

Wind Energ. Sci. Discuss., referee comment RC1  
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## **Comment on wes-2021-95**

Anonymous Referee #1

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Referee comment on "Field measurements of wake meandering at a utility-scale wind turbine with nacelle-mounted Doppler lidars" by Peter Brugger et al., Wind Energ. Sci. Discuss., <https://doi.org/10.5194/wes-2021-95-RC1>, 2021

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### **General Comments**

This article is presenting the results of a field study of the properties of the wake generated by a full-scale wind turbine. The study is based on wind observations acquired by two scanning wind lidars installed on the nacelle of the wind turbine. Flow observations previously acquired mainly in wind tunnel studies now with the help of long-range scanning wind lidars can be also performed around full-scale wind turbines. The measurement configuration enabled the study of the mean and standard deviation of the wind speed in the wake, as well as its meandering in relation to the fluctuations of the transverse wind component. The study of these parameters is important for enhancing our understanding of the interaction between wakes in a wind farm. The study is well structured and written, and the methods used along with the corresponding results are well described.

- The wind observations used in this study have been acquired up- and downwind of wind turbine that is located in an urban area. From the scale presented in Figure 1, one can deduce that in the vicinity of the wind turbine there are buildings. For certain wind directions those buildings are within the measuring range of the scanning wind lidar measuring downwind. I think that it will be helpful for the understanding and the interpretation of the results presented in this study, to discuss if the characteristics of the topography are expected to have an impact on the data which were selected for this analysis
- Equation 1 presents the way that the authors estimate the instantaneous longitudinal component of the wind speed vector. This equation requires the assumption that the instantaneous transverse and vertical (in the case when the PPI scan is not horizontal) wind components are zero. I suggest that the authors should state that in the manuscript and discuss about the validity of this assumption. Furthermore, equation 1 implies that the wind turbine was all the time aligned to the mean wind direction. It would be interesting to present some data that support this. An idea is to see if the mean lateral component is zero over the periods examined in this study.

## Specific Comments

- Lines 60 – 65: I have a few questions regarding the measuring configuration of the downwind looking scanning wind lidar. I think that it would be very useful for the comprehension of the study if the authors clarify the following:
  - Was the scanner head moving continuously during one PPI scan or was it still for each azimuth step?
  - It is stated that 230 PPI scans were acquired over 29 minutes. Based on the time completion of one PPI scan (7.2 seconds), the 230 PPI scans should be completed in 27.6 minutes. Why is there a discrepancy?
  - Does the scanning direction of the PPI scan stay the same or does it alternate between consecutive scans?
  - What was the tilt angle of the line-of-sight measurements during the PPI scan? Is it expected a tilt of the whole nacelle when the wind turbine was operating? Why have the wake scans been scheduled every second hour?
  - One wind lidar was measuring the wake with scans that lasted 29 seconds while the second wind lidar was measuring the transverse wind component for 14 seconds. Why did the authors select a different period for the two measuring modes?
- Lines 90-92: The authors state “that the range gates closer than  $y = 117$  m showed time series that were inconsistent with the flow behaviour observed at further distances”. What kind of inconsistencies were observed?
- Line 96: Over which periods were the standard deviation of the lateral component and the integral time scale computed? Was it over a 14-minute period?
- Line 110: I am not sure if I understand correctly equation 6. The term  $\Delta x/u_{hub}$  corresponds to the advection time between two measuring locations along the x-axis. Is the  $u_{hub}$  the instantaneous measurement from the nacelle anemometer or a mean and is there an expected flow distortion in these measurements due to the presence of both the nacelle and of the two scanning wind lidars? Why is the  $u_{hub}$  and not the  $u_{max}[x]$  used here? And why does the advection time have the subscript “hub”. Maybe I have misunderstood this point, so I would really appreciate if you can clarify it.
- Line 125: Can you please clarify how Sec. 3.1.2 justifies  $u_{adv}=u_{hub}$
- Line 137: Is it larger velocity deficit or smaller velocity deficit? A wake that is partially outside the field of view of the lidar should not result in an observed smaller velocity deficit?
- Lines 139-140: It would be interesting to see what is the distribution of wind speed and turbulence intensity of these 35 wake scans. Also, what was the corresponding yaw direction?
- Line 152: Can you please clarify what is the  $T_{i,u}$  ?
- Page 9, Figure 4: The number of data points in Figures 4 a, b and c shouldn't be equal to 35, one for each of the selected cases? And also, why is the number of blue crosses different from the black ones?
- Page 14, Figure 9: If I counted correctly 23 values appear in the scatter plot. Are some of the 35 selected data sets filtered out? Also, what does the dashed line represent? Is it an identity line or a fit?
- Line 255: The authors write “for short downstream distances”. I think that this point will be clearly if they quantify those distances in terms of rotor diameters.

## Technical Corrections

- I suggest to in general replace the word "stares" that is used to describe the operational mode of the forward wind lidar with the "staring mode"
- Line 26: Please correct the "hypotheis" with "hypothesis"
- Line 27: Please correct the "hypotheis" with "hypothesis"
- Line 27: The authors write: "The passive advection hypothesis also forms the basis of the dynamic wake meandering model ..." why the use the word "also" in this sentence?
- Line 33: Maybe the verbs "described" or "reported" are more suitable than the word "established"
- Lines 36 – 39: I think that the point of the two sentences is the same. I suggest avoiding the repetition
- Line 50: I suggest re-writing the sentence "Measurement were conducted" with "the measurement campaign was conducted..." or something similar.
- Line 65: I suggest replacing the "used a horizontal state at a 90o angle" with "was measuring in a horizontal staring mode at a 90o angle"
- Line 91: Replace "farther" with "further"
- Line 94: Replace the "latereal" with "lateral"
- Line 110: Please correct the beginning of the sentence "The with a moving ..."
- Line 190: Replace the "synchronisations" with "synchronisation"
- Figure 8 – Label: Replace the "coss-correlation" with "cross-correlation"
- References: In some references the DOI is not presented correctly, e.g. the reference of Vermeer et al. 2003 and Sanderse et al. 2011. Furthermore, the Journal names should be abbreviated according to the Journal Title Abbreviations by Caltech Library