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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 #1

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In this study, the authors build on the theoretical work discussed and presented in the companion part 1 paper for reconstructing the wind fields downstream of wind turbines to measure the properties of the turbine wakes. Specifically, the velocity deficit and turbulence intensity are measured. The authors first demonstrate this capability using a virtual lidar simulator to quantify the expected errors, then also demonstrate the capability on measurements near a wind farm in Colorado. The results look compelling, and there is some comparison with in situ measurements to validate the wind field

reconstruction where anemometers were installed. Overall, this is a nice demonstration of the novel technique and the analysis of the wind turbine wakes will be of interest to those in the wind energy field. Still, the virtual lidar simulator needs to be revised as there are several modifications that could be made to it to obtain more realistic results, which will yield a more accurate understanding of how to interpret real-world measurements. This analysis will require significant additional data analysis. Thus, I recommend major revisions to this manuscript after which it may be acceptable for full publication in AMT.

Specific Comments

a) Line 15: It would be helpful to include all the symbols used in the paper in this list, not just those used in LiSBOA.

b) Line 127: This should be projection of the wind vector, not velocity, onto the laser beam to really represent a lidar measurement.

c) Eq. 1: What is u here? Since there is no arrow over it, I'll assume it is just the streamwise component of the wind within the LES simulator, and not the full 3-D vector. To truly simulate a measurement, it should be the full 3-D wind vector as the radial velocity is not only affected by the streamwise component, but also the vertical and crosswise components (whose means are zero, but instantaneous turbulent perturbations are not). This may have significant effects on the results.

d) Line 157: Why is a freeslip enforced on the bottom of the domain? That does not produce a realistic logarithmic wind profile.

e) Line 164-166: The text becomes very confusing to this reader around here. The authors should make it clear that the optimal design of the lidar scan is based on the flow characteristics. Thus, the flow characteristics shown and discussed in the next several paragraphs come from the raw LES field. It might be helpful to make the analysis of the LES flow statistics its own subsection to provide clear separation from

the lidar simulator itself. It was confusing to me to see lidar simulator results in Fig. 1 immediately followed by analysis of the LES field, before returning to the lidar simulator again. Sect. 2 could benefit from some reorganization as well, to mitigate alternating between the two separate subjects.

f) Line 177: Is the integral time scale calculated using a time series of the streamwise velocity in the LES field?

g) Line 185, Fig 2, Fig. 3: Clarify what is meant by the spectra (and other features) are averaged azimuthally. What does that mean exactly?

h) Line 203: Just to be clear, the constant angular resolution $\Delta\theta$ is for both azimuth and elevation, correct? That is $\Delta\theta = \Delta\beta$.

i) Line 225: State the equation for the equivalent velocity approach.

j) Fig. 6/7 (and discussion of it): It would be help to indicate over how much time these statistics are computed over. Based on the statistics, I think it's 160 sec but I may be wrong.

k) Sect 2: Doppler wind lidar measurements are subject to error that increases with decreasing SNR; as SNR typically decreases with range, the velocity measurement also becomes less accurate. This error should be considered within the wind lidar simulator for more realistic results of true measurements.

l) Line 350: Clarify how the wind speed variability is corrected by making the LOS velocity non-dimensional, this is not obvious to the reader.

m) Figure 17: The timestamps above each PPI plot (panels c-e) are confusing and should be removed. It's unclear why each time stamps spans >6 hours.

Editorial Corrections

a) Line 315: Need a space between 65deg and with.

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