Atmospheric Measurement Techniques Discussions

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# Comment on amt-2021-417

Anonymous Referee #1

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Referee comment on "Scan strategies for wind profiling with Doppler lidar – an large-eddy simulation (LES)-based evaluation" by Charlotte Rahlves et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-417-RC1, 2022

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Review of “Scan strategies for wind profiling with Doppler lidar – An LES-based evaluation”

## Summary

The article presents an error analysis of three retrieval methods for vertical profiles of the wind vector with a single Doppler lidar based on simulated measurements within a LES. The influence of zenith angle, scan duration, averaging period, and atmospheric boundary layer state on the error are investigated. Results show generally a decrease of the error with shorter scan duration and longer averaging periods. Scans with a low elevation angle favor retrieval of the wind speed and scans with a high elevation angle benefit the error of the vertical velocity component. A more convective atmospheric boundary layer also affects the error negatively. The discussion evaluates the results and considers results from other literature. It is concluded that the choice of scanning scheme should account for the quantity of interest and the ABL state.

## General comments

The research question of the article is well motivated and relevant. The methods are suitable for the investigation and described in sufficient detail. The results are presented in a clear and objective manner. The discussion and conclusions are supported by the results. My main comments are:

- The implementation of the virtual lidar in the LES seems to be able to change the azimuth and elevation angle of the lidar beam instantaneously. Depending on the lidar type, the scanner head can have a significant travel time resulting in either shorter dwell times or the measurements covering an azimuth range instead of a single point. I believe this behavior could be added to the virtual lidar with either pauses between the sampling of the lidar beams or by averaging a distribution of lidar beams within an azimuth range. At the least, this aspect should be touched upon in the discussion.

- The methods sections suffers from fragmentation of information and some inconsistencies in the usage of terms (see specific comments for examples). It might benefit from further streamlining.

The above comments can be addressed with minor changes to the manuscript. Overall, the paper is already in a good state and I did not detect any major flaws.

**Language**

With the disclaimer that I am not a native English speaker, I find that the text is well written and I noticed only a few typos.

**Specific comments**

Line 11: Instrument orientation could refer to both north alignment or horizontal leveling.

Line 13: The authors could consider to include the scan duration and time averaging aspect of the results into the abstract.

Line 65: The abbreviation RMSD was only introduced in the abstract, but not the text.

Line 150 – 152: From the description I gather that the virtual LiDAR measures 5 seconds at the first position (alpha=0), then travels instantaneously to the second position (alpha=15) and measures the for the next 5 seconds. Wouldn't it be more realistic that the virtual LiDAR measures e.g. for 1 second at first position and then four seconds later

the next measurement for 1 second is made at alpha=15? This way the travel time of scanner is accounted for, which results in less temporal averaging in reality.

Line 168: The same for averaging effects from the pulse length.

Line 178: The height interval is always from 50 m to the top of the atmospheric boundary layer. To avoid fragmentation of information, this could be stated directly here.

Section 3 (and maybe throughout the manuscript in general): The reference values from the LES are referred to as “predicted values”, “truth value”, or “reference”. The output of the virtual lidar are referred to as “observed values”, “measured values”, “virtual measurements”, or “lidar values”. I believe that settling on one specific term for each would increase clarity of the manuscript.

Line 182: The description of the processing here is different to the description in line 154. The previous page states that the data is first accumulated in 120 s steps and later averaged again to 10/30/60 minutes. Here the description states that the individual beams are accumulated and then directly averaged 10/30/60 minutes.

Line 186: Insert “the” before lidar.

Line 190-192: Sometimes the wind profiles from a VAD scan are also interpreted to be representative for a spatial average across the scanning cone (in opposition to being representative for a column above the instrument). I believe this would be another aspect that could be investigated with the setup used here.

Line 277: insert “the” before wind speed.

Line 279: Did the authors use an arithmetic mean or an angular mean for the wind directions?

Line 299-304: Was there a specific motivation why the north alignment of the Doppler lidar was investigated? To me this would fall into the same category as scanning the VAD in a counter-clockwise direction: I would expect some small random variations of the numbers, but no systematic difference. There is nothing wrong with this part, but it strikes me as an odd thing to investigate and was not well motivated in the introduction.

Fig. 4 and Fig. 5: The panels for the 10-min average and 30-min average are unclear to me, because I only see one line for the reference / observation, but I would expect that there are 6 and 2 observations, respectively. Are those panel showing the mean RMSD?

Line 331-332: To me it seems that identical values exist for top left, top center, and bottom left and remarkably close values for top right?

Line 498: Some of the limitations of this study like not accounting for range gate effects were already brought up in the methods section. Maybe the same could be done with the effect of surface heterogeneity on the error to put the readers mind at ease that it has not been forgotten.