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Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaluating biases in filter-based aerosol absorption measurements using photoacoustic spectroscopy" *by* Nicholas W. Davies et al.

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This is a very good paper that should be published in AMT following the authors' consideration of the specific comments below. The logic and methods used are sound, the appropriate literature is cited, the figures and tables are clear, the length and degree of detail are appropriate, and the results are original and worthy of publication.

p.1, line 24: It's more useful here to give typical values, not extremes

p.2, line 27: Good to cite the earlier work, but Lin et al did not measure transmittance continuously during sampling, only before and after sampling.

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p.3, line 28: recommended notation is “refractory BC” (rBC, Petzold et al., 2013)

p.5, line 3: Indeed, this is the first such study.

p.5, line 13: Recommend calling this the attenuation coefficient.

p.8, line 16: This is indeed a correct way to do the calculation, and actually was written this way in the AMTD version of the Müller et al (2014) paper (https://www.atmos-meas-tech-discuss.net/6/11093/2013/amtd-6-11093-2013.pdf). The equation 5 in Müller et al (2014) is correct, as long as one realizes that the summation is over all the particles that have been deposited on the filter, but the equation used by Davies et al. represents a practical way to do the summation.

p.8, line 23: Very confusing to use this nomenclature for the backscatter fraction, as just six lines above you use it to denote the scattering coefficient. Also, a newer version of equation 24, which is also more broadly applicable, is given by Moosmüller and Ogren (2017; Atmosphere 2017, 8, 133; doi:10.3390/atmos8080133)

p.9, line 30: Was the filtered air noise test done in-flight, on the aircraft in the hangar, or in the laboratory? If either of the latter two, are these results representative of the noise level in-flight?

p.10, line 4: This is unsubstantiated speculation. The difference could just as likely be differences between the TAP and CLAP. Since the authors have the ability to repeat the noise test with and without the digital filter, they can readily determine the effect of the digital filter on 30-s averages. Another factor suggesting a difference between the TAP and CLAP is that the present study found a pronounced difference (nearly factor of two) in the noise level of the three wavelengths, whereas Ogren et al (2017) reported that the results for the three wavelengths were very similar.

p.10, line 8: Is there a manufacturer/vendor to go along with this product number?

p.10, line 11: How does this area compare to the spot size recommended by the manufacturer? How do the less-defined spots in ambient samples affect the uncertainty of

the ambient TAP measurements?

p.10, line 30: Only four? Is there a path length correction to deal with a purge flow to prevent contamination of the PAS cell optical windows?

p.11, line 21: Are measurements on filtered air in the lab comparable to measurements on filtered air in-flight? Are there additional contributions to instrument noise from the aircraft environment, such as engine noise, vibration, turbulence, electrical interference, etc?

p.11, line 29: Wouldn't it be simpler, and more useful, to express this percentage uncertainty in terms of an absorption coefficient?

p.12, line 14: This seems like a large difference in time response. How much of the difference can be attributed to tubing lengths? Was the response difference a pure lag (i.e., corresponding to plug flow), or was there also a difference in rise/fall times that could be indicative of differences in response times due to mixing?

p.13, line 16: Not sure why you need a citation here, you could just look out the window and confirm that you were dealing with a near-source smoke plume.

p.14, line 4: Interpreting a regression slope as a bias requires that the regression intercepts are very close to zero. Please justify this implicit assumption.

p.14, lines 20-23: These comparisons provide very helpful guidance for users of M2014 in deciding which parameterisation to use for black particles. Please include the corresponding comparison of biases if you use the B1999 parameterisation for black particles in the M2014 scheme. Also, on p.6, you reported that the difference between the two flavors of V2010 (wavelength-dependent vs. independent) was minimal, but here it appears that there is a substantial difference between parameterisations for black particles. Please elaborate.

p.14, lines 27-31: How does the bias depend on filter transmittance? Is there any relationship between these 10% of points with larger biases and the filter transmittance?

Ditto for the 10% of measurements with low biases.

p.16, lines 11-12: This finding suggests that a possible contribution of BrC is not the source of the discrepancy with Lack's results, but rather that the source of the discrepancy is the correction scheme.

p.17, line 12: Please justify the claimed importance to climate of AAE. For example, what climate model, or radiative transfer model, uses AAE in the calculation of radiative forcing? I would argue that the parameter of more importance to climate is the wavelength-dependent SSA, and the results in Table 3 show that the difference between PAS and TAP+M2014 measurements of this parameter is negligible for all wavelengths and aerosol types studied. AAE is useful for inferring aerosol type, and relative contributions of BrC or dust to absorption, and it is here that the differences among the measurement approaches become important.

p.18, line 16: This should also apply to the code used to implement the various corrections, especially M2014. A brief mention of that code (i.e., what programming language) would be appropriate here. Given the conclusions of this paper, it seems likely that other users of the TAP would welcome publication of the source code for your implementation of the M2014 correction (perhaps as supplemental information?).

p.33: Interesting to see the outliers that are far below the regression line only appear in the red channel. Why don't they show up in the green channel?

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