

We thank Dr. Feng Xu for his 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.

Dr. Feng Xu (Referee #2)

In this paper, Xu et al. extends their earlier work on aerosol layer height (ALH) and aerosol optical depth (AOD) retrieval from ocean to land - using EPIC observations. Comparison to CALIOP retrieval of ALH and AERONET product of AOD show an error

of 0.58 km in retrieved ALH and an error of 0.05 in retrieved AOD, respectively. This work was very well organized. I don't have questions on the general technical routines presented in this work as the previous publications by the authors along this line of research have laid down a solid basis for proceeding with this work.

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

My comments below are for the authors to somehow clarify their approach that readers can better digest the ideas behind it:

1. What is source of oxygen profile adopted in EPIC ALH and AOD retrievals ? Is there any impact from temperature on oxygen profile and then on ALH retrieval ?

The O₂ mixing ratio profile is obtained from the mid-latitude standard atmosphere (McClatchey et al., 1972), with surface pressure enlisted from MERRA-2 data. O₂ is well mixed in the atmosphere. O₂ absorption cross sections are calculated from the HITRAN spectroscopic line parameters in a very high spectral resolution (see Table 2). The high-spectral radiance data then convolved to EPIC bands. Although temperature and pressure have influence to the line position and line width of spectral O₂ absorption. Such influence tends to be negligible in the convolved spectral radiance. So, we don't think there is any impact from temperature on oxygen profile and ALH retrieval.

We have clarified this in section 3.3: ".... Here, we enlisted surface pressure information from the Modern-Era Retrospective analysis for Research and Applications Version 2 (MERRA-2) datasets (Gelaro et al., 2017). MERRA-2's 1-hourly surface pressure at 0.5° by 0.675° grids were interpolated to the location and scan time of each EPIC pixel. In addition, the atmospheric temperature-pressure profile also impacts the width and strength of O₂ absorption lines. However, such influence on the radiative transfer is negligible for EPIC's 1-to-2-nm-wide bands. In this study, our algorithm employs a

standard temperature-pressure profile representing the mid-latitude-summer atmosphere (McClatchey et al., 1972).”

2. The sensitivity of O2-A and B bands to the profiles of smoke aerosols are clear from Figure 3. I’m curious how much the sensitivity will change if aerosol absorption changes gradually from being strongly absorbing to being weakly absorbing?

We performed sensitivity and error analysis to answer this question in the Appendix. We found the DAOS ratios used for ALH retrieval are sensitive to SSA, especially for large AOD values (see Figure A1e). However, SSA only has marginal impact to the ALH retrieval error (see Figure A2).

3. I believe the authors have published it elsewhere, but it would be helpful to some readers if some comments from authors’ side can be made on the sensitivity of O2-A and B bands to the width of aerosol layer.

In our retrieval algorithm we fixed the profile half-width as 1 km, because EPIC measurements are not able to resolve both the ALH and half-width at the same time. In the added appendix, we also performed sensitivity and error analysis to answer this question. We found the DAOS ratios used for ALH retrieval are sensitive to the profile half-width, especially for elevated aerosols (see Figure A1c). From the error analysis, we found a change of 0.5 km in the half-width may cause up to 0.3 km error in the retrieved ALH (Figure A2).

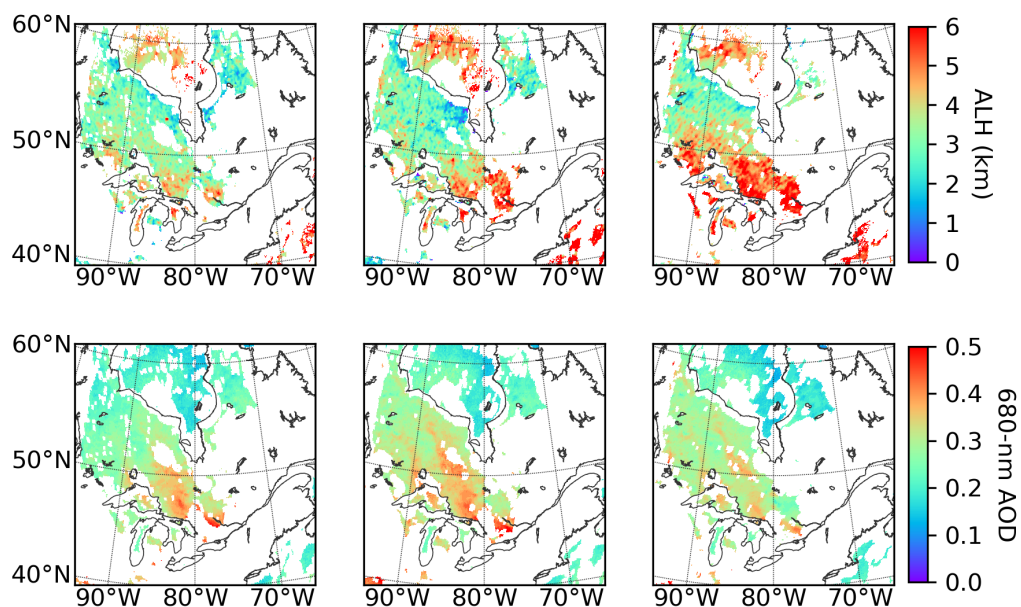
4. To give people a better idea about the “real” sensitivity that measurements have to AOD and ALH, it will be nicer if the authors can describe in the caption of Figure 3 EPIC’s measurement errors in the two O2 bands. Probably it would be clear if Z-score

(ratio of difference of signals in A/B band signals as normalized by measurement errors) is plotted as its axis.

We thank the reviewer for this suggestion. We added that uncertainty in EPIC DOAS ratios are within 3%. In addition, we added Jacobian of DOAS ratio to ALH, as well as the ALH retrieval error due to the EPIC measurements error, in the appendix. We hope those can give readers a better idea of about the real sensitivity.

5. Page 5, though there is a reason (geolocation) on the aggregation of pixels into a box of 3 x 3 pixels, do the authors think the price to pay (reduction of spatial resolution from 24 km to 8 km) too high. What if retrieval is directly implemented on 1 by 1 grid to retain EPIC's original 8 km resolution?

We indeed have tried the retrieval with native EPIC resolution, which is shown in the figure below for the same smoke case on August 25 in the article. The only reason we do 3x3 pixel aggregation is the EPIC geolocation. I understand EPIC version 3 data with better geolocation and calibration will be released soon. We have a plan to implement the native-resolution retrievals with the new EPIC data.



6. Page 8, the smoke particle properties are described for retrieving AOD and ALH. It might helpful if some comments can be given regarding if the pre-determined aerosol model have certain errors and its potential impact on ALH and AOD retrieval accuracy.

Sure. In the added appendix, we included the analysis and discussion about the sensitivity of our retrieval algorithm and the impacts for ALH retrievals from uncertainties in AOD and in the assumed aerosol model (such as SSA and the Gaussian profile width).

Some suggested editorial changes:

1. The reference for Lewis [1994] is not complete. Second author's last name is missing. Correct the citation of this reference in line 24 of Page 6 as well.

The reference is corrected as:

Lewis, P., and Barnsley, M. J.: Influence of the sky radiance distribution on various formulations of the earth surface albedo, in: Proc. Conf. Phys. Meas. Sign. Remote Sens, Val d'Isere, France, 707-715, 1994.

And the citation for this reference is changed to "Lewis and Barnsley (1994)"

2. Delete the redundant set of words "over land" in line 26 of Page 8.

Corrected.

3. Line 27 of Page 8: should "separated" be "separate"?

Corrected.