

#Referee3

Please refer to the attached file.

Chipade et al. developed a theoretical algorithm for lidar ratio estimation for covering all types of aerosol models and analyzed the effect of relative humidity (RH) on lidar ratio. This is a good work and recommended to be published in AMT after concerning some weaknesses.

Major comments:

1. I think the lidar ratio for polluted and continental and polluted maritime aerosols shown in Figure 5 is declined rather than increased. Could you please explain it in more detail? (L313-315)

Answer: The explanation in L313-L315 is with respect to purely the lidar ratio values. With respect to relative humidity as well the lidar ratio values are uniformly increasing for polluted continental and polluted maritime aerosols as compared to clean continental and clean maritime aerosols i.e. polluted vs the clean aerosol types. This is mainly due to the soot particles present in the polluted aerosols. This is clearly explained in the manuscript.

2. I'm confused about why the lidar ratios of aerosols indicate the opposite trends when RH is lower or larger than 80% if the water soluble particles dominate aerosols in both RH ranges. More specifically, why does the lidar ratio of water soluble particles increase after the RH reaches 80%? (L315-322)

Answer: As mentioned in L309-L311, increase in backscattering coefficient with relative humidity at 532 nm and 1064 nm will cause increase or decrease in lidar ratio with respect to relative humidity depending upon the rate at which the extinction and backscattering coefficients are increasing or decreasing. When the relative humidity increases from 0 to 80% there is significant decrease in imaginary part of refractive index leading to decrease in absorption. As a result, the rate at which extinction coefficient increases is either less than or equivalent to the rate at which backscattering coefficient increases. This results in the decrease in lidar ratio of aerosols when RH is increased from 0 to 80%. The increase in lidar ratio from 80% to 99% is primarily due to increase in size of water soluble particles. Corrections in the statement are incorporated now in the revised manuscript.

3. Please cite the reference when trying to use some results from other studies to explain the phenomenon. For instance, L349-351.

Answer: We thank you for this suggestion. These lines refer to Antarctic aerosol model. The references for the Antarctic aerosol model and size distribution of its components are cited in the results and also presented in the Table 3 and 5 of the paper. However, as per our knowledge, not much literature exists for this type and this manuscript would be first to report the lidar ratios of the Antarctic aerosols at 532 nm and 1064 nm. This is the reason, there is no reference cited for the lidar ratios of the Antarctic aerosols in L349.

Language suggestion:

- 1) There should be a comma before 'respectively', please change it throughout the whole paper;
- 2) Line 309/313/341: 'figure' should be 'Figure'.

Answer: This is incorporated in the revised manuscript.