Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-139

Anonymous Referee #1

Referee comment on "Mass concentration estimates of long-range-transported Canadian biomass burning aerosols from a multi-wavelength Raman polarization lidar and a ceilometer in Finland" by Xiaoxia Shang et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-139-RC1, 2021

The manuscript presents a Canadian biomass burning event measured by a multiwavelength Raman lidar (PollyXT) and a Vaisala CL51 ceilometer in Finland. The aerosol backscatter coefficients are converted to smoke mass concentration following the methodologies in literature. Comparison with model from MERRA-2 are shown as well.
I suggest the publication of this manuscript after addressing all the points raised by reviewers.
Please see below some suggestions and comments:
Pp 6, l 163-165: comment on the uncertainty of the water vapor absorption profiles used for the correction in the ceilometer backscatter profiles
Pp 6, l 181: please add uncertainty for LR
Pp 6, l 192: please comment on the existence of the pollen. How do you know is pollen? Did you measure / estimate it? I guess it is typical to find pollen in June.
Pp 7, l 219-220: spatial resolution remains at 7.5m? Later you mention 11 bins sliding average for lidar and 7 bins for ceilometer. Please clarify.
Pp 7, l 195-199: please comment on the choices for AE. Why did you choose the ratios 500/870 and 380/500? Is it the later chosen for comparison with lidar's EAE (e.g. Muller et al., 2013; Nicolae et al., 2019). When you refer to fine particles do you refer to those smaller than 1 um?
Pp 8, l 227-231: EAE of 1.4 is suggested as a delimitation from fresh and aged smoke along with LR532 > LR355 (Nicolae et al., 2013). Higher values of EAE correspond to smaller effective radius (e.g., Muller et al., 2005). Please clarify how you consider the range of fine particles. If you consider fine particles those smaller than 1 um (as for photometer), then we measure fine mode particles with the lidar most of the time. On the other hand, one can consider 500 nm as the delimitation between fine-mode and coarse-mode (e.g., Muller et al. 2016). Mamouri and Ansmann refer to fine dust if the particle's radius is < 500 nm. Please comment on the value of EAE derived from lidar (1.4) and discuss the relationship with AE from photometer for 380/500 assuming the value is similar with that corresponding to 355/532. As seen in Fig. 3, AE for 5th of June is around 0.8-1.05. I would have expected closer values for EAE and AE.
Pp 8, l 241-243: PDR@532 > 5% are observed in literature for aged smoke. Please check the literature review by Adam et al. 2020 (see Supplement).
Pp 9, l 274-275. For 11 bins gliding average over lidar profiles you obtain 82.5 m effective resolution. For the ceilometer, you obtain 70 m resolution. I was expecting more smoothing over ceilometer as it is much noisier. Please comment your choices.

Pp 9, l 278. You mention a maximum value of 45 ug/m3. Please mention to which profile you refer to (355, 532, 910) and the time interval. Also, please add comments on morning and night values as you mention in abstract and summary. Please add the profile at 1064nm as this one compares better with 910nm (closer wavelengths).
Pp 10, l 300. From the text I understand that the fine dust comes from N America. Please comment and justify the presence of dust. I would rather think about Saharan dust as the event described by Osborne et al. (2019). I guess the Hysplit did not show backtrajectories towards N Africa in your case. I saw that MERRA-2 shows a dust component.
Pp 11, l 319: please add numerical values when discussing 'large discrepancies' or good agreements between mass concentrations estimated from 355, 532 and 910. A simple way is to compare the mean value in the layer from each profile. Then you can mention the minimum and maximum differences between profiles.
Pp 12, l 354: please comment quantitatively on 'good agreement'; see above. Also, comment on the agreement between ceilometer and the retrieval of mass concentration starting from 1064 backscatter profile (first, add this profile).
Pp 12, 355: as said, add few comments in the text about those 30 and 20 ug/m3 values in the morning and in night. Nothing is specified in the main text. Mention the time it was observed and the profiles (e.g., 355, 532, 910). When looking at Fig. 6, I can see values of mass concentration around 30 ug/m3 in 532 profile at 06:00 and 09:00. However, I can see also values at 30 ug/m3 at 21:00. I don't know where 20 ug/m3 is observed. Change units from um to ug.
Pp 12, 357-359: taking into account the uncertainties in the retrieval of the mass concentration, the improvement by 4% using dust contribution seems not very relevant.
Fig. 1 Please add uncertainties to profiles. Also, mention the method you use to compute it.
Fig 5. Please add uncertainties to profiles.
Fig. 6. Please add uncertainties to profiles.
Fig. 7 please add uncertainties to profiles.
Table 1. You can add values for BAE from Ancellet by converting CR to BAE. Also, you can add the case of pure BB. More values from literature are given by Adam et al. 2020, Supplement.

References:
Adam et al., 2020 : https://acp.copernicus.org/articles/20/13905/2020/
Mamouri and Ansmann, 2017 : https://amt.copernicus.org/articles/10/3403/2017/
Muller et al., 2005 :
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2004JD005756
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