Referee #2

We would like to thank Reviewer 1 for his/her helpful comments which improved the quality of the manuscript. Our responses to the reviewer are listed below, the reviewer comments in italic and our response in regular font.

Review of "OMPS LP Version 2.0 Multi-wavelength Aerosol Extinction Coefficient Retrieval Algorithm "by Taha et al. General Comments This paper describes the version 2 OMPS LP multiwavelength aerosol retrievals. OMPS results are compared to SAGE III, OSIRIS, and CALIPSO, for a variety of altitudes, latitudes, and measurement wavelengths. Sections 1 and 2 are very well written and enjoyable to read. Insections3-5, however, the writing is of lower quality, with many grammatical errors and poorly formed sentences. The poor writing quality is evident when scanning in Reviewer #1's comments, which also point out many errors. Overall I find the work to be of sufficient quality to warrant publication after some minor revisions as described below. The paper will no doubt be useful to users of the OMPS observations.

Specific Comments

1)line 17: Define the acronym PyroCb

We added "pyrocumulonimbus (PyroCb)"

2)line 31: "ballon-borne"

Done.

3)line 81: Add "and good vertical resolution"

Done

4)line 129: Do you mean solar scattering angle (SSA)?

We mean single scattering angle (SSA). We've modified the text accordingly.

5)line 145: Here and elsewhere, insert a comma before and after the variable name (e.g. h)

Done.

6)line 149: Define the acronyms GSLS RTM

We replaced 'GSLS RTM' it with 'Gauss- Seidel Limb Scattering (GSLS) radiative transfer model (RTM)'

7) line 155: The parenthetical reference should come after the subject

Done

8)line 157: Refractive index can vary with the sulfate composition (wt. % H2SO4), please comment.

We added "(75% H_2SO_4)"

9)line 167: :should be a period, and the parentheses should be deleted.

Done.

10)line 208: "line-of-sight"

Done.

11)line 211: Please quantify "very small"

The difference is generally 1 to 2%. We have now added the following text "Recent calculations performed for a RTM comparison project (Zawada et al., 2020) allow the $\rho_c(\lambda,h)$ values computed by the scalar and vector versions of GSLS to be compared, for a variety of atmospheres and illumination conditions. For the relevant wavelengths (500 nm and greater), these values agree to within 1% or better at 20 km, and within 2% or better at 10 km."

12)Figure 1: The caption does not describe what is in panels a) and b). Please locate "a) "and "b)"before the descriptive text. Also, consider combining Figures 1 & 2 since the point is to see how things change with scattering angle.

We have now fixed the figure's caption.

13) line 216: Please clarify what you term as a cloud, perhaps"...the cloud layer evident as enhanced extinction near 10.5 km..."

We changed the sentence as suggested.

14)line 225 "of" measurements, also, this is a really long sentence...

Done. We also broke the sentence into two.

15)line 229: ...on the Meteor...

Done.

16)line 235: O4 ?

We added the following "oxygen dimer (O_4)"

17)line 238: OSIRIS was already defined above

We have now removed OSIRIS definition.

18)line 261:The lidar ratio can depend on the aerosol size and refractive index (composition), please comment on this.

We rewrote the sentence to “A constant lidar ratio (extinction to backscatter ratio) of 50 sr was used to obtain the extinction profiles, which is a typical value used for stratospheric aerosol background conditions (Kremser et al., 2016).”

19)line 263: Please describe the cloud filtering approach in more detail, or add a reference on the method.

We added the reference (Kar et al., 2019).

20)line 269: This sentence need to be restructured for clarification, also please state the differences (%) with SAGE III/ISS

We have revised the sentence and it reads as “However, the difference with SAGE III/ISS at the middle to high latitudes and low altitudes was substantially large, often exceeding 100%.”

21)line 281 “1 km vertical intervals”

Done.

22)line 290: SAGE II is filtered for what? cirrus? PyroCb’s ?

We have modified the sentence and it reads as “SAGE III is filtered for cloud contamination by using only data with extinction ratio at 510 nm / 1022 nm greater than 2 (Thomason and Vernier, 2013)”

23)line 294 “model” should be “distribution”, also, “ASD” was defined above
Done.

