# Author Response to Review Comment #1

Dear Reviewer,

Thank you for reviewing the manuscript. Your comments were very helpful and improved the quality of the manuscript. The author responses can be found below each reviewer comment.

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| RC 1.1 | This is a strong work and worth of publishing. However I realised that this content has been published before, as you indicated on the webpage. In you paper you did not refer to your previous publication, why? |

AC Results of the wake detection algorithm have been published before. However, these results came from a different experiment at a different wind farm. The correction method has not been published before. A paragraph referencing to the already published results have been added to the introduction section.

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| RC 1.2 | The weak point of your work is the correction. You claim that you need to correct because your assumptions are not valid anymore or phrasing it differently your estimation model is not valid anymore. You phrase your paper as if this is a general problem, however in my point of view this is very specific to the lidar system you use. Let me make two points: 1) a more scientific approach would be to rethink the assumptions of the estimation and change the estimation model/assumptions whenever a wake is detected. 2) a linear data fitting approach is not very novel. You measure a model mismatch fit a correction and your data look nice. I would put a higher standard on a journal publication. Also your simulation work on page 5 is weak. You could introduce a real simulation environment for measuring in a wake in the paper to encourage others to repeat the work. This would give your detection methodology work much more meaning. |

AC The problem of a violation of the assumption of horizontal homogeneity is relevant for many lidar applications (not only nacelle lidars). Here we propose a method that can be applied to all nacelle-mounted continuous-wave lidars.

We present an algorithm that is able to identify situations where the assumptions of yaw misalignment estimation by nacelle lidars are violated. We believe that it is a plausible approach to apply a correction to the estimation, when the assumptions are violated.

We agree that the linear data fitting approach is not very novel. However, it is applied in many areas of wind energy. We show that the linear model agrees well with data gathered during *this experiment* and thus proceed to use it for the correction of the misalignment measurements. For an application of the method to other experiments more data is needed, where the method can be tested. Our goal in this work is to show the results of one setup, where this method works.

The simulation work on page 5 should give the reader an illustration of how severe the effect of wakes on the estimation of horizontal wind speed and wind direction can be.

RC 1.3 p. 1 l. 4: Sufficient large time - statement without a proof / partly disagree

AC It was shown in many previous studies that the assumption of horizontally homogeneous flow is valid in flat homogeneous terrain and when performing sufficiently large time averages. Also in this work agreement between reference sensors and the lidar is demonstrated.

RC 1.4 p. 1 l. 5: You don't tell that you would like to measure with Lidar. What about the anemometer or the vane? Are they disturbed, too?

AC A nacelle sonic anemometer or a wind vane are disturbed by the flow around the rotor and the nacelle. This disturbance is mentioned more detailed in the introduction section. For the lidar system, the disturbance stems from the violation of horizontally homogeneous flow, which can be caused by wakes from neighboring turbines and is thus of different nature.

RC 1.5 p. 1 l. 9: "one or more beams can be identified" unclear phrasing

AC This has been rephrased. Now "measurement locations" is used instead of "beams".

RC 1.6 p. 1 l. 12: "and thus, correcting the Lidar derived wind direction" see general comment. In my point of view the approach is wrong to correct a estimation which comes from non valid assumptions?

AC Again, we believe it is a reasonable approach. See also the response to the previous comment RC 1.2.

RC 1.7 p. 2 l. 16: "as a consequence" – unclear

AC This has been rephrased.

RC 1.8 p. 3 l. 1-3: Figure 1 variables are not introduced close to the Terrain effects are present. With them, the same idea can be followed

AC A reference to the page where the variables are defined has been added.

RC 1.9 p. 3 l. 26: Please also name the multi distances for the Leosphere device

AC The multiple focus distances have been added.

RC 1.10 p. 5 U_hat, Please introduce before naming it for the first time

AC The hat notation is defined on p. 5 l. 3 and the variables are defined on p. 5 l. 10.

RC 1.11 p. 7: Chapter 2: What happens to Phi_hat when a wake is detected? How does it effect the algorithm? What happens if a wind direction change and a wake impingement happen simultaneously?

AC Phi_hat will show large deviations if a wake is affecting on of the measurement locations. This is illustrated for measured data in fig. 4. If a wake is detected, the estimation of Phi_hat will not change unless the proposed correction method is used.
A running average of the wake-free detection parameters is calculated and compared to the instantaneous values. Thresholds then decided whether a wake is detected or not. This has been added to the end of section 2.
A wind direction change can coincide with a wake impingement and in such a case the algorithm cannot distinguish these events. This comment has been added at the end of section 2.

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| RC 1.12 | p. 9 fig. 5: Does it always look like that? How sensitive is the method? |

AC This is an example of two spectra measured during a wake situation. This should illustrate the broadening of the Doppler spectra due to increased small-scale turbulence. In wake situations the spectra will typically look like this. The method is sensitive to the averaging time. We have tried several averaging times and found that 1 minute averages give the best results.

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| RC 1.13 | p. 12 fig. 9: Nice evaluation, however it uses the sonic. The transition to a general met mast free methodology is missing. |

AC For a mast-free correction method more data is need to understand how the linear relationship changes with site specific parameter, e.g. distance between turbines, rotor diameter, ambient turbulence levels. We have added a paragraph at the end of the conclusion section, where this issue is discussed.

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| RC 1.14 | Conclusions: What are the learning objectives? Which conclusions can we draw and is there a way to make it independent of the met mast. Is is just for the 2 beam single distance an issue, or for every Lidar system? |

AC Similarly to the previous comment, more details have been added at the end of the conclusion section. The issues arises for all nacelle-based continuous-wave lidars that focus at different positions at a fixed focus distance.