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Atmospheric Measurement Techniques Discussions

Interactive comment on "LiSBOA: LiDAR Statistical Barnes Objective Analysis for optimal design of LiDAR scans and retrieval of wind statistics. Part II: Applications to synthetic and real LiDAR data of wind turbine wakes" *by* Stefano Letizia et al.

Anonymous Referee #2

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This manuscript applies the LiSBOA algorithm introduced in the companion paper (Part I) to retrieve wind speed and turbulence intensity from Doppler lidar measurements in wind turbine wakes. A LES data set is used to investigate the quality of LiSBOA algorithm and LiSBOA retrievals from ground-based Doppler lidar measurements are compared to anemometer measurements.

This study is within the scope of AMT, but there are some major issues that need to be

addressed before it can be accepted. Overall, this manuscript is rather long and has a large number of figures. I suggest to move the LES discussion (Section 2) to Part I (where it can replace the synthetic data) to keep this manuscript focused on the actual measurements.

Major comments

L160 Some measurements have been conducted with lidars located at the nacelle, but in this study only ground-based lidars are utilised. Please use the LES to assess the quality of ground-based lidar measurements.

L165-198 Determining the flow characteristics for LiSBOA is not trivial, as seen here and in Figs. 2-3. Please test LiSBOA sensitivity to the flow characteristics. In atmospheric applications they may not be known with good enough accuracy, or they may vary during measurements.

Specific comments

L17 "angular resolution" which angle?

L156 Please state resolution in metres.

L157 What is "A radiative condition is imposed at the outlet"?

L157 "freeslip is enforced on the top and bottom" This doesn't create a realistic wind profile. It may not hamper the use of the LES to validate LiSBOA algorithm but should be justified in the text.

Fig. 1. Please state the integration time per radial measurement for panels b-d.

L211 Please make it clear that the aliasing here is an issue for LiSBOA retrieval, not for the lidar itself.

L215 What is the total sampling time?

L226 Please define "equivalent velocity approach".

L227 “turbulence intensity” could be defined at the first use.

Table 2. Please give the actual operating specifications used in this study. E.g. “Scanning mode Step-stare or continuous”, “Frequency [kHz] 10-40”, “Minimum gate length [m]”, “Maximum range [m]” do not tell what settings were actually used.

Fig. 13. Is this relevant information for this study? If not, please remove.

L317 Which SNR limit does this correspond to?

L333-335 Please see Manninen et al. (2016) and Vakkari et al. (2019) for post-processing Halo Stream Line data.

L444 Please check “exposes the rotor to a non-homogeneous flow resulting during off-design operations”

L508-509 “This analysis has also confirmed that the optimal scanning strategy identified by the LiSBOA has been that producing the most accurate flow statistics.” This was not shown. Especially, LiSBOA was not compared to any other retrieval from lidar data. Also, on L377-378 the authors state “Instead, an a posteriori analysis of the statistics retrieved is recommended to select the best sigma−m values.”

L516-517 “The mean velocity and turbulence intensity extracted 1D upstream of the rotors have agreed well with the values provided by the nacelle anemometers, with maximum discrepancies as low as 3%.” On the other hand, Fig. 21 indicates >10% differences in retrieved turbulence intensity depending on the parameters selected for LiSBOA. How well does the upstream comparison represent LiSBOA performance?

L520-521 “Two noticeable advantages of the LiSBOA arise from the present work: first, the LiSBOA allows a straightforward yet effective design of LiDAR scans, which exploits only basic knowledge about the flow under investigation and the LiDARs used.” This seems quite optimistic statement to me. The required “knowledge about the flow” is not really basic. For scan design, the integration time per measurement and elevation angle(s) of the PPI scans are not given by LiSBOA. When these are decided, LiSBOA

does optimise the azimuth angle step. Furthermore, the requirement of stationary flow over an extended period (an hour or more) is a serious limitation.

References

Manninen, A. J., O’Connor, E. J., Vakkari, V. and Petäjä, T.: A generalised background correction algorithm for a Halo Doppler lidar and its application to data from Finland, Atmos. Meas. Tech., 9(2), 817–827, doi:10.5194/amt-9-817-2016, 2016.

Vakkari, V., Manninen, A. J., O’Connor, E. J., Schween, J. H., van Zyl, P. G. and Marinou, E.: A novel post-processing algorithm for Halo Doppler lidars, Atmos. Meas. Tech., 12(2), 839–852, doi:10.5194/amt-12-839-2019, 2019.

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