Author (Daniel Letros) responses to the editor feedback is shown in blue
We would again like to extend our sincere thanks to to all referees and the editor for their efforts.
Thank you!

Editor Comments:

The authors should check their final manuscript carefully for language errors. For example, at some places "affect" should be "effect", "employees" should be "employs", etc..

Effort was again made to ensure correct language.

Please ensure that the colour schemes used in your maps and charts allow readers with colour vision deficiencies to correctly interpret your findings. Please check your figures using the Coblis – Color Blindness Simulator (`https://www.color-blindness.com/coblis-color-blindness-simulator/`) and revise the colour schemes accordingly. →Figs. 3, 9, 12, 15, 16, 17, 18

We have checked the plots and made color changes in the past to help address this. We admit they are still not ideal as we rely heavily on colors to convey information in the plots, but if they need further improvement we require advice to optimize them for all readers.

Please add the proper numbering to your supplement material (see "Supplements" at `https://www.atmospheric-measurement-techniques.net/submission.html#assets`)

Corrected.

Referee #1 - Report 3

line 14: "...with respected to..." → "...with respect to..."

Corrected.

line 94: "...to account for the nm dependence..." → "...to account for the wavelength dependence..."?

Corrected.

line 169: "...off imaging providing..." → "...off imaging provides..."?

Corrected.

Figure 5 caption: why are there periods scattered through the caption, always before parentheses? Please revise.

Corrected.

Figure 5: This is a general comment about all figures: when creating sub-paneled plots, can the axes have the same scale, range, tick locations, and tick labels? That makes interpretation easier for the reader. This applies to all figures, but Fig. 5 provides a good example. e.g., the y-axis in (a) extends from an unknown altitude (0 km?) to 36.3 km, while (b) extends from another unknown altitude to something above 37 km. The reader should have to waste time trying to mentally align wonky axes, instead he should spend it understanding the science. Just a suggestion, but from a reader's perspective this would be very nice to have.

We see your point. Of course, the root issue is the same pixel in an ALI image will see a different tangent altitude as the altitude/attitude of the suspended balloon gondola changes. This is why the scale between (a), (d), and (g) in this figure are different (notably at the high altitude). Since in Figure 5 we are showing the whole images, we have opted to keep these figures as they are with the y-ticks noting (as well as possible) the common tangent altitude locations with respect to image pixel.

However, we have adjusted the y-scales of Figures 9 and 14 to be consistent with your feedback. These are two plots where we see the issue you raised exists without reason.

line 424: "...consists of the of the 10..." → "consists of the 10..."

Corrected.

line 454: "...states is is well..." → "...states is well..."

Corrected.

line 474: "...and we speculate..." No need to speculate! This can be demonstrated with simple Mie theory. Please consider rewording.

Reworded - removed statement of speculation.

Figure 14 (and subsequent): another example of mismatching tick locations, labels, and scales.

Y-axis have been adjusted and plot rescaled (Figure 9 as well).

Referee #2 - Report 2

I remain confused about the definition of the albedo. The response to the earlier comment (referencing line 226 in the earlier draft) states that the "true state" albedo is "... meant to indicate the known surface albedo of the simulated atmosphere (the atmosphere we are estimating the albedo of)." Are we discussing the albedo of a surface, or a surface/atmosphere system, or ... ?"

In the simulation of the albedo estimation, this *effective* albedo is just the surface albedo because that is all that was simulated in this context. However, for the real measurements the *effective* albedo is not only the unknown surface albedo, but also the unknown atmospheric contribution to the up-welling radiation beneath the retrieval altitudes (i.e. clouds).

The authors pledge to "look into" hosting the ALI data in a public archive. For the small amount of data illustrated in this study, I still think that providing that ALI data as a supplement to this paper would be better, but I'll defer to the editors about the journal's requirements.

We have uploaded ALI data here: `https://doi.org/10.5281/zenodo.15707122`. This was indicated in the data availability section of our last submission.

Referee #3 - Report 1

Following the opinion of the editor, we are only addressing the comments and technical corrections.

Author replies, page 14: "The caveat to this statement is if true state conditions and a-priori conditions differ significantly - i.e. the underlying a-priori information given to the Kalman filter is no longer appropriate to reach the true state solution." → This formulation is too imprecise. How different the aerosol state should be to cause a retrieval failure? Is it still within realistic values? Will the retrieval fail, e.g. after a strong volcanic eruption like the one of Hunga Tonga?

