

Reply to Reviewer #1.

We thank Reviewer #1 for the positive review and fair remarks, which have all been carefully implemented in the manuscript.

General comments:

I am very happy to read this article. It clearly outlines the data and methods used, and provides an important new result for the validation of the spaceborn Aeolus lidar.

Specific comments:

I am worried about the presentation of the overall statistics, which are an accumulation of Aeolus data for different baselines (for example in the abstract on lines 25,26).

The Aeolus instrument settings as well as the ground processing has seen several major changes during its mission. These will have an effect on statistical properties like bias and standard deviation/MAD. In addition to the combined statistics I think it would be better to split the results and also present them separately for the different baselines. Also it seems near-real-time and reprocessing results are mixed, i.e. baseline 11 was introduced in near-real-time processing on 8-Oct-2020, so the baseline 11 results before that date must be based on reprocessed Aeolus data. I think it would be better to split this as well, since the reprocessing used different calibration data than the near-real-time processing.

Thank you for your suggestion to split the results and present them separately for different baselines. We appreciate your insight and will surely include this in our revised manuscript. We also appreciate your noting the mix of near-real-time and reprocessed results in the baseline 11 data, and we will ensure that this is clearly distinguished in the new Table 3.

line 47: you state that Aeolus covers nearly the whole globe within 7 days.

This is not really the case. With a 7 day repeat cycle of the orbit the instrument observes a specific pattern on the earth and the slant curtain above this pattern, but it certainly does not observe every location on earth.

After your comment, we decided to remove this line because we realized it didn't add any valuable information and generated confusion.

line 453: The figure depicts a very specific pattern of oscillating nature.

This pattern is indeed striking, and I have not seen such a thing before in previous Aeolus publications. I think it is important to try and understand what is happening here. But I think you should not call this "instrument induced", since you cannot yet prove that this indeed is the case. There could also be some bug or unforeseen effect in the ground

processing or in the data handling of this paper. So I would suggest to find another name and not use the acronym I2OPs. Please contact the Aeolus DISC team and work with them to try and find what is happening here.

You are correct that we cannot definitively prove that the observed pattern is instrument-induced. We have renamed the phenomenon "oscillating perturbations" instead of "instrument-induced oscillating perturbations."

We have also reached out to the Aeolus DISC team and are working with them to try and understand the cause of these oscillations (Here is the link to a confluence discussion about it:

https://www.aeolus.esa.int/confluence/pages/viewpage.action?spaceKey=CALVAL&title=CC_CV_2B_015).

Technical corrections:

line 13: Aeolus is now flying for over 4 years, so please correct your statement that it is operating for 3 years.

We have corrected this imprecise statement.

line 32: wind profiling crucial => wind profiling is crucial

Corrected.

line 49: the first ever Doppler-Rayleigh Wind Lidar =>the first ever Doppler-Rayleigh-Mie Wind Lidar

Corrected.

line 135: classified using particle backscatter coefficient

The classification method was changed to use SNR threshold on 31-Oct-2019 with the start of baseline 7 for the Mie channel, and on 8-Oct-2020 with the start if baseline 11 for the Rayleigh channel.

Thank you for pointing out this error in the text. We apologize for the confusion caused by the change in the classification method. We have revised the manuscript to clearly state that the SNR threshold was introduced in 31-Oct-2019 for the Mie channel and on 8-Oct-2020 for the Rayleigh channel.

line 159/160: the end of the mission's extended life in November 2022. ==>the end of the mission's extended life in spring 2023.

Corrected.

line 168: the difference between vLOS and HLOS becomes negligible

No this is not true. If w is small, then the sine term in equation (1) becomes negligible, but the cosine term still remains. Therefore there still is a difference by a factor of $\cos(\Psi)$ between v_{LOS} and v_{HLOS} .

You are correct that the sine term in equation (1) becomes proportional to the cosine term when w is small, and we apologize for the error in our original manuscript. We have revised the manuscript to reflect this relationship accurately, and we have changed the wording from "negligible" to "proportional by a factor of $\cos(\psi)$ ".

line 181/182: multiple RBC settings are activated at the same time.

No this is not true. Each channel has just one RBS at any given time. But the RBS can be changed multiple times per orbit.

You are correct that each channel has just one RBS at any given time. We have revised the manuscript to remove this sentence.

line 192: The downsampling begins with an averaging of the reference measurements between the middle points of the reference bins

This phrasing is confusing and maybe I misunderstood.

Each Aeolus wind result has just one middle point, so there is no in between. So I think the correct way is to take the reference measurements between the top and bottom edge of the Aeolus measurement bin, and average these results, before comparing to the Aeolus result. That way no interpolation at all is needed.

You are correct that the reference measurements are averaged between the top and bottom edge of the Aeolus measurement bin, rather than between the middle points of the reference bins. This is done to bring the reference measurements to the exact resolution as the Aeolus measurements. Our phrasing was incorrect, and we apologize for the confusion.

Additionally, you pointed out that each Aeolus wind result has just one middle point. This is true, but it also has a lower and higher bin bound. Therefore, when we reference the middle points of the reference bins, we are referring to the same thing as the top and bottom edge of the Aeolus measurement bin.

These changes have been reflected in the text : "Each Aeolus profile is used as a reference for the collocated profiles downsampling, meaning that the averaging grid is specific to each satellite observation. In order to match the resolution of the Aeolus measurements, we first average the reference measurements between the bounds of each Aeolus bin. This avoids the need for interpolation and ensures that

the reference measurements are at the same resolution as the Aeolus measurements."

line 311: to average every profile => to average every Aeolus profile

Corrected.

line 345: shown in Fig. 5a => shown in Fig. 4a

Corrected.

line 387: One reason Sun et al. (2014) raised

One important contribution for orbital phase biases is the telescope temperature effect explained by Weiler et al., 2021.

I think you should mention this as well here.

Thank you for your suggestion. We have indeed added the citation by Weiler et al., 2021 in our manuscript, and we appreciate your suggestion to include it.

line 439: At the same time, the radiosonde drifts along

You could mention here that not only the distance between Aeolus and radiosonde changes with time, but also the time difference between the two systems changes with time and therefore also with altitude.

We have added the following text to our manuscript: "Furthermore, not only the distance between Aeolus and radiosonde changes with time, but also the time difference between the two systems changes with time and, therefore, also with altitude."

line 512: Once can thus conclude => One can thus conclude

Corrected.

line 530/531: the end of the extended mission lifetime in November 2022, =>the end of the extended mission lifetime in spring 2023,

Corrected.

line 580/581: there are fewer particles at higher altitude levels. =>there are fewer molecules at higher altitude levels.

Corrected.

line 603: higher by and average => higher by an average

Corrected.