Dear Editor,

We have revised the manuscript in accordance with the reviewers' comments. We have carefully addressed all of Reviewer 3's suggestions, which we found constructive and valuable for improving the quality of our work. Additionally, we have corrected the technical issue raised by Reviewer 2 regarding the missing reference to Frehlich (1994)a, which is now properly included in the bibliography.

In the present document, we respond point by point to the comments from Reviewer 3 (in black). Our responses are provided in blue.

GENERAL COMMENTS

1. The title seems to suggest that a new lidar can achieve substantially better turbulence measurements, however, the abstract seems to suggest that the prototype tested fell short of expectations in many ways. I suggest rephrasing the title to better match the actual outcome of the analysis.

Thank you for your comment. We agree that the original title may have implied a level of performance improvement not fully supported by the results presented. To better reflect the scope and findings of our study, we have revised the title to: **"Evaluating enhanced sampling rate for turbulence measurement with wind lidar profiler."** This revised title emphasizes the focus on evaluating the impact of increased sampling rate rather than suggesting definitive performance gains, aligning more closely with the content and conclusions of the manuscript.

2. In the analysis of the sonic anemometer data, have you considered (and checked for) also wake effects from the met tower structure itself? Please mention it in Section 2.2.

Yes, we considered potential wake effects from the meteorological mast structure in our analysis of the sonic anemometer data. The wind direction sectors affected by mast-induced flow disturbances were found to overlap with those influenced by wind turbine WT N117. These sectors were excluded from the turbulence analysis, as shown in the blue regions of Fig. 4. We have added these sentences to the text: "Potential wake effects from the meteorological mast structure were considered in the analysis of the sonic anemometer data. The wind directions associated with flow disturbances caused by the mast itself overlap with the wake sector of wind turbine WT N117 which was excluded from the analysis." (Lines 155-157, page 7).

3. Similar to the comment above: do you expect that the structure of the tower will have an impact on the comparison between the flow measured by the sonic anemometer and each given beam from each lidar? It's a bit hard to tell from the maps, but is there a case where a beam measures the flow upwind/downwind of the met tower, while the sonic measures the opposite?

We also took care to avoid mismatches between lidar beam positions and the sonic anemometer due to potential obstruction by the mast. The orientation of the lidar beams was selected to avoid cases where the lidar measured flow either directly upwind or downwind of the mast relative to the sonic.

4. I am a bit confused by the practical utility of the results. The along-wind variance, on which the analysis focuses, is only one of the quantities that are used by industry to calculate TI and/or academia to calculate TKE. How do the (limited) improvements you are finding can translate to practical advancements for the calculation of TI and/or TKE? And if I am missing something and TI and TKE are not meant to be the practical utility here, what is instead?

You are correct that along-wind variance is only one component in the calculation of TI and TKE. In this study, we focused on evaluating the performance of an enhanced-sampling-rate lidar specifically in capturing the along-wind variance because it is typically the dominant component of TKE in atmospheric surface-layer flows and is often the most reliably measured by profiling lidars, given their beam configuration and scanning limitations.

While we do not claim that the observed improvements fully resolve the limitations of current lidars in estimating TI or TKE, our results provide a targeted assessment of how increasing the sampling rate affects the accuracy of a critical turbulence parameter. This is a necessary step toward better characterizing the capabilities of lidar systems for advanced turbulence measurements.

The practical utility of our work lies in identifying the potential and the limitations of using enhanced-sampling-rate lidar systems for future applications that require finer temporal resolution, such as site assessments for wind energy projects, model validation, and inflow condition characterization. Ultimately, the insights gained here can inform both lidar system design and the development of correction or filtering techniques for TI and TKE estimation.

We mention TI in the introduction: “This enhancement is assessed for its impact on measuring mean wind speed, data availability, and along-wind variance and its square root, i.e., the standard deviation. The latter is particularly important, as it is used in the wind power industry to compute turbulence intensity (TI), a critical metric for turbine load assessment, site suitability, and energy yield predictions.” (Lines 95-97, page 4).

MINOR COMMENTS

1. All statements in the first and second paragraph of the introduction (while reasonable) are missing references to substantiate the claims being made.

We have added five references in the first two paragraphs.

2. Figure 1: what do all the black dots represent in the figure? They are not explained in the caption. Also, you use both the capitalized and not-capitalized symbol for the 28-deg angle – please pick one and be consistent.

We have added the meaning of the black dots in the title of Fig. 1: "The black dots indicate the centers of the probe measurement volumes.". Moreover, we choose to use the not-capitalized symbol throughout the paper.

3. L. 95-105: please specify which section talks about each of the things you are listing.

We have now specified the corresponding sections.

4. Fig. 3: "black lines" in the caption can also represent the contour lines. Either change the color of the contours or rephrase in the caption.

We now used the word "arrows" instead of "lines".

5. Fig. 5: in the axis label "db" should be "dB".

The label has been changed.

6. Fig. 6: did you set the lidar such that one of its measurement heights is 97 m a.g.l.? Please specify in the paper.

Yes, we have added this information to the text: "One of the measurement heights of both lidars was set to 97 m above ground to coincide with the height of the sonic anemometer deployment on the mast." (Lines 162-163, page 7).

7. L. 410: why do you think the % data availability may change over longer campaigns?

This is a good remark. We now specified the reason: "While this difference is minimal, longer measurement campaigns, typically lasting over a year for wind site characterization, may accumulate more instances of data loss due to environmental factors, hardware limitations, or maintenance events, potentially making the impact of reduced availability more noticeable over time." (Lines 415-418, pages 20-21).

8. DOIs should be added to all references (whenever available) per WES standard

We have added the DOI for all the references when available.