

Synchronised WindScanner Field Measurements of the Induction Zone Between Two Closely Spaced Wind Turbines

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Reviewer 1

No further comments from Reviewer 1

Reviewer 2

Thanks to the authors for the vast revision implemented. The manuscript can be accepted provided that the two additional comments below are addressed. Please, next time provide a marked up version including only the changes done at the last iteration

We thank the reviewer for the additional comments. The responses to the reviewer are written in blue while the modifications to the manuscript are shown in red. We further attach a marked up version of the manuscript tracking changes from the previous iteration. We hope that these changes positively benefit the manuscript.

New Comments

Comment 1 — L 520: “This interaction of vertical shear 520 with the wake can lead to an asymmetric velocity distribution as the wake rotation due to difference in wake convection speeds between the upper and lower rotor halves enhances mixing between the low and high momentum regions of the wake”: this explanation is not clear. The wake rotation is not “due to differences in wake convection” but is the to the third Newton law applied to the turbine torque. Are the authors trying to say that the wake rotation in case of high shear the wake rotation mixes up layers of fluid with different speeds, as reported at line 609? Please rephrase

Reply: We are indeed referring to the explanation that the rotation of the wake mixes up vertical layers of fluid moving at different velocity due to the vertical shear that can lead to an asymmetric wake velocity distribution. We have rephrased the sentence to the following:

”This interaction of vertical shear with the wake can lead to an asymmetric velocity distribution as the wake rotation mixes the different layers of fluid in the vertically sheared flow.”

Comment 2 — Fig 10: After adding the statistical uncertainty to the propagated uncertainty, the errors seem to be smaller, while they should be bigger by definition (see below). Please provide an explanation and fix it

Reply: Thank you for pointing this out. We have corrected our plotting routines and have updated Figure 10 to ensure that the statistical uncertainty and propagated uncertainty are added in quadrature at every location on the spatial grid. The differences in the wake profiles is shown in Fig. 1 between the revised manuscript (red shaded areas) and the original manuscript (green shaded areas). The updated figure now illustrates that the LES wake profiles have larger error bars due to the addition of the statistical uncertainty to the propagated uncertainty. Due to the normalisation of the wake profiles with mean wind speed $u_\infty = 7.7$ m/s, the differences between the wake profiles with and without the addition of the statistical uncertainty are small, however as expected the total uncertainty is larger than the propagated uncertainty.

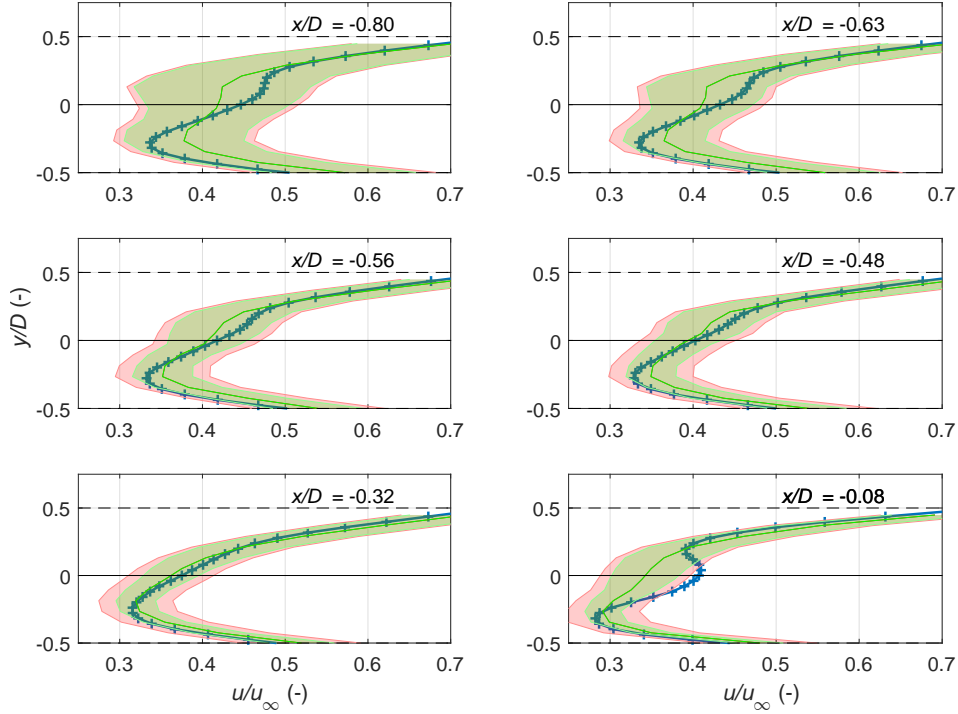


Figure 1: Updated WindScanner longitudinal velocity wake profiles presented in the revised manuscript (red shaded areas) and the original manuscript (green shaded areas).

Reviewer 3

I am satisfied with author's response to my comments and the resulting changes to the manuscript. I only have a minor and a technical comment on the new additions:

We thank the reviewer for their further review of the revised manuscript. The responses to the reviewer are written in blue while the modifications to the manuscript are shown in red. With these changes, we hope to sufficiently addresses the minor and technical comment from the reviewer.

Specific Comments

Comment 1 — Line 192: The abbreviation SNR should be introduced.

Reply: We have added an abbreviation for the term SNR

"The method filters for the line-of-sight velocity and the Signal-Noise-Ratio (SNR) in a bi-variate manner based upon the assumption of self-similarity of valid data. The method is applied on all the collected v_{los} measurements on the measurement plane and is capable of identifying hard targets such as the

nacelle and blades through the clusters in the v_{los} -SNR space. The measurements are discretized and grouped into bins based on their v_{los} -SNR values.”

Comment 2 — Line 515-523: The gist of the author’s reply to Comment 10 of Reviewer 3 should be included in the in the first paragraph of Section 3.2.3. Currently, the text reads like the difference in wake position is explained by the yaw offset alone. It should mention that both, the differences in wind direction and the differences in the yaw offset, contribute to the wake displacement.

Reply: We have added the following sentence to the revised manuscript.

”For both cases, the partially waked inflow into WT2 is caused due to a combination of the yaw offset applied on WT1 and the misalignment of the wind direction with the orientation of the WT1-WT2 axis.”