Cheng, Y.-H. and Yang, L.-S.: Correcting aethalometer black carbon data for measurement artifacts by using inter-comparison methodology based on two different light attenuation increasing rates, Atmos. Meas. Tech. Discuss., 8, 2851–2879, 2015

REVIEW

General

The paper presents a method for a slightly modified use of the aethalometer and its data processing. The method is somewhat similar approach as that in the new dual-wavelength model AE 33, just recently published in AMT by Drinovec et al. Here the authors don't have one aethalometer that has two flows like in the AE 33, instead they are using two individual aethalometers with two different flows. The main point about the paper is on the data processing. They use a similar approach as Drinovec et al. to start with but modify it a bit, enough to deserve a publication of its own. The method apparently makes the data more continuous and most probably better than non-corrected aethalometer data.

The conclusions the authors draw are a bit too strong, however. They write that the method can overcome the light scattering effect. They don't have any data to support this statement. For saying so there should be some independent absorption standard and scattering measurements with a nephelometer. Now there is only a comparison of two aethalometers with and without the corrections. The k factors obviously vary in time and especially at low ATN/Q ratios there are very interesting variations, actually even at high ATN/Q ratios in fig 5. This is possibly due to scattering aerosol or single-scattering albedo. So the statement that the light scattering effect can be overcome is not correct. Also in the terminology there is something that should be changed. But those I point to in the detailed comments below.

Detailed comments

First a small comment on eq. (5). If you multiply it with $\frac{A}{Q\Delta t}\frac{1}{\sigma_{ATN}}$

$$\Rightarrow ATN_C \frac{A}{Q\Delta t}\frac{1}{\sigma_{ATN}} = \frac{\overline{BC}}{(1-kATN)}$$

This means that ATN_C is the ATN that, when applied in eq. (4) gives the average corrected BC which in principle could even be given its own symbol

$$\frac{\overline{BC}}{(1-kATN)} = \overline{BC_C}$$

But then to more critical comments

P2856 L18-20: "*In practice, if the true ATN value can be found, then the artifact effect on the BC measurement can be corrected from the true ATN change rate (dATN/dt). Therefore, determining the true ATN value was the main objective of this stud*y." This is in the core of the work and now I have to say that here the terminology is wrong. ATN is

by definition the one in Eq. (1), it is the true and correct ATN. I would rather call the ATN in eq. (5) "modified" ATN. The term "true ATN" is used in several sentences of the paper and should definitely be changed all over.

P2856 L20 - P2857 L2: " *According to the definition of light ATN, the ATN value is dependent on the amount of BC aerosol deposition.*"
This sentence is simply and unambiguously wrong.
ATN is defined correctly in Eq. (1). It is just about light intensity reduction and intensity can be reduced both by scattering and absorption. It is of course true that in a filter sample most of the intensity reduction is due to BC but at some sites intensity is reduced by light absorbing organic carbon or iron oxides in some soil dust. And also purely scattering aerosol reduces the intensity of light transmitted through the filter. If sampled at a clean marine site the intensity reduction through an aethalometer filter may even be dominated by sea salt.

P2857 L12 - 15: This is somehow contradictory you first write "*In the absence of the artifact effect, the ratio of true ATN values*", but then you use the corrected ATNs in eq. (8). That means the artifact effect is not absent, but it was corrected.

But in principle the derivation of eq (9) is fine. You could simplify it to

$$k = \frac{Q_1 ATN_{F2} - Q_2 ATN_{F1}}{ATN_{F1} ATN_{F2} (Q_1 - Q_2)}$$

P2861 L19 – 21 " *These observation results indicated that the proposed model could overcome the problem of enhanced light ATN resulting from light scattering at a new sampling spot, without using any light scattering coefficient*." This is not true. Like I wrote earlier, at clean sites, for instance at a marine site the effect is definitely significant. Another thing is that the k-values obviously are different especially at low but even at the high ATN/Q values, see Fig 5 in different seasons. What does this depend on? Very probably also scattering, maybe single-scattering ratio.

Another issue of Figs 4 - 6: are they seasonal averages or medians or what of the data? How big are variations in each of them? Further about all figs: add units to the axes of the figures.

P2862, L9.: You use C = 2.14. Please be careful about the C value. There have been many studies with a reference instrument showing different C values. Check the paper by Collaud Coen et al, Atmos. Meas. Tech., 3, 457–474, 2010. I don't think 2.14 is the best one for your site.

P 2865 L 17 – 19 " *The proposed correction model can overcome the light scattering effect and aerosol loading effect on BC measurement results simultaneously*,"
Without scattering measurements and proper absorption standard like photoacoustics or extinction – scattering you cannot say that the scattering effect has been overcome. See my writings above.