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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Detecting layer height of smoke aerosols over vegetated land and water surfaces via oxygen absorption bands: Hourly results from EPIC/DSCOVR satellite in deep space" *by* Xiaoguang Xu et al.

Anonymous Referee #3

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General Comments:

This work builds upon the authors' prior work on retrieving aerosol layer height (ALH) over ocean by extending the algorithm to work over land surfaces. One of the most important differences between the ocean and land studies is the characterization of surface reflectance, which is much more variable and complex than that over ocean. Further, their algorithm has a new smoke aerosol model for retrieving biomass-burning smoke ALH. The ALH retrievals are critical for obtaining accurate aerosol products in the UV. They also employ new data aggregation and spectral fitting strategies. Overall,

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the work is sound and relevant, and should be published.

Specific Comments:

Since the work focuses on land surfaces, what are the effects of non-Lambertian surface reflection (BRDF) on the retrievals?

Is there a difference in ALH retrieval sensitivity as a function of single scattering albedo?

What are the uncertainties in ALH retrievals due to uncertainties in the surface albedo and pressure climatologies used in the algorithm?

There are a lot of grammatical and typographical errors (way more than acceptable for a manuscript published in this journal) in the manuscript, which I have tried to capture in the technical comments section. These must be corrected before the manuscript can be published.

Technical Comments:

Line 18, page 1: in visible -> in the visible

Line 19, page 1: flexible spectral fittings that account for -> flexible spectral fitting that accounts for

Line 21, page 1: to derive the ALH that represents an optical centroid altitude -> to derive ALH, which represents an optical centroid altitude

Line 22, page 1: the measurements -> measurements

Line 23, page 1: United State -> the United States

Lines 23-24, page 1: the algorithm can well capture -> that the algorithm can be used to obtain

Lines 24-25, page 1: Validations are performed against aerosol extinction profile -> Validation is performed against aerosol extinction profiles

Line 26, page 1: and AOD -> , and against AOD

Line 26, page 1: in average -> on average

Line 29, page 1: the EPIC's -> EPIC's

Line 32, page 1: earth's -> Earth's

Line 34, page 1: arrange the authors alphabetically

Lines 37-38, page 1: The thermal signature of dust in particular can likewise influence the earth longwave budget and through the interference of retrievals of water vapor and temperature, thus influencing measure atmospheric state -> The thermal signature of dust, in particular, can likewise influence the Earth's longwave budget, and through interference with retrievals of water vapor and temperature, influence measurement of the atmospheric state

Line 39, page 1-line 3, page 2: Additionally, the knowledge of ALH is essential in retrieving aerosol absorption properties . . ., in retrieving aerosol microphysical properties . . ., and in the atmospheric correction for ocean color remote sensing -> Additionally, knowledge of ALH is essential for retrieving aerosol absorption properties . . ., aerosol microphysical properties . . ., and for atmospheric correction for ocean color remote sensing

Line 5, page 2: arrange the authors alphabetically; leave a space between the two citations

Line 18, page 2: from UV to near-infrared-> from the UV to the near-infrared

Line 19, page 2: Figure 1b-c -> Figures 1b-c

Line 20, page 2: the spectral -> spectral

Line 22, page 2: present -> presented

Line 23, page 2: the EPIC -> EPIC

Line 24, page 2: demonstrate -> demonstrated

Line 26, page 2: in determining -> for determining

Line 28, page 2: robust strategies in the -> rob ust strategies for the

Line 33, page 2: to retrieving -> for retrieving

Line 33, page 2-line 1, page 3: implicating our algorithm development limited to water and vegetated land surface -> limiting our algorithm development to water and vegetated land surfaces

Line 1, page 3: the assumptions -> assumptions

Lines 2-3, page 3: The ALH retrievals are demonstrated in Section 4, that were applied to smoke events over Canada and the United States in August 2017. -> ALH retrievals of smoke events over Canada and the United States in August 2017 are demonstrated in Section 4.

