Atmospheric Measurement Techniques Discussions

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Comment on amt-2021-307

Anonymous Referee #2

Referee comment on "Retrieval of UVB aerosol extinction profiles from the ground-based Langley Mobile Ozone Lidar (LMOL) system" by Liqiao Lei et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-307-RC2, 2021

Review of *"Retrieval of UVB aerosol extinction profiles from the ground-based Langley Mobile Ozone Lidar (LMOL) system" by Lei et al.,*

This paper describes an algorithm for the aerosol extinction retrieval out of the Langley Mobile Ozone Lidar (LMOL) as compared to 20 coincident flights with the NASA Langley High Altitude Lidar Observatory (HALO) 532 nm aerosol extinction product. This work also accomplishes the first known 292nm aerosol product inter-comparison between HALO and Tropospheric Ozone Lidar Network (TOLNet) ozone lidar.

In general, this paper would benefit from an additional proofreading.

Major Comments:

In general this is a very technically developed manuscript. Many of the equations are first principles and well known in the lidar community. In general, substitution of these for graphical elements (flow charts, or signal processing chains) would improve the readability. This also allows the author to highlight sections that are new to this original research.

My major questions

Is this approach actually novel? The authors describe this as working from between 0.5 and 3.5km – does this indicate it may only work properly or is biased for aloft/transported aerosol layers? Please re-emphasize the importance of this work.

Can this method be extended to cases outside of when there were HALO overpasses? Otherwise this does not have as much appeal to the general audiences. A missed opportunity is using the ceilometer to compare with – this is a 24/7 measurement that is made very widely over the country. Then use the HALO data to act as a reference for the quality of the results in this specialized case – and then improve confidence in the ceilometer derived method.

The author described Canadian wildfire smoke, but I cannot tell clearly from any of the images 1) where the smoke resides, 2) how improved the retrieval is in these areas of smoke, or 3) what effects the data set has made to improving the remote sensing of the optical properties of the aerosols.

Minor Comments:

L55 – remove ‘a lot’

L60 - Langley

L64 “In this paper, the impact of the aerosols was low enough that an aerosol correction to the O3 density was not necessary; otherwise, an interative process would have been necessary (Browell et al., 1985)” – Suggest rephrasing this statement. This sounds like it basically voids the need for this work. Although the ozone correction to the signals may not reduce accuracy, the authors state the uncertainty in ozone is 10-20% - that must impact the uncertainty of the aerosol correction.

L66 – New paragraph for LISTOS

L105 - rather than ‘raw’ data, what is being analyzed? Range corrected-Elastic Backscatter Profiles at 292?

L132 – LISTOS

2.4 The Ceilometer located nearby LMOL – consider moving this up to 2.2 since it was co-located with 2.1.

L160 – Lidar ratio is introduced here but is frequently used in the text up until this point

Section 3 could benefit from some sort of "flow chart" graphic. Or illustration of the changes in the corrected signals after certain steps.

Figure 1 caption - (a) August 28fternoon needs to be fixed. Are these derived vertically or for a column?

Table 1- 521nm?

L280 – "These results show that by using the selected S1 and AE in Table 1, LMOL has the capability to retrieve aerosol extinction in 292nm with reasonable accuracy.", What is the estimated uncertainty of this retrieved aerosol component?

Figure 6 – Are you able to convert the ceilometer to 292nm? Please label in the plot title. Is the PBL height detection "in-house" for the ceilometer or the Vaisala standard product?

Figure 7 - total uncertainty (blue) – should be black. Why is the analog Det Nois decreasing with altitude? Wouldn't you expect as the signal to be much higher compared to background noise values, that the uncertainty would increase? Is there a need to show both analog and photon counting here?

Figure 7 In some cases in Photon Counting it looks like the uncertainty in using 60sr is less than using the technique applied in this paper. Is that the case?

Conclusions – rather than say 'good', please use specifics from the retrieval results. . Consequently, further research is needed to characterize S1 AE at UVB wavelengths – what exactly is needed?