The study aims to optically characterize biomass burning aerosols from sub-Saharan African fuels, focusing on accurately determining the multiple-scattering correction factor for AE33 aethalometers and its relationship with particle single scattering albedo (SSA). The research develops a parametrization of the correction factor specific to African BB aerosols under different aging conditions, highlights their distinct wavelength dependence. I have following major questions for authors:

Our responses to the author will be in italic, while changes to the text will be in blue.

1. If emission data from different types of fuel combustion are fitted separately using your fit function, is there a large difference in the fitting quality? Is it possible that the fit works better for one or a few fuel types even if those types are not well-suited? Has the author considered this?

Authors Response: The reviewer raises in interesting point, particularly since a variety of fuels are presented. While we regard this as a strength for the enclosed work, there is likely value in examining a subset of measurements. We have added fuel types to Table 1 to enhance understanding of each fuel. We have also examined the fit results, looking at only emissions from woods found in Africa – the first four fuels in Table 1. Part of the motivation for part of this work is to use the AE33 in future long-term absorption measurements in Africa, so an African BB C_λ would be of practical use.

Changes to the Text: Starting at line 302, the text now reads "Of those, $-C_\lambda/(1-C_\lambda) = A\omega+B$ performed the best, where 49 % of the variability of the Y-term is dependent on SSA and this equation had had the second lowest X^2. Solving for C_λ, this would have the form $C_\lambda = (A\omega+B)/(A\omega+B-1)$, which has a strong potential for future use in SSA-based correction schemes, particularly where filter loading effects are minimized and optical properties dominate the measurement bias. While arctan(C_λ) had slightly lower X^2 values, the R^2 was also lower, so it exhibited a weaker C_λ dependence. The better X^2 for arctan(C_λ) vs. SSA is mainly an artifact of all arctan(C_λ) flattening out.

Given the figures of merit for the AE33, mentioned in the introduction, it is likely to see use in long-term monitoring in future field campaigns in Africa. Supporting this, we have examined the above fit functions for woody African fuels (i.e. the first four fuels listed in Table 1), which was a subset of 20-21 data points for each wavelength. The results of this examination are in Table S2, and show general improvement in fit characteristics, with all X^2 decreasing and all R^2 increasing except the lowest three. The best fit function is still $-C_\lambda/(1-C_\lambda) = A\omega+B$, for the same reasons stated for the full data set. A fit of this function was also done for fresh, woody African fuels. The fit parameters of the best-performing fit equations that manipulate SSA (the nested exponential) and C_λ ($-C_\lambda/(1-C_\lambda)$) are shown in Table 4 and are plotted in Fig. S2 for all fuels, along with fit parameters for African woody fuels.

Table 4. The resulting fit parameters of functions applied to C_λ and SSA for the best overall fits. Parameters A and B are in the function and values are given at each wavelength in this study. Fit parameters are also given for just African woody fuels (fresh and aged) and only fresh African woods.

		C_{370}		C_{470}		C_{520}	
Fuels	Function	A	B	A	B	A	B
All	$C_\lambda = Ae^{e^\omega} + B$	0.3502	1.3030	0.2180	3.5103	0.4229	2.6202
All	$-C_\lambda/(1-C_\lambda) = A\omega+B$	-0.6074	1.7855	-0.2489	1.4279	-0.2972	1.4296
African woods, all	$-C_\lambda/(1-C_\lambda) = A\omega+B$	-0.6425	1.8109	-0.2579	1.4363	-0.3116	1.4398
African woods, fresh	$-C_\lambda/(1-C_\lambda) = A\omega+B$	-0.7502	1.867	-0.2804	1.4459	-0.3255	1.4402

The following Table has also been added to SI:

Table S2. Fit functions applied to the plot of C_λ against SSA for African wood fuels (see Table 1) and the resulting R^2 and the Chi squared (X^2) values at each wavelength.