Line 3, page 3: ALH and AOD from EPIC with -> ALH and AOD from EPIC against

Line 5, page 3: remove “In conclusion,”

Line 11, page 3: Figure 1b-c -> Figures 1b-c

Line 13, page 3: the scattering of presented aerosol particles interact with -> scattered light from aerosol particles interacts with

Line 16, page 3: estimate -> estimated

Line 18, page 3: ‘ among those are -> ; among those are

Line 20, page 3: with O2 absorption -> using the O2

Line 22, page 3: thus reduce the chance of a photon -> thus reducing the chance of that photon

Line 23, page 3: TOA -> Top Of the Atmosphere (TOA)

Line 28, page 3: leave a space between citations

Lines 29-30, page 3: a state-of-the-art -> the state-of-the-art

Line 31, page 3: formulated by -> for

Line 33, page 3: at the geometry of -> for the geometry

Line 5, page 4: contribution from surface -> contribution from the surface

Line 7, page 4: findings -> the findings; the O2 A and B band -> O2 A and B band

Line 8, page 4: leave a space between citations

Line 11, page 4: the retrieval accuracy -> a retrieval accuracy

Line 13, page 4: earth -> Earth

Line 18, page 4: earth -> Earth

Line 20, page 4: remove the comma

Line 31, page 4: at six EPIC -> in six EPIC

Line 4, page 5: at EPIC bands -> in EPIC bands

Line 5, page 5: EPIC original pixels -> original EPIC pixels

Line 9, page 5: of available pixels -> for the available pixels

Line 11, page 5: specific surface type -> the specific surface type

Lines 12-13, page 5: While the retrieval procedure is based up on our algorithm . . . from the EPIC (Xu et al., 2017), it was upgraded in a few aspects -> While the retrieval procedure is based on our algorithm . . . from EPIC measurements (Xu et al., 2017), it was upgraded in several ways.

Line 13, page 5: algorithm extends -> algorithm is extended

Line 14, page 5: O2 -> O2

Line 24, page 5: Obtain -> Obtaining

Lines 29-30, page 5: The two O2 absorption channels (688 nm and 764 nm) were calibrated by lunar surface reflectivity with EPIC lunar observations at the time of full moon as seen from the earth -> The two O2 absorption channels (688 nm and 764 nm) were calibrated using lunar surface reflectivity from EPIC lunar observations at the time of full moon as seen from Earth

Line 32, page 5: by calibration factors derived by above studies -> using calibration factors from previous studies

Line 34, page 5: top-of-the-atmosphere (TOA) -> TOA

Line 2, page 6: where ðİŘű(ðİIJĘ) is EPIC measured signal in the units of -> where ðİŘű(ðİIJĘ) is the EPIC measured signal in units of

Line 6, page 6: Determine -> Determining

Line 8, page 6: leave a space between the citations

Line 12, page 6: leave a space between the citations

Line 16, page 6: in MODIS's first seven channels -> in the first seven MODIS channels; leave a space between the citations

Line 24, page 6: leave a space between the citations

Lines 25-26, page 6: Lambertian surface albedo at MODIS bands of 469, 555, 645, and 858 nm -> Lambertian surface albedo in the 469, 555, 645, and 858 nm MODIS bands

Line 28, page 6: EPIC-bands -> EPIC bands; in the forms -> in the form

Line 31, page 6: spectral locations -> the spectral locations

Line 32, page 6: at each EPIC band -> in each EPIC band; Figure 6c-h -> Figures 6c-h

Line 12, page 7: Mask -> Masking

Line 15, page 7: the land and water -> land and water

Lines 21-22, page 7: higher-resolution geostationary sensors' cloud mask information -> higher resolution cloud mask information from geostationary sensors

Lines 22-23, page 7: if applied operationally -> for operational applications

Line 26, page 7: with MODIS land surface -> using MODIS land surface

Line 30, page 7: constructed with -> constructed using the

Line 3, page 8: of the current retrieval -> for the current retrieval

Line 4, page 8: circumstances -> scenarios

Line 5, page 8: simulated by -> simulated using

Line 6, page 8: at the selected 6 bands -> for the selected six bands

Line 9, page 8: leave a space between the citations

Line 10, page 8: by following -> following

Line 15, page 8: leave a space between the citations

Lines 17-18, page 8: total AOD at the wavelength of 680 nm -> the total AOD at 680 nm

Line 19, page 8: fittings -> fitting

Line 20, page 8: both the water -> both water

Line 21, page 8: fittings -> fitting; account for specifics of surface reflectivity -> accounts for the specifics of surface reflectivity

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Lines 21-22, page 8: First, TOA reflectance in EPIC's "atmospheric window" channels are matched with LUTs to determine AOD, because at these channels the TOA reflectance is independent of ALH. -> First, the TOA reflectance in the EPIC "atmospheric window" channels are matched with LUTs to determine AOD, since the TOA reflectance does not depend on ALH in these channels.

