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## Comment on amt-2021-96

Anonymous Referee #2

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Referee comment on "Comparison of scattering ratio profiles retrieved from ALADIN/Aeolus and CALIOP/CALIPSO observations and preliminary estimates of cloud fraction profiles" by Artem G. Feofilov et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-96-RC2>, 2021

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Reviewer's comments for the paper "**Comparing scattering ratio products retrieved from ALADIN/Aeolus and CALIOP/CALIPSO observations: sensitivity, comparability, and**

**temporal evolution"** by A. G. Feofilov et al., submitted to AMT.

### General comments

Scattering ratio products for ALADIN and CALIOP were compared for collocated data sets. There are several essential differences between the two lidars. CALIOP and ALADIN operate at 532/1064nm and 355nm, respectively. Since ALADIN is a high spectral resolution Doppler lidar and CALIOP is a backscatter lidar, estimation algorithm of scattering ratios and cloud detection schemes were also different between the two space-borne lidars. It is concluded that ALADIN has lower sensitivity to high clouds than the CALIOP and better agreement for the lower cloud detection was found: 61%, 34%, 26% at 0.75km, 2.25km and 8.75km. These findings are quite valuable to understand how to interpret both data sets and also valuable to construct longer time records than those obtained by lidar on a single satellite. There are lack of clarifications in the current form of manuscript.

Theoretical justification of using the simple SR conversion factor method between 355nm and 532nm in Equation (1) is not sufficient. When model outputs are used, there is no need to rely on the conversion factor and the SR for 355nm and 532nm/1064nm can be

estimated independently. The choice in Equation (1) seems to be essential to the theoretical derived value (0.77) for cloud detection agreement between CALIOP and ALADIN. That is, the treatment of model output as well as cloud detection algorithm affect the estimation of the value of 0.77. There are no descriptions about the output parameters for EAMv1 model used in this article. The actual signals in the CALIOP and ALADIN contain the aerosols as well as clouds and molecules. Aerosol signals at 355nm might be larger than those at 532nm and it is naturally expected that the discrimination between clouds and aerosols is more challenging at ALADIN compared with CALIOP. It is not clear how to incorporate the wavelength dependence of aerosols into the equation (1). It is not clear whether aerosols are contained in the EAMv1 model or not. There is no description about how multiple scattering effects for CALIOP and ALADIN are treated in the simulations in section 2. It seems to be possible to apply practically the same cloud detection algorithms used in the ALADIN L2A as well as CALIOP GOCCP products in the theoretical analyses in section 2. If one will do so, it would give a different cloud detection agreement of 0.77. The above-mentioned information are important to interpret the results in section 3 and conclusions.

There are also lack of clarifications in the treatment of CALIOP clouds for the comparisons. It seems there is no sub-grid scale treatment for 87km-ALADIN L2A products so that 0 or 1 cloud fraction for each 87km-grid. On the other hands, CALIOP product has finer resolution (333m or 1km). It is not clear how to treat cloud fraction for CALIOP after 67km averaging for the comparisons compared with ALADIN in sections 2 and 3. Brief description of Aeolus L2A cloud product is also instructive. The SR for CALIOP was originally estimated to create CALIOP GOCCP products where Equation (1) is not needed. It is not convincing why equation (1) is used to simulate SR at 532nm.

After reading the manuscript several times, any reasonable explanation was not found why the upper clouds are smaller for ALADIN compared with CALIOP, though CALIOP did not detect most of PSCs where ALADIN detected (in shown in the Figure 4a and f). The authors attributed the lower sensitivity of high clouds for ALADIN to smaller backscatter at 355nm without conducting further analysis. More discussion of the discrepancies in the cloud detections are requested. It is also noted that it is well established that CALIOP has a good capability to detect PSCs so that Figure 4a is strange.

There are several CALIOP based global cloud products, including NASA Langley's VFM products, GOCCP, DARDAR and KU cloud products and large differences were reported in Cesana et al., 2016 JGR among GOCCP, NASA standard and KU products, indicating the different cloud detection methods caused the differences. There are several ways to bridge gaps between CALIOP and AEOLUS. Some comments are needed in this regard.

The authors might consider above points. Major revisions are suggested.

## Specific comments

p.6 line 182-184, need clarification for the methods and typical values of noises for Aeolus and CALIOP in the target data sets.

p.25 Figure 6, zonal mean cloud frequency for CALIOP and ALADIN would be preferable prior to Figures 6a-d.