

**Answers to Interactive comment by Anonymous Referee #1** on "Differences in Aerosol Absorption Ångström exponents between correction algorithms for Particle Soot Absorption Photometer measured on South African Highveld" by Backman et al. 2014

### Answers to the major comments

**Comment:** "Recently, Lack et al. (2013) reported that the estimation of the contributions of brown carbon using the AAE should have large uncertainties. I recommend adding some comments on the relation of this work with their report."

**Answer:** The referee is correct that the work by Lack and Langridge (2013) should be addressed in the manuscript. As highlighted by Lack and Langridge (2013) the true AAE of the aerosol at the wavelength where BrC does not absorb is unknown. Furthermore, the study highlighted that the estimation of BrC to light absorption depends on the fraction of light absorption by BrC to total light absorption. A paragraph discussing these issues were added to section 3.4 along with the discussion of Fig. (8b).

**Comment:** "When measuring the contributions brown carbon using filter based photometers, change in particle shape of the brown carbon may need to be considered. How do you think about the issue?"

**Answer:** Light scattering species such as sulphates and nitrates are in the solid phase after the aerosol sample has been dried. However, as the referee highlights, this does not need to be the case for light absorbing OC, i.e. particulate BrC (or more generally OC) can be liquid. Laboratory experiments have showed that the re-arrangement, and partitioning between gas-phase and liquid phase OC on the filter, will impact the measurements which is acknowledged in the manuscript in section 3.2. Moreover, it is certainly plausible that particulate matter that deposits onto the filter could change shape once deposited and, therefore, change the optical properties of—not only the particles—but the fiber filter itself. The message of the manuscript, however, is not to provide a quantitative estimate of the contribution of BrC to light absorption, but rather to highlight the differences that different corrections have in relation to each other. The introductory phrase of section 3.4 was changed to make it more clear that the emphasis is on differences between the corrections and not on the absolute amount of light absorption by BrC to total light absorption.

**Comment:** "Discussion in section 3.3: It seems that the AAE values were relatively high, when high  $\sigma_{AP}$  and  $\sigma_{SP}$  were observed (Fig. 7). These results imply that the high  $\sigma_{AP}$  events may be related to the local combustion and  $\sigma_{SP}$  may be related to the dust event. How do you think about the consumptions?"

**Answer:** The site is located in a industrialised region and surrounded by heavy industry; the heavy industry is not in the immediate vicinity of the site. The high  $\sigma_{AP}$  values shown in Fig. (7) in combination with a SSA below 0.9 and AAE well above unity makes a strong case that the aerosol local biomass burning; it can be for heating, cooking or other types of fire. Given the measurements comprise two years of data, local continuous sources such as those associated with the heavy industry surrounding the site should comprise most of the data points (left column of Fig. 7). Thus, the high  $\sigma_{AP}$  values in the (middle column of Fig. 7) that do not correspond to the area with more number of data points (left column of Fig. 7) implies that the high values are events because they do not occur on a regular basis. The high SSA values in combination with the highest  $\sigma_{SP}$  values seen in the figure (Fig. 7 right column) originates from a single event that comprise two data points (i.e. two hours). There was no obvious drop in the scattering Ångström exponent during the event, which would have been indicative of a dust storm. It was decided not to elaborate on events in the manuscript. It was clarified in the text that the values in the middle and right column of the figure should be interpreted in conjunction with the number of data points for a coordinate of interest.

### Answers to the minor comments

**Comment:** "Page 9736, line 10 "In addition, desert dust is a major constituent of total suspended particle mass also absorbs light at short wavelengths." => I recommend adding some reference in this sentence."

**Answer:** References will be provided in the revised manuscript.

**Comment:** "Page 9739, line 22 => What is the "regular basis" means?"

**Answer:** This was clarified in the text. The flows were checked when the filter was changed.

**Comment:** “Page 9741, line 9 “The noise of  $s_0, S$  the can be estimated...” => “the” may not be needed.”

**Answer:** The mistake was corrected.

**Comment:** “Page 9742, line 1 “...and their standard deviation ( $d_{QDIL}$  and  $d_{QS}$ ) calculated from the data set.” => The possible systematic uncertainties in the determination of flow rates should also be taken into account.”

**Answer:** The equation provides the relative measurement uncertainty associated with the dilution equation when the uncertainty of  $\delta\sigma_{0,DIL}$  can be neglected. The drift and systematic uncertainties should—in the authors' opinion—not be included in the calculation because the relative uncertainty is a measure of the uncertainty of the measurements, not their long term performance which was assessed separately (Fig. 3). Both flow rates were calibrated against a reference flow meter and the linear regression provided the true flow rates.

**Comment:** “Page 9742, lines 5-6 “Data associated with significant deviations or fluctuations from the desired  $QDIL$  value were omitted.” => Criteria of the data selection should be added.”

**Answer:** The criterion was added to the text as suggested by the referee. The impact of the criterion was added to the discussion regarding Fig. (3).

**Comment:** “Page 9744, lines 9-10 => One of the two “absorption” is not needed.”

**Answer:** The mistake was corrected accordingly.

**Comment:** “Page 9744, line 10 => “Eq.(11a)” may be “Eq.(12a)””

**Answer:** The mistake was corrected accordingly on Page 9744, Line 21.

**Comment:** “Page 9744, line 26 => “Eq.(11)” may be “Eq.(12)””

**Answer:** The mistake was corrected accordingly.

**Comment:** “Page 9745, line 21 => Why the authors use ‰ instead of ‰?”

**Answer:** The value was changed to 0.06‰ to be consistent with the other percentage values reported throughout the manuscript.

**Comment:** “Page 9748, “The use of ATN to calculate AAEs will in both cases show consistently lower AAE values than those calculated from AP using different correction schemes” => This sentence is unclear. The AAE values calculated using ATN seem to be larger than those using some corrections in Fig. 5(b).”

**Answer:** This sentence did read incorrect. The sentence should have addressed the trend of AAEs calculated using ATN in relation to the corrections. The sentence was corrected and elaborated further for clarity.

**Comment:** “Page 9749, line 9 => “chan” may be “can””

**Answer:** The typo was corrected accordingly.

**Comment:** “Figure 5, caption => “Tr <0.775” should be “Tr <0.575””

**Answer:** The typo was corrected accordingly.

**Comment:** “Figure 8 => Unit of the y-axis in (a) may not be “Mm-1”. It seems to be relative value to absorption at 660 nm.”

**Answer:** The referee is correct. The values are relative to light absorption at 660 nm. The left y-axis label of panel (a) was changed to read Absorption (arbitrary scale). The line colours were also changed in the figure to be coherent between the panels.