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Interactive comment on "Characterization of a wind turbine wake evolving over an intertidal zone performed with dual-lidar observations" *by* Changzhong Feng et al.

Anonymous Referee #1

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Overall Comment:

The manuscript describes the investigation of wake characteristics during a time period of rising tide. The goal of the paper is to determine if the rising tide contributes to changes in wake length. The topic of research is quite interesting and is worthy of study. However, there are several flaws in this manuscript. The current experiment design although unique, seems quite ill suited for the purpose of this study. In addition, the reviewer finds cases of improper logic and justification. With this in mind, the reviewer recommends a rejection of this paper. Hopefully the comments below will help the authors to refine their future plans for this study. Detailed comments and suggestions to the authors are given below.

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Discussion paper

Specific comments:

1) Why was the angle of the tilted plane chosen to be 4o? This angle seems quite steep to account for lifting of the wake center-line. In addition, the choice of only 1 scanning plane is poor experiment design as there is no guarantee that the wake will be aligned with this tilted plane.

2) The authors use a unique scanning geometry to perform the measurements. However, it is not clear, if this actually helps in the present case. One thing is clear, more measurement levels are required.

3) In terms of performing dual-Doppler, the accuracy of the retrieval is a function of the ΔAZ within each measurement volume. That is, the retrieval is more accurate as ΔAZ approaches 90 deg and less accurate as ΔAZ approaches 0 deg (or 180 deg). From the experiment design, it seems like the ΔAZ will be quite low towards the left and the right edges as well as close to the lidar locations. Therefore, to put the quality of the measurements in context, please include a figure showing the ΔAZ as well as follow uncertainty quantification as described in Simley et al. (2016).

4) There is no description of the data quality control. This should be properly defined.

5) Wake merging: From figures 2 and 3, panels (b), (c) and (d): It seems like the magnitude of the wake deficit is on the same order of the spatial variability within the individual transects. This is quite interesting and needs investigation. However, it is not the best example to study wake merging as several other background effects dominate.

6) As the authors point out themselves on page 8, line 20, the reduction in deficit is most probably due to the measurement plane leaving the wake region. Therefore, the "measured" wake length is not an accurate estimation of the actual wake length (the sudden drop in deficit should point to this). This (again!) points to the requirement of having several levels of measurements in order to accurately estimate the actual wake length.

7) The authors report that as the tide rises, so does the wake length. However, they fail to note the importance of wind direction. During the time period of the tide rise, the wind direction shifts from south-westerly to westerly. As the wind direction shifts to westerly, now, the wake from turbine T1 is measured. In this case, the measurement plane is almost parallel to the turbine hub axis along the wake direction. Hence, the wake region remains in the measurement plane for much longer, resulting in reporting of longer wake lengths. Therefore, the increase in wake length is NOT due to tide levels, but rather the angle of the measurement plane relative to the turbine hub axis! It just turns out that the wind direction shift is correlated with the rising tide and the authors mistake this correlation for causation.

8) Apart from the above point, any conclusions about the impact of change in surface roughness characteristics on wake length need to be back by reproducible results spanning several time periods. One case study is not enough as presented here. It is suggested to have several periods of wake measurements for each set of turbines with similar characteristics (hub-height, rotor diameter, wake fetch etc).

References:

Simley, E., Angelou, N., Mikkelsen, T., Sjöholm, M., Mann, J., and Pao, L. Y.: Characterization of wind velocities in the upstream induction zone of a wind turbine using scanning continuous-wave lidars, J. of Renewable and Sustainable Energy, 8, 013 301, 2016.

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