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Atmospheric Measurement Techniques Discussions

Interactive comment on "Determination of Aethalometer multiple-scattering enhancement parameters and impact on source apportionment during the winter 2017–2018 EMEP/ACTRIS/COLOSSAL campaign in Milan" *by* Vera Bernardoni et al.

Anonymous Referee #1

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Review of the manuscript: "Determination of Aethalometer multiple-scattering enhancement parameters and impact on source apportionment during the winter 2017-2018 EMEP/ACTRIS/COLOSSAL campaign in Milan." By Bernardoni et al.

General comments: This manuscript presents an estimation of the filter multiple-scattering enhancement parameter at different wavelengths for AE31 and AE33 Aethalometers. The C parameter was obtained by comparing the ATN measurements

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obtained with AE with off-line absorption measurements performed by means of the PP_UniMI polar photometer. Both PP and PaM approaches were tested. The effects of different instruments/αexp on the Aethalometer source apportionment were also evaluated.

This work deals with an important aspect related to absorption measurement performed by means of Aethalometers which is the determination of the optimal C factor. The C is actually quite variable with time. The C is also site-dependent and the harmonization of the C factor looks quite complicated. This is why studies like the present one are potentially useful in order to contribute to our knowledge about the C factor. The strong advantage of the technique presented here is that the C was determined at 4 different wavelengths. And this is also important given that the C can be wavelength-dependent.

However, the C factors studied here are for the AE31 filter tape (quartz filter tape Pall Q250 quartz) and for the AE33 filter tape (TFE-coated glass fibre filter tape T60A20). My main concern is about the fact that the filter tapes characterized in this manuscript are quite out of date. The filter tape which should now be used in AE33 instruments is the tape M8060. The tape M8060 is, since 2017, the recommended filter tape. In this manuscript authors describe and characterize the multiple scattering artefacts for other tapes than the M8060.

The work cited in this manuscript (Drinovec et al., 2015) was published in 2015. But, recently, the tape M8060 (since 2017) has been indicated as the tape that should be used for ATN measurements with AE33. Many AE33 instruments in Europe actually use the tape M8060. Check for example Table 3 in this AMTD paper (https://amt.copernicus.org/preprints/amt-2020-344/amt-2020-344.pdf). Consequently, my main concern is about the relevance of this study given that the M8060 filter tape is not characterized here.

I suggest the authors to comment on this. The authors should explain why (and if) it is

important to characterize old filter tapes. Maybe the analysis presented here could be useful to harmonize previous measurements performed with the old tapes. The author should also mention that the filter M8060 is not studied here.

Despite this, the C values reported in this manuscript could be useful to correct previous AE measurements performed worldwide with AE31 and with AE33 deploying the old filter tape T60A20 (for AE33).

Specific comments: Page 2, Line 40-46: Mineral dust is also an important contributor to absorption, especially larger particles (>3-5 ïĄ■m) due to the high FeO2 content with consequent absorption in the UV and in the LW spectral ranges. Dust episodes are sporadic (but quite frequent actually in the Mediterranean Basin) and must be detected and removed from the database in order to properly characterize the UV BC or BrC absorption properties. Did you?

Pag 2, Line 45: "another possible light absorber". Please, remove "possible". Dust absorbs a lot of UV and LW radiation (especially larger particles). This is the reason why its effects on radiative forcing are not yet well constrained by global models.

Pag. 4, Line 105: It should be mentioned here that eBC at 880 nm is used for the quantification of BC concentrations.

Pag. 5, Line 138: "and correction does not affect data in terms of the absorption Ångström exponent". The authors should explain why the Sandradewi's algorithm does not affect the absorption Ångström exponent (AAE). If the algorithm is lambda-independent then, obviously, it does not affect the AAE. If it is lambda-independent, then, this is not necessarily a good thing because the correction could be ïĄň-dependent.

Pag.5, line 157: Here one of my major concern: The actual filter tape which should be used in AE33 is the tape M8060. The tape M8060 is the recommended filter tape. In this manuscript authors describe and characterize the multiple scattering artefact

for other tapes than the M8060. Is this true? The work cited in this manuscript (Drinovec et al.) was published in 2015. But, more recently, the tape M8060 has been indicated as the tape that should be used for measurements. Many AE33 in Europe actually use the tape M8060. Check Table 3 in the following AMTD paper (https://amt.copernicus.org/preprints/amt-2020-344/amt-2020-344.pdf). Consequently, my main concern is about the relevance of this study given that the M8060 filter tape is not characterized.

Paragraph 2.2.2, MAAP: MAAP data should be further corrected by applying a multiplicative factor of 1.05 to take into account that MAAP actually works at 637 nm and not at 670 nm. If the factor 1.05 is not taken onto account, then the MAAP data reported in this manuscript are at 670 nm (Müller et al., 2011).

Paragraph 2.6: Here different groups of wavelengths were used depending on the information available for each instrument. It would be useful for the reader if the authors could summarize these calculations in a table or in a block diagram.

Pag 13, Lines 397-408: Did the authors take into consideration that the AE software already includes C_0 values of 2.14 (or 1.57 depending on the AE used) in the calculations? If these C_0 values are not taken into account, then the experimental C will be overestimated.

Pag 13, Line 403: Why the intercept between PP and AE was not comparable to zero at 470 nm and 880 nm? Was it comparable when PaM was used? The authors suggest that a possible additive contribution from scattering could explain the non-zero intercepts. But if this is the reasons, why this effect was observed only at 470 and 880 nm?

Pag. 14, Line 402. The daytime C values were observed to be slightly higher compared to nighttime C. Is there any reason for this? Higher scattering (or SSA) during daytime?

Pag. 15, Line 445: Why the authors used C=2.14 (AE31) and C=1.57 (AE33) to obtain

the absorptions rather than using the experimental C values?

Paragraph 3.3: Is there any statistical significant difference among the C values obtained at the different wavelengths? Is the C parameter wavelength-dependent?

Paragraph 3.4; Figure 4: In relationship to Figure 4 the authors claim that “These graphs immediately show that different λ-dependence is present in data from different instruments.”. I do not see a big difference considering that different wavelengths were used for PP and PaM compared to AE33 and AE31 in Figure 4. Moreover, the difference between AE33 and AE31 could be only due the compensation which is performed on-line by AE33. Note that almost no difference was reported between PP and PaM.

Pag. 15, Line 466: “The comparison of Fig. 5c and 5d to Fig. 4a as well as Fig. 5e and 5f to Fig. 4b, showed that the use of optimised multiplescattering enhancement parameters was not enough to harmonise the results of αexp from different instruments.”. I think that the main reason is that the optimized multiple-scattering parameters used are wavelength-independent thus these do not have a strong effect on the Absorption Angstrom exponent. Is this right?

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