

We thank the reviewer for his/her careful reading of the manuscript and offering many constructive feedbacks and helpful suggestions. We have incorporated most of the suggestions and believe the revised paper is substantially improved. In order for the reviewers and the editor to more readily identify our changes, we've submitted two versions of the revised paper, one with "track changes" and the other with same changes incorporated.

Because we made substantial revisions, we include below a list of main changes, after which we provide a detailed response to the reviewer's comments. The original comments by the reviewer are in black font, our replies in blue.

#### **Major changes in the revised manuscript:**

- We added an appendix to investigate the potential retrieval error in ALH due to several assumptions made in the retrieval algorithm, including the surface reflectance, smoke single scattering albedo, aerosol optical depth, and half width of the assumed quasi-Gaussian aerosol vertical profile.
- In the validation for EPIC-retrieved ALH, we now use two sets of CALIOP-based ALH (updated Figures 9 and 10): one with a background aerosol amount added for undetected CALIOP aerosol layers, the other one without. While there is a mean difference of 0.36 km between these two sets of CALIOP ALHs, we found EPIC ALH retrievals are in general consistent with the both sets with a RMSE of 0.57-0.58 km.
- The language of the manuscript has been substantially improved by incorporating reviewers' comments and authors' further proof reading.

#### **Anonymous Referee #1**

This paper demonstrates nicely that aerosol layer height information can be retrieved from EPIC/DSCOVER data. This is especially of interest since hourly information can be

retrieved – a unique contribution indeed. The paper should be published following minor revisions which are mostly due to suggested minor phrasing corrections.

We thank the reviewer's positive comments to the significance of this article.

Page 7, lines 20-23. These two sentences are awkward. The sentence "Besides, cloud mask thresholds" leaves the reader in a state of uncertainty. The phrase "might need.." is inconclusive. It is suggested to delete the sentence "Besides, cloud mask thresholds". Perhaps one can replace this sentence with "This is a topic of further investigation."

Following the reviewer's suggestion, we removed the sentence "Besides, cloud mask thresholds ... operational applications."

Page 10, lines 10-15. The sentence "To compensate for this bias,.. " is not clear. I am having difficulty in accepting the methodology used to account for undetected aerosol. How can one impose an exponentially-decaying background aerosol amount to an undetected aerosol layer if you don't know if the undetected aerosol is there or not? To assume that undetected aerosol is everywhere is problematic. The amount of undetected aerosol likely varies from place to place. Furthermore, the summertime Arctic aerosols do not correspond to conditions elsewhere. I think it would be best to estimate the bias in ALHCALIOP due to the undetected aerosol for a number of observations, state the uncertainty in the paper, and then calculate ALHCALIOP without adding undetected AOD amounts anywhere.

Thank you for this suggestion. Through a close inspection, we found that the background aerosol profile was not added in the CALIOP ALH shown in Figures 9 and 10a. So, in the revised manuscript, we keep those figures based on your suggestion. At the same time, in the validation analysis we also included the CALIOP ALH by adding undetected background aerosol. We found the mean difference between these two sets of CALIOP ALH was 0.36 km, and our EPIC ALH retrievals are consistent with both sets

of CALIOP ALH with a RMSE of 0.57-0.58 km (see the revised Figures 9 and 10 in the revised manuscript).

Page 11, lines 28-29. What are typical ALH uncertainties due to MODIS surface products uncertainties and GOME-2 LER uncertainties?

To answer this question, we added an error analysis and discussion (in the article Appendix) for ALH retrievals due to uncertainties in surface reflectance and other parameters. We found a surface reflectance error of 0.01 may lead to ALH retrieval errors from 0.1 km to 0.6 km for both water and vegetation surface types, depending on the aerosol loading and vertical allocation.

Technical corrections:

Page 1, line 3: change to “from the EPIC/DSCOVR”

Corrected.

Page 1, line 38: change to “temperature, influence the measured aerosol extinction profiles”

Corrected.

Page 3, line 4: change to “aerosol extinction profiles measured”

Corrected.

Page 3, line 20: change to “ALH utilizing the O<sub>2</sub>”

We changed to “ALH using the O<sub>2</sub>”.

Page 6, line 2: change to “where  $C(\lambda)$  is the EPIC”

Corrected.

Page 6, line 29: change to “from analyzing USGS (United States Geological Survey)”

Corrected.

Page 7, line 30: change to “constructed with the UNL-VRM model.”

We changed to “constructed using the UNL-VRM model.”

Page 8, line 1: change to “It also incorporates HITRAN spectroscopic gaseous absorption with up to 22 trace gases”

Corrected.

Page 8, line 27: change to “satellite instrument, separate over-land”

Corrected.

Page 10, line 6: change to “(2013), the CALIOP day time aerosol extinction threshold is 0.01 – 0.03 km<sup>-1</sup> for 80-km horizontal resolution and up to 0.07 km<sup>-1</sup> for 5-km horizontal resolution.”

We changed to “(2013), aerosol extinction threshold in a daytime CALIOP scan is 0.01 – 0.03 km<sup>-1</sup> for 80-km horizontal averaging resolution and increases to 0.07 km<sup>-1</sup> for 5-km horizontal averaging resolution.”

Page 10, line 19: change to “65% of the ALH retrievals are within an uncertainty envelope of”

Corrected.

Page 10, line 22: change to “The collocation method follows Ichoku et al. (2002), but was”

Corrected.

Page 10, line 33: change to “smoke by using the UV aerosol”

Corrected.

Page 11, line 9: change to “satellite, since both perform hyperspectral measurements from the UV to the NIR and both cover the O2 A and B bands”

We changed to “satellite, both of which obtain hyperspectral measurements from the UV to the NIR covering the O2 A and B bands”

Page 11, line 21: change to “dust ALH from the EPIC experiment (Xu”

We changed to “dust ALH from the EPIC experiments”

Page 11, line 28: change to “information. Surface reflectance values are specified using MODIS”

Corrected.

Page 12, line 5: change to “The three years of data recorded” Page 12, line 18: change to “group at the University of Iowa”

Corrected.

Page 12, line 20: change to “acknowledge the AERONET program”

Corrected.

Page 20, line 6: change to “includes all ten EPIC bands,”

Corrected.

Page 21, line 8: change to “resulting in less absorption by O<sub>2</sub> and “ Page 22, line 4: change to “and surface reflectance (A<sub>s</sub>) values”.

Corrected.