Reply to Reviewer #3.

We thank Reviewer #3 for the appreciation of our work and the detailed review. All the remarks have been carefully addressed in the revised manuscript.

The topic of the submitted study is the evaluation of the Aeolus Rayleigh-clear winds against radiosondes and ground-based lidars acquired at two observatories (OHP, OPAR) in the framework of the AboVE validation campaigns. Moreover, an assessment throughout the satellite mission is performed using twice-daily routine Météo-France radiosondes and regular lidar observations. Overall, it is a very interesting work covering all the necessary aspects of a comprehensive Cal/Val study. I would like to acknowledge also that the authors are comparing their results against those obtained from numerous previous studies. However, I think that the weak point of the study is the absence of evaluation results for the Mie-cloudy winds. I believe that the authors should either support better their decision or include a similar analysis for the Mie-cloudy winds. Please find below my (minor) comments which should be addressed prior publishing the manuscript.

1. Lines 32-33: Please rephrase this sentence.

We rephrased the sentence to be "Therefore, continuous global wind profiling is essential for enhancing our understanding of atmospheric dynamics and improving the accuracy of numerical weather predictions (Houchi et al., 2010; Albertema et al., 2019; Stoffelen et al., 2005; 2020)"

2. Line 50: Aeolus provides vertical profiles of HLOS and not of LOS.

Corrected.

3. Line 56: Replace "Aeolus's" with "Aeolus'".

We corrected the three instances in the text where this error occurred.

4. Lines 144-150: Please explain why you are focusing only on Rayleigh-clear winds.

The description of the cross-talk issue can be improved.

The study focuses on the Rayleigh-clear wind cal/val for the following reasons.

First, both ground-based DWLs only have one detection channel based on the double-edge FPI, that is the same as the ALADIN Rayleigh channel. Thanks to the spectral configuration of the ground-based lidars' FPI, the measurements of Doppler shift using the Mie scattering are possible within thin cirrus clouds and aerosol layers, however the measurement error increases with the backscatter ratio. The respective mention has been included into the DWL description in the manuscript. In addition, both lidars are optimized for the middle atmosphere and

cannot measure winds within the boundary layer, where the aerosols are more abundant.

Second, for the above reason, the DWL measurement sessions (and collocated radiosoundings) were mostly restricted to the clear-sky conditions, which substantially limited the number of the collocated Mie detections by ALADIN. Occasional high-level thin cirrus clouds, occurring during the measurement sessions, do not allow for drawing up conclusive intercomparison statistics.

A sentence has been added to the introduction: "Since the optimal performance of the ground based Doppler lidars is achieved in the clear sky conditions, this paper will only focus on the ALADIN Rayleigh clear data analysis. Rayleigh clear stands for clear skies."

We do consider performing a separate study focusing on the Mie cal/val that will take advantage of the Hunga Tonga stratospheric aerosols that have been extensively sampled over La Reunion since January 2022.

A sentence has been added to the discussion: "With this study, we have addressed the performance of the ALADIN Rayleigh channel at a broad range of altitudes, from the lower troposphere to the maximum altitude of 30 km enabled by the AboVE-2 range bin setting. The performance of the ALADIN Mie channel in the lower stratosphere remains to be assessed using the lidar and radiosonde measurements at La Reunion. This site was to provide the most extensive lidar observations of the 2022 Hunga Tonga volcanic eruption plumes in the stratosphere (Baron et al., 2022), that were sampled by the ALADIN Mie channels (Legras et al., 2022; Khaykin et al., 2022)."

5. Line 149: It is the first time that the HLOS is mentioned in the text and should be written explicitly. Check all similar instances throughout the text.

This issue has been corrected since HLOS is now mentioned in line 56.

6. Lines 153-154: Rephrase this sentence.

We rephrased the sentence to be "In the following study, we present data from baselines ranging from 2B02 and from 2B11 to 2B13, covering the period from September 2018 to January 2022."

7. Lines 164-170: It will be helpful to mention here Figure 5a in Lux et al. (2020).

Added a reference to (Lux et al., 2020a, their fig. 5a).

8. Lines 188-194: Can you add a figure visualizing the applied methodology? It is not clear to me why you are averaging the radiosondes measurements and the lidar

retrievals between the Aeolus bins' middle points and not within their range (i.e., from base to top of each Aeolus bin).

Thank you for your suggestion. We apologize if our original explanation was not clear. We have already addressed this issue in a previous comment, where we explained 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.

Each Aeolus profile serves as a reference for the downsampling of collocated profiles, meaning that the downsampling grid is specific to each satellite observation. The downsampling procedure involves averaging the reference measurements between each Aeolus bin bound (which is the same as saying "the averaging window being half the distance between the upper and lower adjacent bins"). This allows the reference measurements to be brought to the exact resolution as the Aeolus measurements, without the need for interpolation.

