Responses to Editor and Referees Comments

Dear Dr. James Allan,

We thank you and referees very much for critical reading of the manuscript and comments / suggestions, which helped to improve the quality of the MS further. The MS is revised according to all the comments, and our point-by-point responses are provided below. Please see the revised MS for details of the revisions. The page numbers noted here correspond to the revised MS with track changes version.

Editor

Please see the further comments by the reviewers. Much of this is largely technical and should be fixed before publication. In the specific case of SFE raised by reviewer #1, it is certainly true that the scattering effect of BrC will be very important in the atmosphere when considering the instantaneous radiative forcing, however I also recognise that this will be impossible to constrain using the sampling methods described here because information on the specific size of the particles will be lost, on which the scattering has a stronger dependency than the absorption. Instead, I would invite the authors to make clear in this work that the SFE presented is the absorption component only (maybe identifying with a subscript) and explaining that a complete evaluation of the SFE would also contain an evaluation of the scattering, which is likely to be substantial.

Response: We completely agree with you. Following your suggestion, we clarified that the reported SFE is only the absorption component and presented it as "SFE_{Abs}" in the revised MS (please see Section 2.3.3 (Lines 267-270), Table 1, Figure 3 and Section 3.2).

Referee #1

The authors have addressed most of the questions and concerns raised during the first round of review. However, there is one confusing but important point regarding their calculation of specific forcing efficiency SFE), which only considers absorption from BrC and ignores scattering. It would help to show how absorption from BrC changes with respect to a non-absorbing OC, but that's not how it is presented in the manuscript. Therefore, the results can be misleading.

Response: We thank the referee for his/her critical reading of the manuscript, appreciation of our work and constructive comments/suggestions.

To avoid any confusion or misleading the reader, we clarified that the SFE presented in the revised MS correspond to only absorption component (please see Section 2.3.3 (Lines 267-269), Table 1, Figure 3 and Section 3.2).

Specific Comments:

- In the specific forcing efficiency calculations (Section 2.3.3), the values for constants are chosen based on previous studies (as written in the response document), but these are not referenced in the manuscript.

Response: We calculated the SFE using the constants reported by Deng et al (2022). We cited this reference at appropriate place in the revised MS (see Line 265).

- Also, in the specific forcing efficiency calculations it is stated that brown carbon particles only affect direct radiative forcing through absorption and ignore the scattering component. This is not a fair assumption as these particles typically have significant single-scatter albedos (of at least 0.4), meaning their scattering coefficients cannot be ignored. Ignoring the scattering would overestimate the SFE from BrC.

Response: We fully agree with the referee. To avoid any such error / misreading, we clarified that the reported SFE is only the absorption component and presented it as "SFE_{Abs}" in the revised MS (please see Section 2.3.3 (Lines 267-270), Table 1, Figure 3 and Section 3.2).

- P7L30: Absorption units are missing.

Response: We added the units in the revised MS (see Line 316).

- The authors could consider adding the short discussion regarding the AAEs of WS and WI-MS OC being similar (from the response document), to the manuscript.

Response: Following the referee's suggestion, we added discussion regarding the AAE of WSBrC and WI-MSBrC in the revised MS (see the lines 417-425).

- P11L27: typo in this sentence "...from 2.08 12.9 (ave. 6.06)..."

Response: We corrected it in the revised MS (see the line 414), and throughout the text.

Referee #2

The paper is interesting and I find it useful. The authors have replied sufficiently to the questions of the reviewers. However, I still have some minor revision wishes of my own.

Response: We thank the referee for his/her critical reading of the manuscript, appreciation of our work and constructive comments / suggestions.

1) You have several equations, just written in the text. Use equation editor, give them proper equation numbers and refer to them in the text.

Response: Following the referee's suggestion, we used the equation editor for equations and numbered them in the revised MS (please see Section 2.3).

2) p.5, lines 24-32. You present MAE and MAC. But the are the same thing, some authors simply prefer using MAC, some MAE. Make up your mind and be consistent. Reading the paper I see you have mainly used MAE so it would make sense to change the few occasions of MAC to MAE.

Response: Following the referee's advice, we replaced MAC with MAE, unifying the abbreviation of mass absorption efficiency, throughout the text in the revised MS.

3) p. 6, lines 8-14. Present also FI, BIX and HIX as equations with eq. numbers. Give references to all of them, this is not the first paper on them.

Response: Following your suggestion, we added the references for FI, BIX and HIX and presented them as equations in the revised MS (see Section 2.3.2).

4) p. 12, line 20-21. You present E2/E3. Give also that as an equation with a number.

Response: We modified it into the equation form in the revised MS (see eq. 5 in Section 2.3.2).

5) There is no uncertainty analysis, not even the word "uncertainty" in the paper. Use error propagation to calculate uncertainties of the different quantities that you have calculated.

Response: Since we measured the light absorption and emission and then calculated all the optical parameters following the standard procedures reported in the literature, and not used any authentic standards, we did not consider estimating the uncertainty through error propagation. However, we included the uncertainty found in the measurements of carbonaceous and ionic components in the revised MS (see Section 2.2).