General assessment

This manuscript presents a comprehensive laboratory study examining brown carbon (BrC) emissions from the combustion of diverse biomass types associated with Eurasian and South African ecosystems. The experimental scope is broad, including multiple combustion conditions (smouldering and flaming), analysis of both primary and aged emissions, and optical and chemical characterization of soluble organic carbon fractions.

The work is generally well-structured and systematically documented. The methods are clearly described, and the supplementary information provides useful detail for understanding the combustion setup and analytical techniques. While the study mostly relies on existing methods, the use of the specific fuels and associated findings contribute missing data relevant to the atmospheric behaviour of BrC, in relation to its emission factors and optical properties under different fuel types and aging scenarios.

The manuscript is technically sound, and the results are presented in an organized fashion. A few clarifications and refinements are warranted before publication.

Specific comments

Line 151: Provide supporting information or references indicating how closely this heating method reproduces the temperature profiles or combustion behaviour observed in real-world biomass burning.

Lines 186-187: Was this definition based on the authors' own measurements, previous literature, or a combination of both?

Line 199: How was the RH controlled in the chamber experiments? Was a specific humidification setup used?

Lines 225-226 & 288: The phrase "added externally" refers to direct injection into the chamber?

Lines 285-286: The current approach injects oxidants (e.g., O_3) into the chamber after the biomass burning emissions have been introduced. This may result in direct reactions between O_3 and primary organic compounds, potentially competing with the intended NO_3 radical chemistry. Discuss whether, in terms of experimental design, preconditioning of the chamber, i.e., allowing O_3 and NO_2 to react before introducing BB emissions, would be feasible and better isolate the target aging mechanism and more closely resemble atmospheric conditions. A brief justification of the chosen protocol, with reference to relevant studies (e.g., DOIs: 10.1073/pnas.2010365117; 10.1039/d2ea00031h; 10.1080/02786826.2024.2412652), would be helpful.

Line 350: It is recommended to use the term Mass Absorption Efficiency (MAE) rather than Mass Absorption Coefficient (MAC) when referring to solvent extracts, as MAC is conventionally used for aerosol particles in the particulate phase (e.g., DOI: 10.5194/acp-21-12809-2021).

Line 383: "Eq. 4" appears to be incorrectly cited and may refer to "Eq. 8". Please confirm and revise as needed.

Line 384: Similar to the above, "Eq. 5" may also be misnumbered.

Lines 577 & 821: Organic carbon (OC) is used throughout as a proxy for organic aerosol (OA) mass in emission factor and absorptivity calculations. This may lead to their underestimation or overestimation, respectively, as OA mass > OC mass. A brief comment acknowledging this and its implications for comparison with other studies is recommended.

Line 808: The discussion could be strengthened by referring to recent field or modelling studies on BrC emissions and impacts from boreal and African biomass burning. Highlight how your findings may contribute to improved estimates of radiative forcing or inform regional air quality modelling efforts.

SI: Please number the pages.

SI Text S1: The rationale for fuel selection could be better contextualized. Please briefly explain, with supporting references, whether the selected biomass types and burning conditions reflect those commonly encountered in wildfires across the targeted regions (Eurasia and South Africa).

SI Fig. S6: In the legend, the first marker for “SW smouldering” likely refers to “SG smouldering”.

SI Fig. S19: Why is BFS plotted in (c)? Also, its colour may have been incorrectly assigned, when compared with the BFS spectrum shown in panel (a).