24)line 300: No need to redefine SSA

We deleted the SSA definition.

25)lines 302-303: It is not clear how the results in Fig. 3 demonstrates that the algorithm is insensitive to errors in the assumed ASD. You need to justify this statement with additional detail.

We never made the claim that the algorithm is insensitive to the errors of the assumed aerosol model. The main assumption here is that, if the retrieved aerosol values are different when the instrument is measuring the same air mass but with different scattering angle, then there is an error in the assumed phase function and ASD model. As shown by Rieger et al. (2019), the ASD errors can introduce seasonal variations that correlates well with the SSA. Figure 3 shows little dependency on the SSA at 20 km, and somehow larger dependency at 16 and 25 km. Those results are similar or better than the 0.5% per degree reported by Rieger et al. (2019).
We have modified the text to include the following sentences “The main assumption is that, if the retrieved aerosol values are different when the instrument is measuring the same air mass but with different scattering angle, then there is an error in the assumed phase function and ASD model. As shown by Rieger et al. (2019), the ASD errors can introduce seasonal variations that correlates well with the SSA.” And “Similar analyses made by Rieger et al. (2019) has shown that the OSIRS V7.0 aerosol extinction SSA dependence is 0.5% per degree.”

26)line 310: By reflecting surface, do you mean Earth surface?

Not necessary, it can also be clouds or aerosols. We have now added the following sentence “It doesn’t mean the Earth’s surface reflectivity, since the scene can contain clouds or aerosols.”

27)lines 319-320: this sentence should be clarified.

We have revised the sentence and it now reads “Outside the tropics, *R* mean value is generally greater than 0.3, with strong seasonal dependence that peaks in the winter. Therefore, any observed differences outside the tropics are uncorrelated with cloud presence.”

28)line 321: Remove the parentheses from this sentence.

Done.

29)Figure 4: put the letters (e.g., “(a)”) before the description.

Done.

30)line 337and elsewhere): The preferred syntax would be “869 nm wavelength”

We deleted “wavelength” as suggested by the reviewer 1.

31)line 336: This paragraph is a bit clumsy overall.

We have revised the paragraph and it now reads as
“Figure 6 is a summary plot of the mean difference between OMPS and SAGE III coincidences for wavelengths 510, 600, 675, 745, 869, and 997 nm. In general, 869 nm

is the best OMPS retrieved wavelength relative to SAGE III with differences of 5% or less for most altitudes and latitudes. Other wavelengths agree with SAGE III to within 10%. Exceptions to this occur at high altitudes (above ~28 km) where the aerosol loading is minimal, and near the tropopause, which is affected by cloud contamination. The 510 and 600 nm OMPS extinction values have a slightly larger bias of 20% in the tropics. This is due to the ozone interference in both OMPS and SAGE III 600 nm aerosol retrievals. The 997 nm OMPS extinction values have systematic bias of -10% between 60^{o}S and 20^{o}N, caused by stray light contamination in the OMPS measurements. Unlike the other wavelengths, the 997 nm laboratory characterization is poor, and its stray light correction therefore has lower quality (Jaross et al., 2014). In the SH, 510 nm shows large positive bias relative to SAGE III below 18 km. This is an artifact in OMPS retrieval algorithm, which often results in noisy and large extinction values when the measurement vector is too small, (see Figure 12)."

32)line 351: There is no need to list the wavelengths at the end of this sentence.

Done.

33)line 352:To be precise, the comparisons do not show this. You deduce this, based on your knowledge of OMPS, and the comparison differences.

We deleted "The comparison shows that".

34)Figure 8: Please correct the label on the color bar, which should say 1 -the standard deviation of the difference (or 1 -sigma).

Done.

35)line 369: This is one xample of a poorly formed sentence, which seem to be common in this section. "Based on SAGE III comparison, ..."should be "Based on the comparisons with SAGE III,..."

We changed the sentence to start with "Based on the comparison with SAGE III,"

36)line 386: Did OMPS measure "more aerosol "or "report higher extinctions"? Please clarify.

