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# *Interactive comment on* "Validating TROPOMI aerosol layer height retrievals with CALIOP data" *by* Swadhin Nanda et al.

## Anonymous Referee #1

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The manuscript entitled by "Validating TROPOMI aerosol layer height retrievals with CALIOP data" shows the initial validation results of aerosol vertical structure information from TROPOMI sensor. The aerosol vertical information is important result for the trace gas retrieval and air quality information relating to the PM2.5 etc. For this reason, the validation of aerosol layer height retrieval result is essential to publish. However, several supplements are required before the publication.

Specific comments 1) In page 2, Lines 23: Although the aerosol layer information by the environment satellite mission is limited, several previous studies were investigated including sensitivity results and methodology. Therefore, please add the reference for the aerosol height retrieval algorithm relating to next generation of environmental satellites (such as GEMS, TEMPO etc.).

e.g.) Choi, Wonei, et al. "Effects of spatiotemporal O4 column densities and temperature-dependent O4 absorption cross-section on an aerosol effective height retrieval algorithm using the O4 air mass factor from the ozone monitoring instrument." Remote Sensing of Environment 229 (2019): 223-233. Kim, Mijin, et al. "Optimal Estimation-Based Algorithm to Retrieve Aerosol Optical Properties for GEMS Measurements over Asia." Remote Sensing 10.2 (2018): 162. Park, Sang Seo, et al. "Utilization of O 4 slant column density to derive aerosol layer height from a space-borne UV–visible hyperspectral sensor: sensitivity and case study." Atmospheric Chemistry and Physics 16.4 (2016): 1987-2006. Zoogman, P., et al. "Tropospheric emissions: Monitoring of pollution (TEMPO)." Journal of Quantitative Spectroscopy and Radiative Transfer 186 (2017): 17-39. Vasilkov, A., J. Joiner, and R. Spurr. "Note on rotational-Raman scattering in the O 2 A-and B-bands." Atmospheric Measurement Techniques 6.4 (2013): 981-990. Wagner, T., et al. "A sensitivity analysis of Ring effect to aerosol properties and comparison to satellite observations." Atmospheric Measurement Techniques 3.6 (2010): 1723-1751.

2) In page 4, Lines 34 : For the forward model simulation, the aerosol optical and physical properties based on the Henyey-Greenstein scattering phase function is insufficient. Also, the fixed single scattering albedo affects the estimation errors due to the variability of aerosol optical properties. The atmospheric layer is also too simple as we compared to the previous researches of aerosol height estimation studies. Author has to be explained the reason of simple assumption for aerosol optical and physical properties in the TROPOMI algorithm. Especially, retrieval error of aerosol height relating to the single scattering albedo and size information were reported in several previous studies.

3) In page 6, line 11: For the validation of ALH, author used both level 1 and 2 data of CALIPSO. If both data exists, which of the two data do you use first?

4) In page 7: The CALIOP data has potential error to classify cloud and aerosol. For the validation, additional consideration for cloud contamination in the aerosol products

of CALIOP is also important.

5) Figure 2: From the Fishman et al. (2012) in BAMS, the reference value of aerosol layer height error is 1 km. However, only 50% of the data satisfies the error within 1 km, and the standard deviation is always larger than 1 km as author wrote in the manuscript. Compared to the expected error (1 km), the error is relatively large. Given these results, do you think the accuracy of these results is sufficient?

6) Figure 7: Compared to the slope value, the Y-intercept is too large. Please discuss the reason of large positive bias of Y-intercept.

7) In Page 11: For the further study, the author discusses to update the LER product. However, updating aerosol properties are most important point in this study. Please add the author's opinion.

Simple Technical comment:

1) In page 9 (Line 17) : correct the typo-error (4thrd -> 4th)

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