Review of amt-2016-361 on “Comparison of different Aethalometer correction schemes and a reference multi-wavelength absorption technique for ambient aerosol data” by Jorge Saturno et al.

GENERAL COMMENT

The study targets the measurement of absorption Ångström exponents (AAE) by filter-based multi-wavelength light absorption measurement methods. Light attenuation data from the widely used 7-wavelength Aethalometer are analyzed by applying two correction schemes according to Schmid et al. (2006) and Collaud Coen et al. (2010) and comparing the results to data from the filter-based off-line Multi-Wavelength Absorbance Analyzer MWAA (Massabò et al., 2013; Massabò et al., 2015). Reference methods of the measurement of light scattering and light absorption were a 3-λ Integrating Nephelometer (Model Aurora 3000, Ecotech) and a single-wavelength Multi-Angle Absorption Photometer MAAP (Model 5012, Thermo Electron Group). Data have been collected at the ATTO site in Amazonia from the wet-to-dry transition season to the dry season in 2014.

The topic of the study is of relevance for the research area of determining black carbon (BC) and brown carbon (BrC) from the wavelength dependence of the light absorption coefficient, characterized by the AAE. The presented data is well suited for the study and of high importance and thus deserves publication in AMT. However, before being suitable for publication, the manuscript requires major revisions which are highlighted in the following.

SPECIFIC COMMENTS

1. A more detailed description of the approaches in sections 2.3.1 and 2.3.2 is required. Particularly, the connections between Equations 8 to 14 need better explanation. Furthermore, the links between R_{meas} and R, and between C, and C_{ref}, as well as their respective wavelength dependencies need to be introduced. As an example, the authors say on lines 243 ff that “By applying a linear fit to Eq. (8) vs. ATN data, it is possible to obtain the shadowing factor as follows …”. However, the connection of Eq (8) and Eq (9) via the claimed fit procedure is not clear. Then, on lines 248 ff, C is parameterized as a function of AAE, although the physically based relationship is on the wavelength. Again, the approach for this parameterization is not clearly described.

In Eq. (11), the wavelength dependence of the single-scattering albedo (SSA) is parameterized as a function of the AAE, although the physical-based relationship is on the wavelength. Furthermore, the parameters required for a direct determination of SSA as a function of λ are available: σ_{sca} is measured for 3 wavelengths and σ_{abs} is measured for one wavelength, so that SSA can be determined directly for one wavelength and extrapolated to the other wavelengths by the described iteration procedure. The direct approach would avoid the assumption that σ_{sca} and the scattering contribution of the SSA scale both with $å_{sca}$ and same for the absorption part. A comment is requested why this approach was chosen.

2. The authors have excluded the comparison of $å_{atn}$ from AE data to $å_{abs}$ from MWAA data; see Fig. 6, although they state that the original attenuation Ångström exponent was also found to fit very well the MWAA-retrieved AAE, see Fig. S4. I recommend to include the $å_{atn}$ values in the intercomparison and to discuss whether or not the wavelength-dependence of $å_{abs}$ is affected by the correction algorithms. The potential result that the original attenuation Ångström exponents may give reliable estimates of the wavelength dependence of σ_{abs} would be very important.

3. The discussion of the results presented in Fig. 5 is critical. Here, the authors compare absorption coefficients obtained from MAAP and MWAA and found significant differences. When inserting the 1:1 line it becomes evident that σ_{abs} from MAAP are always larger than respective values from MWAA. Although the authors find a slope of 1.04 for the polluted period, there is a statistically

significant offset of 1.18 Mm^{-1}. In the considered range of σ_{abs} values the offset can reach more than 10% of the total value. Furthermore, the data for the cleaner period with $\sigma_{abs} < 5\ Mm^{-1}$ are highly correlated which conflicts the argument, that the under-determination of σ_{abs} for low values may be explained by the proximity to the detection limit of the MWAA method. If this would be the case, I would expect a less linear relationship between the σ_{abs} values with arbitrarily scattered values from the MWAA method. A careful discussion of the results shown in Fig. 5 is recommended.

4. A clear conclusion of the study is required. What have we learned from the presented work? Do the authors recommend the adapted Collaud Coen algorithm for future use, or one of the other two investigated approaches?

MINOR COMMENTS

1. The nomenclature used in the manuscript requires careful cross-checking, particularly for the following issues:

- BC mass concentrations obtained from light absorption methods are referred to as equivalent BC (eBC). This acronym should be used throughout the manuscript whenever appropriate.
- The absorption Ångström exponent is referred to as AAE, as $å_{ABS}$, or as $å_{abs}$.
- The light absorption coefficient is referred to as σ_{abs}, as σ_{ABS}, or as σ_{ap}. Consistency is requested.
- The city of Genoa is referred to as Genoa or Genova, please check.

2. The complete reference (Kirchstetter et al., 2004) should be listed in the bibliography.

3. When referring to Virkkula's PSAP correction scheme (Virkkula et al., 2005), also the correction (Virkkula, 2010) should be referenced.

4. Line 66: The sentence "retrieving the wavelength dependence of ambient aerosol requires …" is misleading. I assume the authors mean "retrieving the wavelength dependence of ambient aerosol optical properties requires …".

5. Line 117: The acronym PAS should be introduced.

6. Line 169: The correct name of the MAAP is (Model 5012, Thermo Electron Group, Waltham, USA).

7. Line 204: The correct equation deduced from the Lambert-Beer law is ATN = 100 ln (I_0 / I) or ATN = -100 ln (I/I_0); see e.g. (Hansen et al., 1982; Petzold et al., 1997; Weingartner et al., 2003).

8. Line 211: The meaning of „ (14625/λ)" is not clear. If it should refer to the parameterization of α_{ATN} values as a function of wavelength, a clarification and the addition of units are needed.

9. Eq. (6). Why not inserting the MAAP wavelength value given one line above instead of using the variable λ_{MAAP}?

10. Line 238: Please specify for which variable the parameter C_{ref} was averaged.

11. The use of reference wavelengths of 637 nm or 880 nm is confusing; see Section 3.1. A short explanation may help to clarify why the specific wavelength is used as a reference.

12. Line 436: On a statistical basis, the offset of the Collaud Coen algorithm of -0.07 ± 0.30 is not slightly negative but indistinguishable from zero. This statement should be corrected.

13. Figures: For all scatter plots, 1:1 lines and grid lines should be shown as guidelines to the reader. In Fig. 7, the range of x- and y-axes should be similar, it might be of advantage to show only the relevant AAE - range from 0.5 to 2.0.

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