were these phases visually confirmed or inferred from MCE calculations?
- Lines 132-134: “*The multiwavelength measurement allowed separation of light absorption by black carbon (BC) from brown carbon (BrC), which has unique wavelength dependence based on fuel and combustion conditions (Chow et al., 2015b; 2018; 2021)*”. Does this statement contribute to the manuscript, or can it be omitted?
- Line 153: please provide the abundances of OC and EC from the referenced studies, and then draw comparisons with the data from your own research.
- Line 156: it would enhance the clarity of the figure caption if a direct reference were made to Fig. S1b and the related content in the SI, specifically Text S1, lines S 23-34.
- Line 156: please cite a study to support the choice of “*(organic matter= OC × 1.4)*” and justify its use (is it because you study primary organic emissions?).
- Line 158: refer the readers to the SI text (Text S1) to support the equation: “*minerals = 2.2×Al + 2.49×Si + 1.63×Ca + 2.42×Fe + 1.94×Ti*”.

#### **Technical correction**

- Line 255: please correct the unit (g kg<sup>-1</sup>).