		R^2			X^2		
Function	Form	370	470	520	370	470	520
Linear	$C_\lambda = A\omega+B$	0.467	0.311	0.393	4.12	5.21	9.73
Polynomial	$C_\lambda = A\omega^2+B\omega+D$	0.491	0.322	0.396	3.99	5.10	9.71
Log	$C_\lambda = A\cdot\ln(\omega)+B$	0.446	0.318	0.386	4.33	5.14	9.88
Exponential	$C_\lambda = Ae^{B\omega}$	0.485	0.305	0.396	4.11	5.39	10.04
Power Law	$C_\lambda = A\omega^B$	0.463	0.314	0.394	4.30	5.29	10.06
Schmid/Yus-Díez	$C_\lambda = A\omega/(1-\omega)+B$	0.433	0.329	0.379	5.06	5.53	11.08
	$C_\lambda = -A/\ln(\omega)+B$	0.434	0.330	0.379	5.06	5.53	11.07
Arctangent	$C_\lambda = A\cdot\arctan(\omega)+B$	0.453	0.317	0.389	4.26	5.15	9.81
	$C_\lambda = A\cdot e^{(\omega-1)}/(1-\omega)+B$	0.430	0.329	0.379	5.09	5.54	11.08
Nested Exp.	$C_\lambda = A\cdot e^{e^\omega}+B$	0.511	0.284	0.395	3.85	5.51	9.85
	$-C_\lambda/(1-C_\lambda) = A\omega+B$	0.576	0.429	0.476	0.14	0.04	0.05
	$1/\ln(C_\lambda) = A\omega+B$	0.574	0.417	0.470	0.37	0.16	0.20
	$\arctan(C_\lambda) = A\omega+B$	0.562	0.408	0.469	0.03	0.02	0.02

2. The paper mentions that PAM was used to simulate aging experiments. Specifically, what degree of aging equivalent 3days? or 7days? did the authors simulate? During the aging simulation, did the degree of aging vary?

Authors Response: We thank the reviewer for pointing out this omission. With the exception of part of one experiment, there was only a little variation.

Changes to the Text: The following was added to line 124: Several experiments used a potential aerosol mass (PAM) flow reactor, which was operated with two lamps. BB aerosol experienced 2.2 equivalent days of OH oxidation in burn 35O, 1.9 days in 36O and 42O, and most of burn 39O had the equivalent of 2.2 days except for the first 9 minutes where there were 5.0 equivalent days of oxidation. Except burn 39O, the equivalent OH oxidation time had a standard deviation of less than 40 min.

Moreover, the authors combined fresh and aged data in the linear relationship shown in Fig. 3, which makes it difficult to see the differences in SSA correlation between fresh and aged emissions. Therefore, it is unclear whether the authors' statement that the results also apply to aged aerosols is justified. It is recommended that the authors present separate linear fit plots of the fit function for fresh and aged data.

Authors Response: The authors admit that the aged measurements should be differentiated from fresh ones. We have done this in Figure 3. We have found that the best fit function for fresh measurements is still $-C_\lambda/(1-C_\lambda) = A\omega+B$*, as we discuss in response to the previous question. There are only four data points at each wavelength for aged fuels. Since these are all at high SSA values, they are clustered to the right-hand side of the plot and there are so few data points, a linear fit is quite different and different fit functions cannot be distinguished. For these reasons, the authors feel that fitting only aged samples is not useful, though the values for these points are given in SI for the reader to use.*

Changes to the Text: Figure 3 is now:

