As claimed by authors in the manuscript that “However, theoretical simulations have shown that the AAEBC can reasonably vary between 0.9 and 1.1 depending on the size and internal mixing of BC particles”

Lack and Langridge (2013) reviewed a range of field measurements of “encapsulated” BC and suggested an AAE_{BC} of 1.1±0.3 (0.8-1.4), Luo et al. (2022) simulated variations of AAE_{BC} and discussed key factors that influencing variations in AAE_{BC} and found that the largest factor that influence the variations in AAE_{BC} is the black carbon mass size distributions, and the AAE_{BC} could even out the range of 0.8-1.4 (Figure 1a), larger than the range stated by the authors “However, theoretical simulations have shown that the AAE_{BC} can reasonably vary between 0.9 and 1.1 depending on the size and internal mixing of BC particles (Bond et al., 2013; Lu et al., 2015, e.g.,)” . This could be verified by results from field measurements, for example, the probability distribution of $AAE_{880-950}$ and $AAE_{660-880}$ show in Figure 2a of Luo et al. (2022).

let’s assume three cases and ignore the spectral dependence of AAEBC in this part.

The first case is that AAE_{BC} equal to 0.9, however, the significant contribution of BrC made the fitted AAE is 0.95; The second case, is that AAE_{BC} equal to 1.05, however, the contribution of BrC is negligible, which made the fitted AAE is still 1.05. The third case is AAE_{BC} equal to 1.1, however the contribution of BrC resulted in the fitted AAE is also 1.15. Based on the method used by authors, the AAE of 0.95 would be chosen to represent AAE_{BC}, however would bias from the true average AAE_{BC} of 1.02. This example tells us the 1st percentile of fitted AAE depends on the covariations of AAE_{BC} and BrC contributions, it does not help acquire the average AAE_{BC}. The most important factor that influencing variations in AAE_{BC} - black carbon mass size distribution and BrC absorptions are controlled by complex processes that is quite difficult to disentangle. The derived AAE_{BC} lie between 0.9 and 1.1 does not make this method valid.

Authors argued that “Zhang et al. (2020) have reported an uncertainty of approximately 11% in the estimation of the BrC contribution to total absorption at 370 nm when using different AAE_{BC} values ranging from 0.9 and 1.1”. That being the case, using AAE_{BC} of 1 is just fine, there is no need to derive AAEBC using a method seems reasonable. I agree with authors that sometimes signals at 950 nm can be very low, however that at 660 nm should be fine, I suggest that authors present the probability distribution of $AAE_{660-880}$ to show possible variation ranges of AAE_{BC} and directly using the average $AAE_{660-880}$ to represent average AAE_{BC} of each site might be more reasonable, because BrC absorption at 660 nm is also very small. With respect to spectral dependence of AAE_{BC}, Wang et al. (2018) found that the spectral dependence of AAE_{BC} should be considered, however, the proposed method assume that BrC absorption is negligible which is not the real case, as stated by authors. Therefore, Luo et al. (2022) proposed an improved AAE ratio method considering both variations and spectral dependence of black carbon AAE to differentiate brown carbon (BrC) absorptions from total aerosol absorptions. They use $AAE_{880-950}$ to account for the variations embedded in AAE_{BC} and the ratio $R_{AAE}(\lambda)=AAE_{BC,\lambda-880}/AAE_{BC,950-880}$ to take spectral dependence of AAE_{BC} into account, not using $AAE_{880-950}$ to account for AAE_{BC} as stated in responses of authors.

Therefore, the formula of deriving BrC(λ) is :

$$\sigma_{BrC}(\lambda) = \sigma_a(\lambda) - \sigma_{BC}(880\ nm) \times (\frac{880}{\lambda})^{AAE_{BC,950-880} \times R_{AAE}(\lambda)}$$

Let’s move back to the BrC(370) calculation formula presented by authors:

$\sigma_{BrC}(\lambda) = \sigma_a(\lambda) - \sigma_{BC}(880\,nm) \times (\frac{880}{\lambda})^{AAE_{BC}}$

Authors using $\sigma_{BC}(880\,nm)$ to derived $\sigma_{BrC}(\lambda)$, based on the definitions of AAE, the $AAE_{BC,\ \lambda-880}$ should be the focus. If using constant AAE_{BC} derived through fitting BC absorptions at multi-wavelengths, would result in different uncertainties at different λ values. Therefore, if we want to accurately retrieve for example, $\sigma_{BrC}(370)$, then we should focus on representing $AAE_{BC,\ 370-880}$ accurately. However, as simulated by Luo et al. (2022), $AAE_{BC,\ 370-880}$ would be much smaller than $AAE_{BC,\ 660-880}$ or $AAE_{BC,\ 880-950}$ and the ratio between RAAE(370) depends mostly on black caron mass size distributions (Figure 1b). The used $R_{AAE}(370)$ in Luo et al. (2022) for deriving $\sigma_{BrC}(370)$ is 0.79, if this ratio holds for sites of this manuscript. Then $AAE_{BC,\ 370-880}$ should be less than 0.8, which I believe would result in non-negligible underestimations of $\sigma_{BrC}(370)$ if authors use AAE_{BC} of 1 or other values to derive $\sigma_{BrC}(370)$.

In summary, I agree with authors that "This is a reasonable uncertainty considering the overall uncertainty of the AAE method. Moreover, also the modeling part presented in this work is prone to uncertainties and any change of AAE_{BC} can add uncertainties that however lie well within the overall uncertainty of the approach presented in this manuscript".

Now that authors mentioned variations in AAE_{BC} and tried to derived a reasonable one, we should discuss comprehensively the best way of deriving $\sigma_{BrC}(\lambda)$ on the basis of limited multiwavelength aerosol absorption measurements and deliver clearly to readers.

In summary, I suggest that authors using the average $AAE_{660-880}$ to represent AAE_{BC} variations of different sites, and account for the spectral dependence by simulating a ratio $R_{AAE}(370)=AAE_{BC,370-880}/AAE_{BC,660-880}$ using typical black carbon mass size distributions in Europe on the basis of Mie theory. If not, at least discuss the potential uncertainties associated with the spectral dependence of AAE_{BC} to deliver comprehensive understanding of $\sigma_{BrC}(\lambda)$ derivations that including latest advancements. Moreover, I want to highlight that considering the spectral dependence of AAE_{BC} is quite important if we want to investigate the spectral dependence of BrC absorptions.

I greatly appreciate this manuscript, which synthesizes measurements from over ten sites in Europe. Therefore, it deserves thorough scrutiny and attention.

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