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Review of manuscript amt-2021-131

Anonymous Referee #1

Referee comment on "Assessment of online water-soluble brown carbon measuring systems for aircraft sampling" by Linghan Zeng et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-131-RC1, 2021

GENERAL REMARKS

The manuscript presents are carefully conducted assessment of instruments for collecting and measuring water-soluble brown carbon (BrC) in atmospheric aerosol samples from airborne platforms. The investigated methods for sampling water-soluble BrC particles include two Particle-into-Liquid-Samplers (PILS) and one Mist Chamber (MC). All particle samplers transfer the collected BrC particles to a liquid waveguide capillary cell (LWCC) and grating spectrometer which measures the light absorption by the BrC- containing particles across the UV-VIS spectrum. The method assessment includes instrument deployments on different airborne platforms during different field experiments (NSF C-130 aircraft during WE-CAN 2018; NASA DC-8 and NOAA Twin Otter aircraft during FIREX-AQ 2019), where the instruments sampled fresh and moderately aged wildfire plumes. The assessment reports method-characteristic parameters like limit of detection and uncertainty.

The study is carefully designed and performed. The presentation of the results is well structured and clear. The manuscript fits well into the scope of the journal and can be accepted for publication, after few minor revisions have been implemented.

SPECIFIC COMMENTS

- The manuscript assesses the measurement of light absorption by water-soluble BrC. In the manuscript, the used nomenclature refers to brown carbon measurements in terms of light absorption coefficients which are reported in $Mm^{-1,}$ whereas black carbon is referred to in mass concentration units. For consistency, a clearer term for BrC light absorption may be used. I am aware that the text may become a little more cumbersome, but in the current version it is confusing to switch between BrC in units of

Mm^{-1} and BC in units of μg m^{-3}.

- In section 2.6, the authors point to the fact that the reported light absorption measured in the liquid phase is not identical to the light absorption which would be measured in the airborne state of the particles because of size-dependent effects related to Mie theory. A short paragraph would help to explain whether the wavelength-dependence of light absorption coefficients measured in the liquid phase deviate from the respective properties measured in the gas phase, since absorption Ångström exponents (AAE) are used in the manuscript.
- In the discussion of Fig. 5a (line 351 and following), a short section on the meaning of the red symbols would help. The use of these values is mentioned in the paragraph on the baseline correction (line 379) but mentioning their meaning earlier would increase the clarity of presentation.
- In line 428, the authors refer to the assumptions used for the decomposition of the hysteresis effect. One short sentence o the explanation of the meaning of the second assumption would clarify the presentation.

MINOR ISSUES

- In the Introduction, the integrating sphere method for separating BC from BrC is missing; see Wonaschütz et al., (2009). It would be worth considering to include this reference.
- The effect of coating on aerosol light absorption properties was studied in-depth for urban and continental sites by Liu and co-workers (2015). This reference should also be considered in the introduction.
- Line 172 ff: The description of the sampling sequence should also contain a brief description of MC2 and the connected IC analysis. Currently, the entire description is focusing on MC1 and the light absorption measurement.
- Line 176: Please correct "Absorbance" instead of "Aabsorbance".
- The statement on authors' contributions should be added.

REFERENCES

Liu, S., Aiken, A. C., Gorkowski, K., Dubey, M. K., Cappa, C. D., Williams, L. R., Herndon, S. C., Massoli, P., Fortner, E. C., Chhabra, P. S., Brooks, W. A., Onasch, T. B., Jayne, J. T., Worsnop, D. R., China, S., Sharma, N., Mazzoleni, C., Xu, L., Ng, N. L., Liu, D., Allan, J. D., Lee, J. D., Fleming, Z. L., Mohr, C., Zotter, P., Szidat, S., and Prevot, A. S. H.: Enhanced light absorption by mixed source black and brown carbon particles in UK winter, Nat. Commun., 6, doi: 10.1038/ncomms9435, 2015.

Wonaschütz, A., Hitzenberger, R., Bauer, H., Pouresmaeil, P., Klatzer, B., Caseiro, A., and Puxbaum, H.: Application of the Integrating Sphere Method to Separate the Contributions of Brown and Black Carbon in Atmospheric Aerosols, Environ. Sci. Technol, 43, 1141-1146, doi: 10.1021/es8008503, 2009.