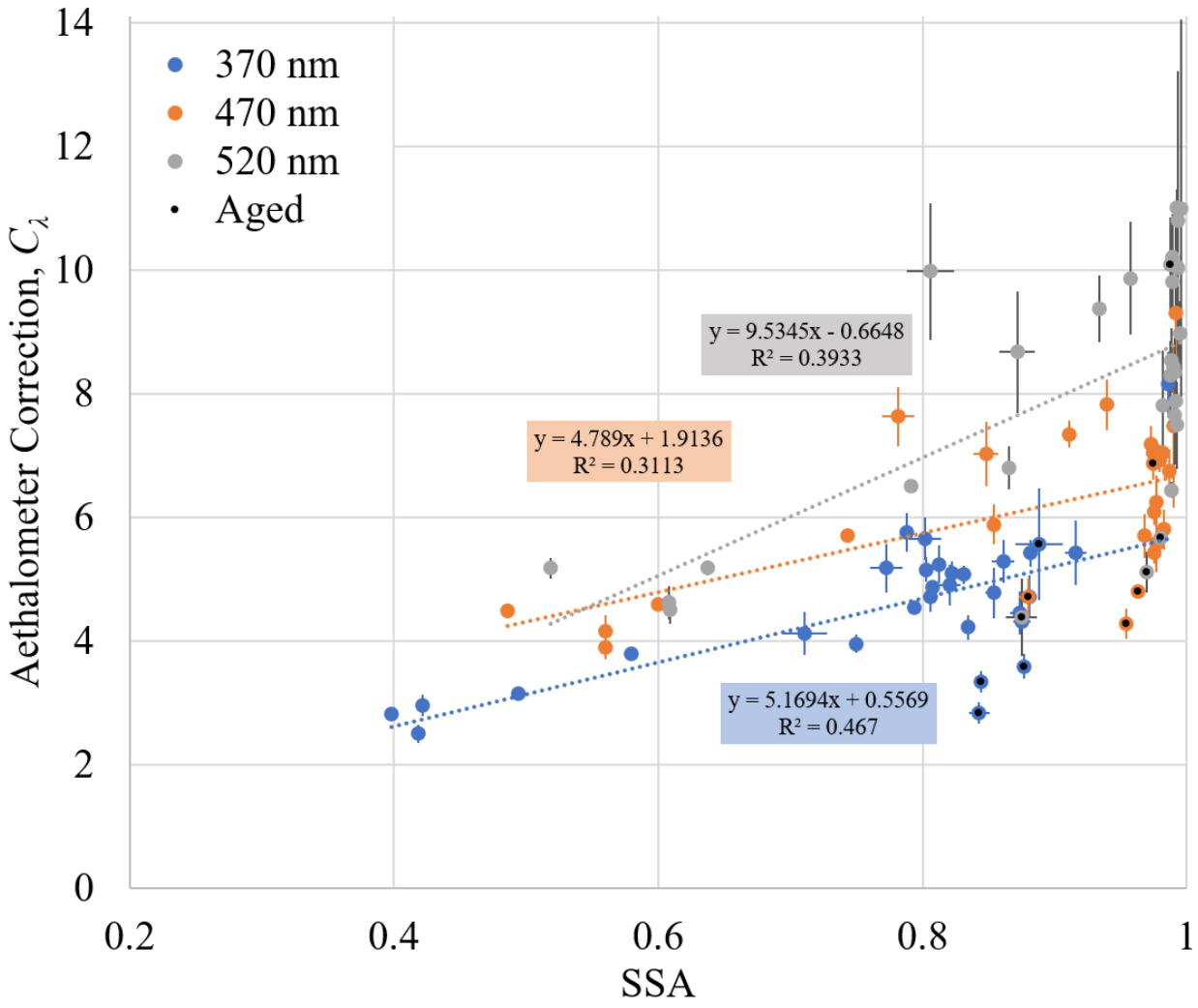

Figure 3. The aethalometer correction factor C_λ plotted against SSA at three wavelengths. PAM oxidation experiments were included and are marked with black dots. Results of a linear fit are shown.

3. First, Fig. 4 is difficult to interpret because the dashed lines are too cluttered. Second, what do the shaded areas represent? Does the pink shading indicate aged aerosols and the grey shading indicate fresh aerosols? From my understanding, there is still considerable discrepancy between the experimental data and the reference data. Since the comparison is made for similar sources, why do the authors' experimental results differ so much from previous studies in Africa?

Authors Response: The dashed lines have been replaced by solid lines. Unfortunately, we cannot change the crowding of these lines because they've been established by previous observations in other works. While we stand by our observations, it is clear that differences between these sets of data require more explanation. We would not call these previous measurements "reference data" since they were simply previous measurements of similar African fuels in our lab. Since differences have been observed, we will attempt to explain it in the text.

Changes to the Text: Figure 4 has been changed:

