Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-40-RC2, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaluation of UV Aerosol Retrievals from an Ozone Lidar" *by* Shi Kuang et al.

Anonymous Referee #2

Received and published: 7 June 2020

1 General Remarks

The authors give a comprehensive description of their approach for retrieving aerosol backscatter profiles from the return signals of an atmospheric lidar operating in the UV near 290 nm. Their aerosol results in the UV are compared with HSRL lidar measurements of aerosol at 532 nm. Generally good agreement is found. Uncertainties of the retrieved aerosol properties in the UV are also estimated. They usually exceed 50% over a wide range of altitudes.

I agree with reviewer 1 that comparison to Aeronet optical depth data would be a good addition to the paper. I also agree with reviewer 1 that a few more cautionary remarks on the variation of extinction to backscatter ratio and aerosol wavelength dependences

between aerosol types should be added. However, in many cases the stated large uncertainties probably cover a good fraction of these changes between aerosol types.

Overall I think this is a solid paper, well suited to the scope of AMT. I recommend publication with only a few minor revisions.

2 Suggestions

line 33: "weighing" or "weighting"?

lines 35/36: I suggest to add the Browell et al. 1985 reference here as well. Ed Browell really pioneered operational airborne UV-lidar measurements of tropospheric ozone in the 1980s.

lines 32 to 42: Here, and in several other places of the paper (e.g. lines 256 to 262), I suggest to add more cautionary sentences on the general problem of aerosol interference on DIAL ozone measurements (Browell et al. 1985, but also Steinbrecht and Carswell, JGR, 1994). Especially the differential backscatter term can cause large problems for narrow aerosol layers (errors exceeding 10s of percents). Investigations of aerosol effects on ozone, of the order of a few percent, are very desirable, but substantial caution is required.

lines 48/49: there is ozone absorption at 532 nm, which is not necessarily negligible. Add statement.

lines 55 to 62: Maybe the authors should move this to the beginning of the paragraph, and even extend it? Important lidar facts are: Because of the strong wavelength dependence of molecular Rayleigh scattering (λ^{-4}), and the weaker wavelength dependence of aerosol scattering $\approx \lambda^{-1.5}$, aerosol is measured best by lidars at 532 and 1064 nm (NdYAG) or 694 nm (Ruby). Nevertheless, the authors' UV lidar also measures aerosol, and aerosol interference on the ozone measurement needs to be

looked at. Fortunately, because of the large increase of ozone extinction from 320 nm to 250 nm (2 orders of magnitude), aerosol interference at your wavelengths (around 290 nm) is a factor of 5 to 20 smaller than, e.g., for a stratospheric ozone DIAL (around 310 nm) for the same amount of aerosol.

line 154: "owning" -> "owing"?

line 186: Why is the extinction wavelength exponent (1.49) different from the backscatter wavelength exponent (1.34). Is that because the constant lidar ratio ($S = 55$) is only used for the UV lidar, whereas the HSRL actually measures extinction? The authors might want to clarify that. I also wonder how meaningful this entire extinction comparison then is, because the UV lidar really only measures backscatter, and extinction is largely assumed.

lines 225 to 236: In Fig. 2, the UV lidar measured backscatter above 6 km during daytime clearly is too high (lighter blue colors). The authors state that they are not looking at these altitudes. However, I am wondering if the systematic high bias above 5 km in Fig. 4, has something to with the daytime high bias above 6 km in Fig. 2? Have the authors considered that? A few additional sentences might be good.

Figure 3: Maybe a logarithmic plot (both axes) would be better here? A lot of the data points are close to the lower left corner (0,0).

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-40, 2020.