We have changed the sentence to "where OMPS LP initially reported higher aerosol extinction than SAGE III."

37)line 387: What do you mean by "heavily skewed by few daily measurements..."? Please explain this effect.

We agree that this sentence is not clear, so we deleted it. The original text that reads "This might be caused by the different coverage and frequency of measurements for each instrument." Is sufficient enough to explain the differences.

38)line 389: "...use of a fixed..."

We deleted this sentence in response to reviewer 1.

39)line 393: I do not see how differences in vertical resolution could lead to differences in the time series of extinction after a volcanic eruption. These statements seem misdirected. Please clarify your thoughts on this, and / or consider other explanations.

Vertical resolution differences were previously reported by various studies (Chen et al., 2020; Bourassa et al., 2019).
We have now added the following text "Bourassa et al. (2019) compared nearby OMPS LP and SAGE III/ISS aerosol profiles following the aftermath of the British Columbia fires in 2017. They showed that both instruments have very similar layered vertical structure and magnitude. However, they noted that some differences in layer height and magnitude can be expected from differing vertical resolutions."

40)line 400: Please remind us which Figure you are discussing.

We added "(Figure 11)" to the text

41)Figure 12: This is a bit of a challenge to interpret. It might be improved by adding a legend to the figure, and using unique colors.

Done.

42)Figures 13 & 14: Referring back to Figure12 for a description of the lines is tedious, please add captions to the figures.

Done.

43)line 429: should be "...18.5 km in the tropics.."; this is just one example of poor grammar in this section.

Done.

44)Figure 15: "Top panels show the...". Also, the color scale for panels d -f should indicate the units as (%).

Done.

References

Bourassa, A., Rieger, L., Zawada, D. J., Khaykin, S., Thomason, L., and Degenstein, D.: Satellite limb observations of unprecedented forest fire aerosol in the stratosphere, J. Geophys. Res., 124, 9510-9519, https://doi.org/10.1029/2019JD030607, 2019.

Chen, Z., Bhartia, P. K., Torres, O., Jaross, G., Loughman, R., DeLand, M., Colarco, P., Damadeo, R., and Taha, G.: Evaluation of the OMPS/LP stratospheric aerosol extinction product using SAGE III/ISS observations, Atmos. Meas. Tech., 13, 3471–3485, https://doi.org/10.5194/amt-13-3471-2020, 2020.

Kar, J., Lee, K.-P., Vaughan, M. A., Tackett, J. L., Trepte, C. R., Winker, D. M., Lucker, P. L., and Getzewich, B. J.: CALIPSO level 3 stratospheric aerosol profile product: version 1.00 algorithm description and initial assessment, Atmos. Meas. Tech., 12, 6173–6191, https://doi.org/10.5194/amt-12-6173-2019, 2019.

Kremser, S., Thomason, L.W., Hobe, M., Hermann, M., Deshler, T., Timmreck, C., Toohey, M., Stenke, A., Schwarz, J. P.,Weigel, R., Fueglistaler, S., Prata, F. J., Vernier, J.-P., Schlager, H., Barnes, J. E., Antu na-Marrero, J.-C., Fairlie, D., Palm, M., Mahieu, E., Notholt, J., Rex, M., Bingen, C., Vanhellemont, F., Bourassa, A.,Plane, J. M. C., Klocke, D., Carn, S. A., Clarisse, L., Trickl, T., Neely, R., James, A. D., Rieger, L., Wilson, J. C., and Meland, B.: Stratospheric aerosol-Observations, processes, and impact on climate, Rev. Geophys., 54, 278–335, 2016.

Rieger, L. A., Zawada, D. J., Bourassa, A. E., and Degenstein, D. A.: A multi-wavelength retrieval approach for improved OSIRIS aerosol extinction retrievals, J. Geophys. Res.-Atmos., 124, https://doi.org/10.1029/2018JD029897, 2019.

Thomason, L. W. and Vernier, J.-P.: Improved SAGE II cloud/aerosol categorization and observations of the Asian tropopause aerosol layer: 1989–2005, Atmos. Chem. Phys., 13, 4605–4616, https://doi.org/10.5194/acp-13-4605-2013, 2013.