Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-55-RC1, 2018

Atmospheric Measurement Techniques Discussions

Interactive comment on "Wind Turbine Wake Measurements with Automatically Adjusting Scanning Trajectories in a Multi-Doppler Lidar Setup" *by* Norman Wildmann et al.

Anonymous Referee #1

Received and published: 23 March 2018

Review of the manuscript amt-2018-55 entitled: "Wind turbine wake measurements with automatically adjusting scanning trajectories in a multi-Doppler lidar setup", by N. Wildmann, N. Vasiljevic, T. Gerz.

This manuscript presents a test from the Perdigao field campaign using fixed-point triple-Doppler lidar measurements. According to the occurred wind direction, one lidar scanned roughly from an upstream position, while the other to lidars scanned from the same side of the wake.

The scanning setup is far to be an ideal configuration for 3D velocity retrieval. As I suggest below at comment 2, a quantification of the expected accuracy on the 3D velocity

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Discussion paper

retrieval should be provided. This analysis has even more relevance considering the complex topography of the Perdigao site.

The results presented consist in time-averaged streamwise wind velocity at fixed points for various downstream locations. No information is provided about the other two velocity components. No information is provided about the possible relative position of the measurement points within the wake.

The time-averaged streamwise velocity is then compared to the prediction of the Jensen-Park model. In my opinion, this analysis is not really pertinent; indeed, I don't see any reason why a space-averaged velocity deficit obtained from a top-hat model should match with a time-averaged fixed point measurement.

Then, time-averaged line-of-sight measurements are provided. As mentioned before, two lidars measured roughly transversally to the wind direction; thus, I understand the authors detected a velocity deficit; however, I am skeptical about the measurement accuracy of these measurements considering the large azimuthal angle between laser beam and wind direction.

I think that the highest potential of these measurements has not been exploited yet, namely analysis of 3D turbulence within a wake. In contrast, the analysis of the time-averaged velocity field adds little value to our understanding on wind turbine wakes. Detailed comments are provided below, which might help for a revised manuscript.

1. P1L16: wind energy converter is something different than a wind turbine? This name sounds a bit exotic. Consider to name it simply wind turbines;

2. Fig. 2. From this figure, it seems that the scanning scenario used to retrieve 3D velocity components is far to be ideal. One lidar laser beam is roughly in the mean wind direction, while the other two lidars are practically orthogonal. Can you use the method proposed by Debnath et al. 2017, Atmos. Meas. Tech. 10, 431-444, (Table 5) to quantify expected accuracy for the 3D lidar retrieval? Maybe this analysis can be

added to Sect. 3.2.

3. Sect. 3.3. This section needs a broader description and more details. For instance, which lidar(s) did you use to detect the wake center? Did you analyze simply the radial velocity? Lidars 1 and 3 are practically orthogonal to the typical wind direction, how did you characterize the wake velocity field from these data?

4. P10L16 In the same line you use WEC and turbine, but I guess you mean the same thing, namely the wind turbine. Consider to call it simply wind turbine.

5. P10L18: Calculating the expansion factor, kw, from log law has no sense for such complex topography. At least, mention this comment and explain that you cannot have better predictions with the available data.

6. Sect. 4.1: I guess that the poor accuracy of the VAD can be ascribed to the complex topography under investigation. You can add this comment in the text. Please report, slope, bias and r-square value of the linear regression between met-tower and VAD for both wind speed and direction.

7. P12L12 “The results show that the actual wind speed deficit is larger than predicted by the Jensen-Park model in both cases and for the majority of 30-minute averages.” Why did you expect that that a top-hat model, such as the Jensen-Park model, could predict the same velocity deficit as for point-wise measurements? Likewise, for P14L20.

8. Sect. 4.3.2 and Fig. 9: Lidars 1 and 2 have a large azimuthal angle with respect to the mean wind direction, let’s say larger than 45 degree. I don’t think that the analysis of the radial velocity may enable accurate estimates of the velocity deficit.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-55, 2018.