#Referee2

General Comments:

This manuscript applies Mie scattering theory to estimate the lidar ratio for different CALIPSO aerosol models. From a technical perspective, this study lacks significant innovation. Additionally, the analysis of the impact of relative humidity on the lidar ratio, based on the estimation results, holds some scientific value. Therefore, it is recommended to reconsider the acceptance of this study after the following issues have been well solved.

Specific Comments:

1) Many studies have already computed the Lidar ratio based on Mie scattering theory and analyzed the influence of relative humidity on the lidar ratio, such as Zhao et al. (2017). However, there are relatively few studies that apply these computed results to the retrieval of CALIPSO data. The author should, upon calculating the Lidar ratio, conduct an in-depth analysis by combining CALIPSO observational data to investigate the impact of relative humidity or aerosol hygroscopic growth on the retrieval of CALIPSO data.

Answer: We thank you for your comment. We also agree with you that there are studies that have reported before the Mie theory for estimation of Lidar ratio. However, as per our knowledge, this study is one of the firsts that reports the theoretically estimated Lidar ratio for CALIPSO aerosol models. The Lidar ratios proposed in the study can be used in the retrieval of particulate extinction profiles using CALIPSO data. However, retrieving the extinction and backscatter profiles using the CALIPSO data is a three-step process, which is as follows (Young et al. 2009):

Step1: Feature Detection Algorithm to identify the features like aerosol and clouds using the CALIPSO Level 1 data

Step2: Classification of identified features as either aerosol or clouds and further sub-classification in to various aerosol types and cloud phases.

Step3: Hybrid Extinction Retrieval Algorithm (HERA) to retrieve extinction and backscatter profiles using CALIPSO data.

In our opinion, carrying out in-depth analysis by using CALIPSO data to investigate the impact of relative humidity or aerosol hygroscopic growth on the retrieval of CALIPSO data will involve all these three steps and outcome of each of these steps will bear the potential of a separate research paper. In addition, this work is beyond the scope of the present paper.

2) Mie scattering theory is only applicable to spherical particles. In the CALIPSO aerosol models, several are predominantly non-spherical, and it's evident that Mie scattering theory cannot be applied to them. Some of the results in section 4.1 of this manuscript also confirm this. The author should, considering the results from section 4.1, distinguish between CALIPSO aerosol models for which Mie scattering calculations are applicable and focus the subsequent analysis only on those aerosol models where Mie scattering is applicable. It would be inappropriate to simply summarize the comparison results for various CALIPSO aerosol models in section 4.1 as "good agreement."

Answer: We have provided the details about the applicability of the proposed approach for spherical particles in the revised manuscript. The CALIPSO aerosol models reported in the present study have been used in CALIPSO's operational algorithm (Omar et al. 2009, Young et

al. 2009). These aerosol models have been obtained by classifying the AERONET data using cluster analysis (Omar et al. 2005, Young et al. 2009). Mie theory results given by AERONET level 1 data have been used to classify the data into different aerosol models (Omar et al. 2005). Thus, in the present study Mie theory is used to derive the lidar ratio for all the CALIPSO aerosol models.

3) The calculation results regarding the impact of relative humidity on lidar ratio and backscattering coefficient offer many details for further exploration. For instance, lidar ratio appears to exhibit opposite trends with relative humidity variations at low and high relative humidity levels. Furthermore, if the vertical axis of Figures 3-6 could be presented in relative terms, it might allow for a better comparison of gradient differences between different curves.

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. This is explained clearly in the revised manuscript.

The figures are updated in the revised manuscript.

Reference:

Zhao, G., Zhao, C., Kuang, Y., Tao, J., Tan, W., Bian, Y., Li, J., and Li, C.: Impact of aerosol hygroscopic growth on retrieving aerosol extinction coefficient profiles from elastic-backscatter lidar signals, Atmos. Chem. Phys., 17, 12133-12143, 10.5194/acp-17-12133-2017, 2017.