Line 26, page 8: because over land the satellite signal tends to be dominated by surface contributions over land -> since the satellite signal tends to be dominated by surface contributions over land

Line 27, page 8: separated -> separate

Line 28, page 8: in characterizing -> for characterizing

Line 30, page 8: the surface type -> surface type

Line 33, page 8: In contrast, the band of 780 nm is excluded for the spectral fitting -> In contrast, the 780 nm band is excluded for spectral fitting

Lines 1-2, page 9: weights to ratios in the O2 A and B bands are given differently for different surfaces -> different weights are given for the ratios in the O2 A and B bands for different surfaces

Line 5, page 9: Demonstration -> demonstration

Line 9, page 9: shown in EPIC RGB images -> shown in the EPIC RGB images

Line 10, page 9: plumes emitted from wildfires in western Canada and, crossing -> plumes emitted from wildfires in western Canada and crossing

Lines 11-12, page 9: The retrieved smoke ALH are shown in Figure 7b and 8b; and retrieved 680-nm AOD in Figure 7c and 8c. -> The retrieved smoke ALH is shown in Figure 7b and 8b, and retrieved 680-nm AOD in Figure 7c and 8c.

Line 13, page 9: and ALH retrievals -> ALH retrievals

Line 18, page 9: towards southeast -> southeast

Line 23, page 9: validations -> validation

Line 25, page 9: observation -> observations

Line 29, page 9: in 532 nm -> at 532 nm

Line 31, page 9: defined in our EPIC algorithm -> as defined in our EPIC algorithm

Line 1, page 10: with the layers where aerosols are detected -> for the layers where aerosols are detected

Line 4, page 10: backscattering ratio that depends -> backscattering ratio, which depends

Line 6, page 10: daytime CALIOP scan -> a daytime CALIOP scan

Line 7, page 10: reaches up to -> increases to

Line 9, page 10: predominately -> predominantly

Lines 10-11, page 10: To compensate for this bias, we use a exponentially-decayed background aerosol extinction profile for substitute of aerosol extinction coefficients of these undetected aerosol layers within troposphere. -> To compensate for this bias, we use an exponentially-decaying background aerosol extinction profile to provide a proxy for aerosol extinction coefficients of these undetected aerosol layers within the troposphere.

Line 13, page 10: summertime atmosphere of the Arctic -> summertime Arctic atmosphere

Line 15, page 10: bias of ALHCALIOP -> bias in ALHCALIOP

Lines 16-17, page 10: Quantitatively, 67

Lines 18-20, page 10: Considering all EPIC- CALIOP ALH pairs, 65

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Line 21, page 10: observations of 675 nm AOD -> 675 nm AOD observations

Line 22, page 10: (Ichoku et al., 2002) -> Ichoku et al. (2002)

Lines 22-24, page 10: “but was modified to associate a subset of satellite retrievals within a 3 X 3 AOD subset centered at each site to a subset of 1-hour AERONET observations around EPIC scan time.” It is not clear what the authors mean by 3 X 3 AOD subset. The sentence needs to be revised for clarity.

Line 24, page 10: EPIC scan time -> the EPIC scan time

Lines 24-25, page 10: Comparison of EPIC AOD and AERONET are shown in Figure 10b. -> A comparison of EPIC and AERONET AODs is shown in Figure 10b.

Lines 25-26, page 10: The collocated AOD pairs, though with limited data samplings, have over 77

Line 26, page 10: EPIC AOD -> The EPIC AOD

Line 34, page 10: UV aerosol index -> the UV aerosol index

Line 1, page 11: because -> since

Line 9, page 11: both perform -> both of which obtain

Line 10, page 11: leave a space between the citations; Is it Omar et al or Torres et al?

Line 14, page 11: which are in contrast to clouds which-> which are in contrast to clouds that

Line 15, page 11: Because -> Since

Line 16, page 11: correlation -> the correlation

Lines 17-18, page 11: may results in a value UVAI from less than 1 to about 4 -> may result in UVAI values ranging from less than 1 to about 4

Line 19, page 11: EPIC’s O2 bands -> the EPIC O2 bands

Lines 21-22, page 11: Based on our previous efforts in retrieving over-water dust ALH from the EPIC (Xu et al., 2017), we extend the retrieval algorithm to biomass burning smoke aerosols over both the water and vegetated land surfaces. -> We extend our retrieval algorithm for retrieving over-water dust ALH from EPIC (Xu et al., 2017) to biomass burning smoke aerosols over both water and vegetated land surfaces.

