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Interactive comment on "On Aethalometer measurement uncertainties and multiple scattering enhancement in the Arctic" *by* J. Backman et al.

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Reply to comment by Anonymous Reviewer 2

The authors wish to thank the referee for the constructive comments and criticism.

Specific comments

Comment: Page 9, line 5: The authors estimate an uncertainty of determining the filter spot area to be 2%. Is that the actual uncertainty derived from the spot to spot variability or is it the precision of the measurement of a single spot area. Were time series corrected for systematic deviations of the spot size (cf. Eq. 2) as described in Bond et al. (1999) for the PSAP.

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Reply: The unit-to-unit variability is greater than what the spot size measurement uncertainty of 2%. The 2% is the uncertainty by which the spot size can be measured. We see no need to change the sentence as this should be clear as it stands. Both the PSAP and CLAP instruments were spot size corrected as described by Bond et al. (1999). The Aethalometers were not spot-size corrected because we do not have filter spots to measure on from all the instruments. We do not have filter spots from the MAAPs either.

Comment: Note: Page 7 line 26 ff.: The reviewer thinks that it needs to be better explained why data from CLAP are corrected using the "Bond" corrosion. One possibility could be as follows. PSAP and CLAP use the same type of filter and similar design. Nakayama et al. (2010) showed that similar instruments, COSMO and PSAP, with the same type of filter have a similar size-dependent scaling factor. A similar size dependent scaling factor is a hint that the overall correction could be similar. Are there other publications showing that CLAP and PSAP are similar in the literature?

Reply: The explanation is that both instruments use the same type of filters; namely the Pallflex type E70-2075W filter. This is the same argumentation why the COSMOS also uses the Bond et al. (1999) correction (Miyazaki et al., 2008). A sentence was added that both the PSAP and CLAP use the same type of filter. Moreover, an additional sentence was added stating that “It has been shown before that the same type of filter and a similar optical design yield very similar results (Miyazaki et al. 2008; Nakayama et al. 2010)”. There are only grey literature reports on the intercomparison between PSAP and CLAP instruments such as the one cited and ACTRIS reports (http://www.wmo-gaw-wcc-aerosol-physics.org/files/actris-intercomparison-workshop-integrating-nephelometer-and-absorption-photometer-02-03-2013.pdf). The most relevant report is already cited.

Comment: Page 7, line 16 ff: Why is it justified to use PSAP, MAAP, and CLAP as reference instruments? On page 14 line 13 the authors wrote "...the reference absorption measurements also rely on measurements using filter-based absorption measure-

ments it remains unclear to which extend this will affect the absolute value of Cref ...". The reviewer agrees that a full analysis of the error of Cref under this circumstances is not possible. Anyway, the question still is what are the advantages of PSAP, MAAP, and CLAP compared to Aethalometers and what are the reasons for using this instruments as reference. Otherwise, Cref would merely be a harmonisation factor for comparing results from instruments of different type.

Reply: The choice of PSAP, MAAP and CLAP as 'reference' instruments is pragmatic; no other instruments were available. The shortcomings of the 'reference' instruments are even more clearly stated in the revised manuscript. Moreover, the revised manuscripts make it even more clear that C_{ref} (changed to C_{f}) is a harmonisation factor for the comparison of Aethalometers with the co-located filter-based absorption photometers. We also clearly state that C_{f} should not be literally interpreted as a multiple scattering correction factor but merely a harmonising correction factor. This criticism is thoroughly discussed in the replies to the general comments by the other anonymous referee.

Comment: Chapter 4.2 The reviewer thinks that estimated uncertainties and detection limits for the reference instruments should be presented along with that values for the Aethalometers.

Reply: The absolute uncertainties of PSAP and MAAP are now stated in Section 4.2 and compared to values in Table 3 which comprise the absolute uncertainties of the different Aethalometers. Since we did not perform zero air measurements on the MAAP, PSAP and CLAP instruments the discussion is restricted to previously published values.

Comment: The reviewer is wondering how the noise reduction algorithm affects the final results, the value and uncertainty of Cref.

Reply: Three additional paragraphs were added to the beginning of section 4.2 discussing this topic in more detail. This was also picked up by the other referee.

Additional references

Miyazaki, Y., Kondo, Y., Sahu, L. K., Imaru, J., Fukushima, N. and Kano, M.: Performance of a newly designed continuous soot monitoring system (COSMOS), J. Environ. Monit., 10(10), 1195, doi:10.1039/b806957c, 2008.

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