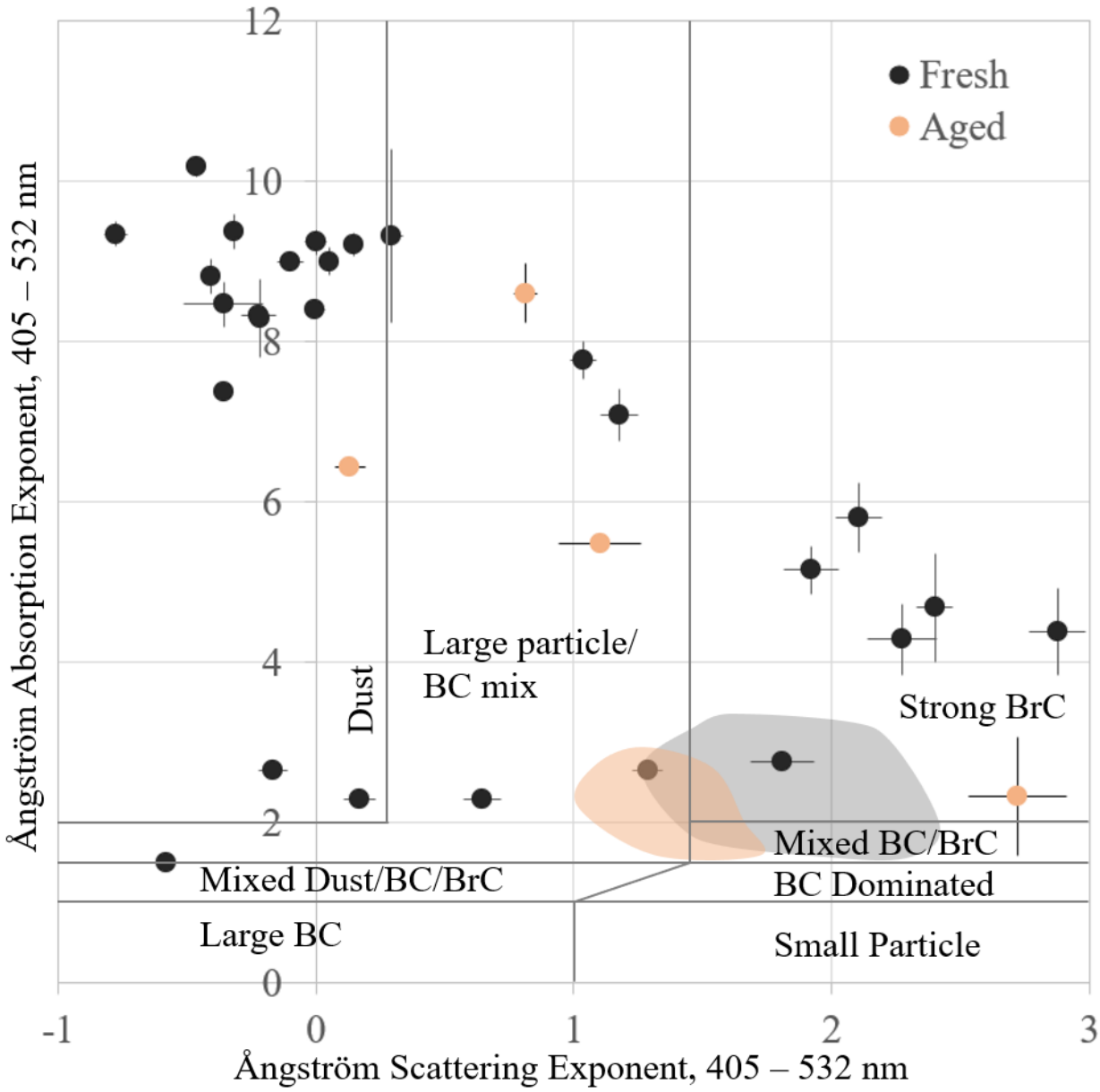

Figure 4. The Ångström matrix plot (ASE vs AAE) for fresh (black dot) and PAM-aged (tan dot) observations in this work. Previous measurements on similar fuels are shown in shaded areas for fresh and photo-aged BB aerosol (McRee et al. 2024).

The following has been added to the end of section 4:

This clearly shows that BB aerosol from African fuel sources are distinct in their optical properties. Differences between observations in this work and studies McRee et al. (2024) are likely due to a number of factors, including differences in wavelength range and instrumentation; 405 and 532 nm scattering and absorption measurements using a PASS in this work vs. previous absorption measurements at 520 and 590 nm using an AE33 and scattering measurements at 453 and 554 nm with a nephelometer. The correction for the AE33 used a different correction method (Moschos et al., 2024) and a single power-law relationship may not hold so close to the UV. It is

also very likely that there are differences in photo-aging between the PAM and smog chamber. The largest difference between studies is that McRee et al. (2024) focused only on smoldering-dominated combustion, which would have a relatively high BrC content, while a variety of combustion states were explored in this work. Regardless, in both studies, the range of values for both AAE and ASE decreased upon photoaging, as well as with dark aging and dark aging with additional nitrate radical (McRee et al., 2024). This demonstrated that both processes reduced the wavelength dependence of scattering and absorption.

If AAE and ASE differ substantially, could this affect the general applicability of the fit function to African fuel data?

Authors Response: Data in Figure 4 was derived purely from the PASS, so the fit functions used for the AE33 do not factor into this plot.