

## ***Interactive comment on “Minimizing light absorption measurement artifacts of the Aethalometer: evaluation of five correction algorithms” by M. Collaud Coen et al.***

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Answers to anonymous Referee #1

The authors thank the referee for valuable comments. The referee has pointed out some lack of precision concerning the context of the study. Most of these points have been analyzed and/or briefly mentioned during this study, but were not precisely enough described in the paper.

1. Since no reference method exists for a control measurement of sigma, the performance evaluation of the correction schemes, presented here, is either relative to

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each other or based on concurrent measurements of sigma by the MAAP. Although the MAAP has been found to provide an improved measurement of sigma, it has not been established as a universal measurement method for absorption. It is suggested that this is made clear in the manuscript.

REPLY: As also stated by W. P. Arnott, the MAAP is not an absolute reference method. No absolute reference method measuring the aerosol absorption coefficient at relatively low concentration levels is however presently available. All the filter based methods suffer from several artifacts linked to the use of the filter, but the other absorption measuring methods also suffer from other artifacts and/or some limitations in their applications (for example the need of sufficiently high absorption). However, MAAP has already resolved some of the filter based artifacts by using backscattering information and leads to more reliable absorption coefficients than the Aethalometer. Its fairly widespread use over the past several years also permits the authors to find 4 datasets allowing the comparison for sufficiently long measuring periods of both measuring methods for different ambient aerosol. However the authors completely agree with the fact that MAAP is not an absolute reference method and this will be explicitly explained in the revised paper.

2. Table 1 lists the instrumentation used for obtaining the datasets under examination. It includes sampling of different size fractions under different conditions (dry-ambient) and on different filter tapes. Some indication of the uncertainty introduced in the evaluation from these factors is necessary.

REPLY: A complete uncertainty estimation is certainly beyond the scope of this paper. Using a large number of datasets obviously induce differences between the measurement conditions. However, the most important fact concerning this paper is that the comparisons between absorption coefficients are always done for two instruments (Aethalometer and MAAP) working on the same inlet involving the same sampling conditions (size fraction, temperature and relative humidity). Otherwise, no working restrictions are given for the Aethalometer, and the correction should be applicable to

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all measurement conditions (different size fraction, scattering and absorption, T and RH) so that they can be tested on all datasets independently of sampling conditions. The most sensible point is the different filter types between AE16, AE10 and all the newest instruments since the optical properties of the filter can have a clear impact on the multiple scattering correction and therefore on the calibration constant  $C_{ref}$ . All the Aethalometers filters consists of non-woven polyester backed quartz filter material, but the filter type has been changed between the AE10 version and the newest instruments using all the Pallflex Q250F filter type. In our study, only the Mace Head Aethalometer use another filter type, so that the filter difference cannot explain the large variability in the multiple scattering correction constant  $C_{ref}$  (Fig. 4). Moreover,  $C_{ref}$  is seasonally dependent for two stations (CAB and JFJ) with the same instrument and filter type. The authors therefore believe that the filters used at Mace Head and in the other stations are comparable. These two points will be however better described in the revised manuscript.

3. According to table 1, a PAS was available as a reference instrument for sigma in one of the campaigns (AMA). Despite the short measurement period it would be advantageous for the manuscript to present the comparison between the PAS values and the corrected sigma obtained by the old and new algorithms.

REPLY: The LBA-SMOCC campaign in the Amazon Basin lasted about 2 months. The PAS measurements were however not available at the site during the whole LBA-SMOCC, so that the comparison between the AE and the PAS absorption coefficients comprise only 250 hourly averages. This corresponds to about 10 days of measurement that were measured during the wet season (very few points), the transition season and the dry season. Secondly, scattering coefficient at only one wavelength was available for this period, which precludes an estimation of the scattering Ångström exponent to be applied to the new corrections. A first comparison between the AE and PAS absorption coefficient was published by Schmid et al. (2006). The authors also did a comparison between PAS and AE applying all the different corrections. The slope for

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the whole period is about 0.80 with confidence limits of 0.75 to 0.84. The slope for the wet season is not representative since only a few points were measured with the PAS. The transition season has a similar slope, whereas the dry season leads to a higher slope of 0.89. These low slopes can perhaps be partly explained by the fact that the AE sampled ambient PM<sub>10</sub> aerosol and the PAS sampled dried PM<sub>1.5</sub> (RH < 45%), leading to a greater Babs measured by the AE. Even if the comparison was done, the very small simultaneous measurement period (10 days) in comparison with the other datasets, the absence of a wavelength dependence of the scattering coefficient measurement and the difference in the sampling procedures for both instruments leads us not to consider these results in the submitted paper. For the foregoing reasons, the authors will not add this comparison to the revised version of the paper.

#### Reference:

Schmid, O., Artaxo, P., Arnott, W. P., Chand, D., Gatti, L. V., Frank, G. P., Hoffer, A., Schnaiter, M., and Andreae, M. O.: Spectral light absorption by ambient aerosols influenced by biomass burning in the Amazon Basin. I: Comparison and field calibration of absorption measurement techniques, *Atmos. Chem. Phys.*, 6(11), 3443–3462, 2006.

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