Response to Editor

We sincerely thank the editor for the valuable suggestions and comments. We have carefully revised the manuscript to address the points raised. Detailed point-by-point responses to each of the editor's comments are provided below.

A notation of the MAC values calculated based on the organic carbon mass needs to be clearly stated in the abstract.

Response: We thank the editor for this insightful comment. In the revised manuscript, we have clarified the basis of MAC calculation in the abstract by adding the following sentence:

BrC mass concentrations were determined either based on thermally desorbed organic carbon or water-soluble organic carbon, and the corresponding mass absorption cross-sections (MAC) were calculated accordingly.

We believe this revision ensures that readers are aware of the basis for MAC determination from the outset.

Lines 162-163: method for the 'subtracting the absorption coefficient attributed to BC from the total particle absorption coefficient' needs to be elaborated and included either in the paper itself or in the SI file.

Response: We thank the editor for this comment. In fact, the method for subtracting the absorption coefficient attributed to BC from the total particle absorption coefficient was already described in our original manuscript (Line 171-178), as shown below:

We consider the light absorption coefficient at a wavelength of 880 nm detected by the aethalometer to be primarily attributed to BC, with minimal contribution from BrC absorption (Laskin et al., 2015). Based on the fact that BC has minimal wavelength dependence, with an AAE of ~1 (Bond and Bergstrom, 2006), the BC absorption coefficient at wavelength λ, $b_{abs,BC}(\lambda)$, *is given by:*

$$b_{abs,BC}(\lambda) = b_{abs,BC}(880) \times (\frac{\lambda}{880})^{-1} \quad (2)$$

And thus the $b_{abs,BrC}(\lambda)$ *is calculated by:*

$$b_{abs,BrC}(\lambda) = b_{abs}(\lambda) - b_{abs,BC}(\lambda) \quad (3)$$

To avoid disrupting the structure of the manuscript, we have retained this content in Section 2.2.1, and we hope this addresses the editor's concern.

Lines 239-241: A relationship between MAC defined based on the organic carbon (OC) versus organic mass (OM) needs additional elaboration, discussing plausible ratios between MAC(OC) and MAC(OM) based on the literature reports and characteristic O/C values allowing to estimate OM from OC. A general trend of MAC(OC)>MAC(OM) needs to be noted.

Response: We thank the editor for this valuable comment. We have added a detailed explanation in the revised manuscript to clarify the relationship between MAC values defined on an OC basis versus an OM basis:

It should be noted that some studies report MAC values normalized to organic matter (OM) rather than OC. To convert between the two, an OM/OC ratio is typically assumed, which depends on the oxidation state of the aerosol. Literature values suggest that OM/OC ratios range from ~1.6 to 2.5 and are strongly correlated with the O/C ratio (Turpin and Lim, 2001;Aiken et al., 2008). Consequently, MAC values defined per unit OC are generally higher than those defined per unit OM ($MAC_{OM} = MAC_{OC} \cdot [OC]/[OM]$). For example, assuming an OM/OC ratio of 2.0, a MAC_{OC} of 1.2 m^2/g would correspond to a 0.6 m^2/g MAC_{OM}. This trend should be taken into account when comparing MAC values across different studies.

Figure 3: A note of the OC-defined MAC and units of MAC values need to be included in the figure caption.

Response: We thank the editor for this suggestion. We have revised the caption of Figure 3 to (1) indicate that the MAC values were calculated based on thermally desorbed organic carbon, and (2) clarify the units by presenting MAC_{550} in the form of $\log_{10}(MAC_{550}\ [m^2/g])$:

Figure 3. *Optical-based BrC classification scheme (Saleh, 2020) in the $\log_{10}$ (MAC_{550} $[m^2/g]$) vs. $AAE_{370\text{-}550}$ space for (a) BrC and (b) WSOC. The shaded areas represent very weakly absorbing BrC (VW-BrC), weakly absorbing BrC (W-BrC), moderately absorbing BrC (M-BrC), and strongly absorbing BrC (S-BrC). BC is also shown for reference (Bond and Bergstrom, 2006). The scatters in (a) correspond to the online results of Case 1–3. BrC mass concentrations used for the $MAC_{BrC,550}$ were determined based on thermally desorbed organic carbon. The scatters in (b) correspond to the filter-based results during the sampling period with each scatter representing a filter in 24 h sampling duration. The color scale in (b) denotes the ozone concentration in ppb. The size of scatters in (b) denotes the concentration of K^+ detected by the MARGA. Error bars denote the standard deviation of the results for three repeated experiments.*

Figure S2: units of absorbance coefficients need to be added to either caption or legends.

Response: We have added the unit Mm^{-1} for the absorption coefficients in the caption of Figure S2 to improve clarity.

Figure S2. *The correlation of absorption coefficients (Mm^{-1}) derived from the aethalometer ($b_{abs,520}$) and the PAX ($b_{abs,532}$).*

Figure S3: units of mass concentrations need to be added to either caption or legends.

Response: Thank you for the suggestion. We have added the unit $\mu g/m^3$ for mass concentrations in the caption of Figure S3.

Figure S3. *The correlation of BrC mass concentration ($\mu g/m^3$) detected by the thermal desorption method ($[OC_T]$) and the dissolution method ($[WSOC]$).*

Figures S6-7: A note of the OC-defined MAC and units of MAC values need to be included in the figure caption.

Response: Thank you for the helpful comment. We have updated the captions of Figures S6 and S7 to indicate that the MAC values were calculated based on either thermally desorbed organic carbon or water-soluble organic carbon, and we have added the corresponding units as $[m^2/g]$.

Figure S6. *Optical-based BrC classification scheme (Saleh, 2020) in the log10 ($MAC_{BrC,550}$ [m^2/g]) vs. $AAE_{370-550}$ space for online measurements throughout the whole sampling period. BrC mass concentrations used for the $MAC_{BrC,550}$ were determined based on thermally desorbed organic carbon. The color scale denotes the concentration of ozone in ppb. The size of scatters denotes the concentration of K^+ detected by the MARGA.*

Figure S7. *Relative absorbance of CHON detected in WSOC vs. log10 ($MAC_{WSOC,550}$ [m^2/g]) from offline filter-based measurements throughout the whole sampling period. BrC mass concentrations used for the $MAC_{WSOC,550}$ were determined based on water-soluble organic carbon. The color scale denotes the concentration of ozone in ppb. The size of scatters denotes the concentration of K^+ detected by the MARGA.*

Table S1: meaning of the listed absorbance values is unclear. Relevant descriptions and units need to be included.

Response: We thank the editor for pointing this out. In Table S1, the listed "absorbance" values refer to the simulated molar absorption intensities (i.e., molar absorptivity, ε, in $L \cdot mol^{-1} \cdot cm^{-1}$) at the electronic transition wavelengths calculated using TD-DFT (time-dependent density functional theory) in Gaussian 16. These values were extracted and visualized using Multiwfn (v3.8), and reflect the intrinsic light-absorbing capacity of each molecule under isolated conditions. We have added a note in the caption of Table S1:

Table S1. *Molecular formula, molecular mass (Da), simulated molar absorptivity ($L \cdot mol^{-1} \cdot cm^{-1}$) at 370 nm, and proposed structures of major light-absorbing BrC chromophores identified in this study.*