This statement in our response to your last feedback was intended to generally note that Kalman Filtering (like any optimization method) has limits. The importance of the a-pirori is well known from literature, but the specifics always depend on a particular application of the Kalman filter. This is why prototyping and tuning a filter with simulation is an important and necessary step. The simulation work we present in the paper is our demonstration of the efficacy and limitations our approach. Much of this relates the a-priori assumptions to the aerosol state and limitations of correctly retrieving the aerosol.

Author replies, page 19, my comment to Fig.7: The paper claims that DoP is a suitable measure to distinguish between the aerosol and clouds. To justify this, it is not enough to show you can see a cloud, you also need to show that there is no false identification for strong aerosol levels. Furthermore, it is unclear if the method also works for water clouds.

As we discussed in the response you are referencing, we agree there is more work to do on this aspect. While important and interesting, we are aligned with the suggestion of the editor and are allocating this to future work.

Introduction: I do not understand why you cannot describe how the capabilities of the ALI balloon-borne instrument are compared with those of current satellite instruments.

We have added a sentence in the introduction addressing a core difference between satellite and balloon limb instruments.

Page 2, line 55 (tracked changes version): ".... so the top lines of sight are flat and level with the (idealized) surface of the Earth." → I do not understand what you want to say here, please reword the sentence.

We have reworded this sentence.

Fig. 1 caption: please spell out SPS and LCR also in the figure caption

Done.

Page 6, line 119 (tracked changes version): please replace "flat" by "homogeneous".

Done.

Page 6, line 136 (tracked changes version): please replace "flat uniform" by "homogeneous".

Done.

Fig. 1 caption: black dots in the left panel are still not explained.

We believe you mean Fig.4. What we think you mean by black dots in the left panel (Fig.4(a)) are just part of the actual detector image, and deep blue on the DN color scale. These are dead pixels with poor illumination response. These pixels turn white in Fig.4(b) as this image is synthetically reproduced from the calibration coefficients, which has identified these pixels as non-ideal for discard. We already took action in the last set of revisions to note the different level of image correction between (a) and (b) in the caption of Fig.4.

Page 7, line 143 (tracked changes version): please replace "flat" by "homogeneous".

Done.

Page 7, line 172 (tracked changes version): "However, for the scope of the present work we select only three of these science scans for demonstration." → please write how many states are available in total and justify why only 3 of them are used.

Detail added.

Page 12, line 253 (tracked changes version): "The measure we take to quantify the albedo is the integration of the high-altitude radiance with respect to wavelength" → What happens if the surface albedo is wavelength dependent? Please check the wavelength dependence of the surface albedo for common surface types and investigate implications for the retrieval if albedo of any of them shows significant wavelength dependence in the relevant spectral range.

We would like to say again that we think this (and other suggested studies) are very good and interesting exercises to do. However, following from previous discussion, we are aligned with the suggestion of the editor and are allocating this to future work

Page 15, line 340 (tracked changes version): "This albedo informs θ of a simple Rayleigh atmosphere (no aerosol or ice) which constructs the a-priori profile." → I do not understand what you want to say with this sentence, please reword.

Reworded.

Page 25, line 501 (tracked changes version): "produced a true state DoP approximately ranging between 0.3 - 0.4" → As you do not show the corresponding plot it is completely unclear where these values come from.

We state that these values come from a simulation of this geometry with GloSSAC aerosol loading. We also provided the plot in our previous response on this topic. We still do not think the inclusion of the plot within the paper adds substance which the statement in text does not.

Page 26, line 520 (tracked changes version): "This does still present a polarized aspect to the ALI retrievals of this exercise which hampers a completely level methodology to the comparison." → I do not understand what you want to say with this sentence. Please reword.

Reworded.

Page 29, line 597 (tracked changes version): "we find encouraging indication of size agreement between ALI and SAGE III/ISS with the metric of effective radius." → I think this statement is too optimistic.

We are unsure of what action (if any) you would like us to take here.

Figs. 17 and 18: Last sentences in the figure captions should be moved to the main text.

Done.

Page 15, line 342 (tracked changes version): "Fig. 7 is discussed" → "Fig. 7 are discussed"

Corrected.

Page 15, line 348 (tracked changes version): "that is not" → "that are not"

Corrected.

Page 20, line 329 (tracked changes version): "consists of the of the 10 wavelengths" → "consists of the 10 wavelengths"

Corrected.

Page 21, line 460 (tracked changes version): "states is is well" → "states is well"

Corrected.

Page 28, line 587 (tracked changes version): "is shown" → "are shown"

Corrected.