Line 23, page 11: flexible spectral fittings that account for specifics of-> flexible spectral fitting that accounts for the specifics of

Line 25, page 11: then uses -> and then uses

Line 28, page 11: And, surface reflectance -> Surface reflectance

Lines 31-32, page 11: We found the algorithm captures AOD and ALH multiple times daily over both the water and vegetated land surfaces. -> The algorithm is able to retrieve AOD and ALH multiple times daily over both water and vegetated land surfaces.

Lines 33-34, page 11: , showing EPIC retrieved ALH has a rmse of 0.58 km and captures 52

Line 1, page 12: mrse -> rmse

Lines 1-2, page 12: and over 77

Line 2, page 12: What does an error envelope of +/- (0.05 + 10

Line 4, page 12: the EPIC's UV bands -> the EPIC UV bands

Line 9, page 12: dust or smoke -> (dust or smoke)

Line 15, page 12: NASA the DSCOVR Earth Science Algorithms Program -> the NASA DSCOVR Earth Science Algorithms Program

Line 16, page 12: Office of Naval Research (ONR's) -> the Office of Naval Research (ONR)

Line 17, page 12: under the award -> under award

Line 20, page 12: NASA's -> the NASA; AERONET program -> the AERONET program

Line 21: the AOD data -> AOD data

Table 2 caption: in constructing the LUTs -> for constructing the LUTs

Figure 1 caption: Change to: EPIC instrument filter response function (blue) and atmospheric spectral transmission 5 (orange). Panel (a) includes all ten EPIC bands, whereas panels (b) and (c) show zoom-ins for the 688-nm channel in the O2 B-band and the 764-nm channel in the O2 A-band, respectively. Here, the atmospheric transmission is simulated by the UNL-VRTM model, with a spectral step size and a spectral full width at half maximum of 0.02 nm.

Line 5, page 21: physical principal for -> physical principle of

Line 6, page 21: scattering of aerosol -> scattering by aerosol

Line 7, page 21: path way -> pathlength

Line 8, page 21: than in the lower-altitude aerosol -> than those scattered by the lower-altitude aerosol; less chance -> lower chance

Line 5, page 22: at the geometry of -> for the geometry

Figure 4 legend: Change "Green vegetations" to "Green vegetation surfaces"

Figure 5: What does 3X3 aggregation mean? Do you aggregate 9 pixels at a time? Why? Some explanation is needed in the text and better wording in the Figure.

Line 5, page 25: the statistics -> statistics

Line 6, page 25: red dot line -> red dotted lines; their respective -> the respective

Lines 7-8, page 25: reflectance at each EPIC band versus reflectance at corresponding MODIS bands -> reflectance in each EPIC band versus reflectance in the corresponding MODIS bands

Line 4, page 26: UTC time -> UTC times

Line 6, page 26: CALIOP sub-orbital track with an overpass time 19:05 UTC -> the CALIOP sub-orbital track with an overpass time of 19:05 UTC

Line 8, page 26: EPIC scan time -> the EPIC scan time

Line 5, page 27: UTC time -> UTC times

Line 6, page 27: CALIOP overpass time was at 18:15. -> The CALIOP overpass was at 18:15 UTC.

Line 4, page 28: Comparison of ALH retrieved from EPIC and the ALH derived from CALIOP level-2 aerosol extinction profile -> Comparison of ALH retrieved from EPIC and CALIOP level-2 aerosol extinction profile

Line 5-6, page 28: CALIOP orbital tracks are marked on EPIC RGB images in Figure 7–8. -> The CALIOP orbital tracks are marked on EPIC RGB images in Figures 7–8.

Line 7-8, page 28: Error bar of EPIC ALH represents standard deviation for an array of 3x3 24-km retrieval pixels, while the error bar of CALIOP ALH represents standard deviation of over 5 adjacent CALIOP 5-km footprints. -> The error bar for EPIC ALH represents the standard deviation for an array of 3x3 24-km retrieval pixels, while that for CALIOP ALH represents the standard deviation of over 5 adjacent CALIOP 5-km footprints.

Line 4, page 29: counterparts from -> corresponding

Line 5, page 29: Color of -> The color of

Line 6, page 29: scatter -> scatter point; EPIC 680-nm AOD value of -> the EPIC 680-nm value for

Line 7, page 29: Dotted lines -> The dotted lines

Line 8, page 29: one-by-one -> the one-to-one

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Line 9, page 29: regression fitting -> regression fit; scatters -> scatter points; the linear -> linear

Line 10, page 29: scatters -> scatter points

Line 4, page 30: UVAI were -> UVAI was

Line 4, page 31: linear regression fitting -> the linear regression fit

Line 5, page 31: scatters -> scatter points

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