Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-42

Anonymous Referee #1

Referee comment on "Correcting for filter-based aerosol light absorption biases at ARM's SGP site using Photoacoustic data and Machine Learning" by Joshin Kumar et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-42-RC1, 2022

The manuscript "Correcting for filter-based aerosol light absorption biases at ARM's SGP site using Photoacoustic data and Machine Learning" by J. Kumar et al. shows that a random forest tree machine learning algorithm can correct particle absorption coefficients measured with filter-based instruments. The analysis was performed for a specific measurement site, but the study itself can be used as a blueprint for testing ML algorithms for other stations with various aerosol types.

The manuscript addresses a relevant topic and falls within the scope of AMT. It is well written and the conclusions are sound. The reviewer recommends the manuscript for publication after considering the following minor comments.

Specific comments:

Page 1, line 18: The reviewer does not fully agree with the chosen explanation or wording why filter-based instruments have problems in predicting the particle absorption coefficient. The reviewer believes that the reason for the limitations is not that fixed analytical (*) forms were chosen, but rather that there are hidden influencing parameters. There is also no algorithm that takes into account all known influencing parameters, e.g. Nakayama et al. (2010) present a correction for particle penetration depth, the restricted two-stream method (Mueller et al., 2014) takes into account particle asymmetry but not particle size. It should not be concluded that solvers with fixed analytical functions are generally unable to predict particle absorption coefficients with high accuracy.

(*The reviewer means that iterative solvers for fixed parameterised functions are also included in the class of fixed analytic functions.)

Page 1, line 31: Does the RFR model use the particle size distribution as input? Cf. line 195, where it says that the total mass concentration is used as input. What does total mass concentration mean? Is the cumulative mass on a PSAP filter spot meant?

Line 59: Can PASS be considered a first principle method? A few lines later the authors describe the problem with liquid or multiphase particles, which is a fundamental problem of the method?

Line 98: Do the authors mean the absorption coefficients or the uncorrected absorption coefficients?

In Figures A3 and 1, the axis label and caption should indicate whether corrected or uncorrected absorption coefficients are shown.

General comments to chapter 2:

Because of the known artefact due to light scattering particles, it would be informative if the authors presented single scatter albedos.

Why was the Virkkula (2010) correction revised but not the Ogre (2010)-Bond (1999) correction?

Figure 5: It seems that there are fewer data points in Figure 5 than in Figures 3 and 4. Is the split of the data into training and test data sets the only reason?

Line 303: Does it have any influence that the laboratory dataset was taken with a TAP photometer and the data from the SPG site was taken with a PSAP photometer?

Appendix A4: check sentence: “Tune the parameters of the ML model if the performance to achieve desired level of accuracy.”

References:

Nakayama, T., et al. (2010). "Size-dependent correction factors for absorption measurements using filter-based photometers: PSAP and COSMOS." Journal of Aerosol Science **41**(4): 333-343.

Mueller, T., et al. (2014). "Constrained two-stream algorithm for calculating aerosol light absorption coefficient from the Particle Soot Absorption Photometer." Atmos. Meas. Tech. **7**: 4049-4070.