9. Lines 199-201: Why the azimuth angles are the same between dawn and dusk Aeolus orbits?

The values displayed were only the ones corresponding to the ascending orbit. The corresponding values for descending orbits have been added. The text now reads :

" Where θ (259.9°/100° for OHP and 259.0°/101° for Maido, for ascending/descending orbits) is the topocentric azimuth angle, which is defined clockwise from north of the horizontal projection of the target to the satellite pointing vector. Therefore, each observation site has its own azimuth angle value."

10. Lines 238-245: Please consider rewriting and improving this paragraph. Can you explain better the statements "…measurements better than 10km…" and "…still remained within 100km."? To my opinion, they are not obvious in the relevant figure.

We apologize for the error in the previous text. We mistakenly wrote 100 km instead of 200 km. The correct statement is that the ascending orbit remained within a distance of 200 km after the ANX configuration was changed to ANX 2.0. The new text is as follows:

"The ANX, or Ascending Node crossing, is the point where the orbit of Aeolus intersects the x-y plane in the Earth's fixed coordinate system. During the campaign, the orbit parameter for the ANX was changed from ANX 4.5 to ANX 2.0 (as shown in Fig. 1) to support the Aeolus tropical campaign activities in Cape Verde. This change resulted in a shift in the orbit's location relative to the

observatory. Previously, the ANX 4.5 ascending orbit was located within 10 km of the lidar's eastward line-of-sight in the lower stratosphere on Wednesdays. After this change, the ascending orbit moved further away from the lidar's eastward line of sight, but remained within a distance of 200 km."

11. Lines 255 – 256: This sentence needs a correction.

The sentence was corrected to "During both campaigns, 19 Aeolus-collocated RS ascends were carried out, and 15 were time-coordinated with ground-based lidar acquisitions."

12. Line 311: How have you defined the 200 km window?

The collocation window of 200 km was chosen empirically as a trade-off between the number of collocations and their proximity. The goal was always to obtain around 2 or 3 different profiles, but no more. This approach allows for a good balance between having enough profiles to get an accurate average, while still avoiding any outliers that might skew the results.

13. Lines 317-319: Please rephrase this sentence.

We replaced the sentence with "The AboVE OHP2 lidar measurements were the only ones that had extended coverage below 5 km, which significantly reduced the number of data points in the lower troposphere."

14. Figure 3: Do you see a different behavior when reproducing the same plots separately for each station?

After conducting additional analysis, we did not notice any notable differences when reproducing the same plots separately for each station. While we are confident in the accuracy of our results, it is always important to consider the possibility of variations within the data.

15. Line 347: I think that you are referring to Figure 4.

Corrected.

16. Line 412: Which method?

Corrected to say "both methods".

17. Lines 511-513: I think that it is not feasible to generalize such results since maybe there are not valid for other stations characterized by different weather/wind regimes. There is also a similar statement in the Discussion section.

We agree with your opinion that it is not feasible to generalize the results of this study to other stations characterized by different weather and wind regimes. You are correct that the results of this study may not be directly applicable to all stations, as the characteristics of different stations can vary significantly.

However, based on the results of this study, it is possible to conclude that temporal offset is more critical than spatial offset when collocating satellite and ground-based wind measurements, at least in the specific context of this study. This conclusion is based on the observed higher random error at the site with a more significant time offset, and similar patterns may be observed at other locations with similar characteristics.

Therefore, rather than making a generalization about all stations, it may be more appropriate to focus on the specific context of this study and the conclusions that can be drawn from the results within that context, as you suggest.

Here is an additional sentence we provided for context: "While it might not be trivial to generalize these results to other stations with different weather and wind regimes, the findings of this study may be relevant to locations with similar characteristics."

The discussion was also modified.

18. Figure 6: It would be very useful to use different shading colors (as background) corresponding to each baseline and show with double-edge arrows the two later periods (FM-A, FM-B).

Your remarks were added into the revised version of the figure, including both a varying coloring depending on the baseline and arrows annotations to provide context on the periods. In addition, we added this short sentence in the figure description :" The black line represents the average value, and the shading represents its standard deviation. The colors are relative to the 4 baselines used: 2B02(violet), 2B11(blue), 2B12(green) and 2B13(yellow) in that order."

19. Lines 616-618 and lines 619-623: There is a contradiction between these two parts. Can you clarify better your statements?

The first half of the text states that the current study did not observe any significant difference between the ascending and descending phases. This goes against previous observations that there are orbit-dependent characteristics. The second half of the text presents the results of the current study, which show that the mean correlation coefficients and scaled MAD values for the ascending and descending

phases are similar. Therefore, the first half of the text does not contradict the second half because the current study's results do not support the idea of orbit-dependent characteristics, as previously observed.

One potential explanation for the similarity in the results could be that the atmospheric conditions during the ascending and descending phases were similar, leading to similar measurements. This could be due to meteorological phenomena such as inversion layers, which can cause temperature and moisture profiles to be relatively stable over a specific altitude range. Additionally, the similarity in the results could be due to the accuracy and precision of the instrumentation, which has been calibrated to minimize any differences between the ascending and descending phases.