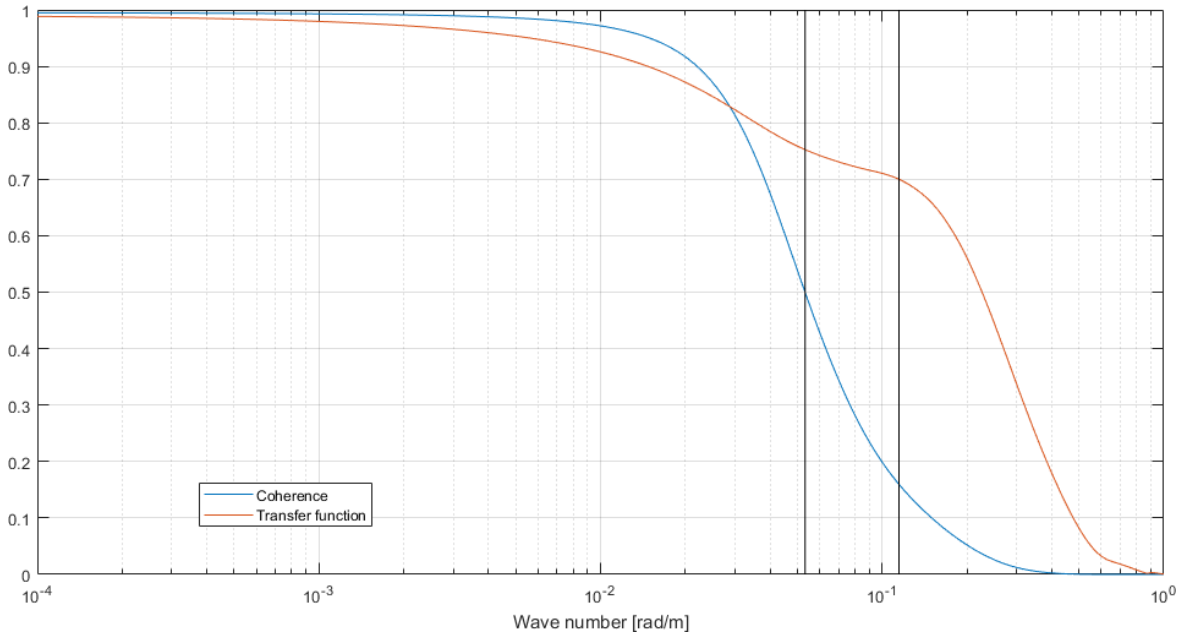
Author Response to Review Comment #2

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.

RC 2.1 Time delay: The calculation of the time delay via the "information theoretical delay estimator" is an interesting approach. However, the information in Figure 11 is hard to read. Couldn't you use mean and standard deviation for each discrete time delay? Or wind speed bin? Further, the calculation of the filter preview can be improved. First, the frequency at 1P is quite high since the frequencies you are still able to measure with a good coherence are much lower. Also, the coherence level of 0.5 might be not a good cut-off-frequency, depending on the lidar spectrum. E.g. rotor and lidar estimate of the REWS can have a coherence of 1 and still have different spectra (if the transfer function is linear). In this case, using the coherence level of 0.5 would lead to no filtering, but filtering would be necessary depending on the transfer function. The transfer function at -3dB (for first order linear filter, approx. 0.7) should be better suited, especially for lidars with little averaging effect as the ones presented in this work. The 0.5 coherence level should be only close to the -3dB, if S_LL is quite similar to S_RR. Thus, would be good to better motivate the coherence level of 0.5 or use the transfer function at -3dB.

AC Yes, we agree that the readability of fig. 11 can be improved. We have added the bin mean and +-1 standard deviation to the plot.
For a discussion on the 1P frequency please see review comment 1.14 from reviewer 1.
Choosing the cutoff frequency at 0.5 has been also done in previous research. We wanted to follow this approach to generate comparable results. If we understand you correctly, you are suggesting to consider the wave number where the transfer function has dropped to 0.7 as a cut-off frequency? We have compared there these two approaches in the figure below using the model based on Mann turbulence. It shows that choosing the wavenumber where the transfer function dropped to 0.7 will result in a larger wave number and even less filtering.



RC 2.2	Eq. 3 and 4: What is \delta, k'?

AC \delta is the Dirac delta function. The usage indicates to considering an infinitely small slice of the wavenumber space.

RC 2.3	Eq. 9: Some intermediate steps how to get there might be helpful. Maybe in the appendix? How do they relate to the equations from Mirzaei and Mann (2016)?

AC We have added more intermediate step in eq. 9.

RC 2.4	Eq. 20 and 21: It is also not really clear, how the correction is applied to the real data, since only 1 Hz data are collected. Is this algorithm done on the lidar system or in post processing? It is also not clear, where this correction comes from. Line-of-sight wind speeds are often used in a wind field reconstruction algorithm which directly provides derived signals such as the REWS. And maybe I am wrong, but the correction seems to be the same than reconstructing the average horizontal wind speed. For small misalignment angles it might be not very important. For larger angles however, it is more the average longitudinal wind having an "effect" on the rotor. Thus it is not clear, why this correction is necessary. But maybe I missed something. Thus, some explication might be helpful.

AC Yes, this is correct. A correction for turbine misalignment is not necessary. This part has been added by mistake to the manuscript and the misalignment correction has not been used in the data analysis. We have removed this section in the manuscript.

RC 2.5 Organization: The paper is mostly well organized. Only Section 4 might be separated into subsections and Section 2 might be better organized. The part before the current 2.1 could be included in a subsection “Overview Coherence Model”. Currently, 2.1 is including the model of the rotor spectrum, 2.2. how you get the REWS estimate from turbine data. Then 2.3 combines model of the lidar spectrum, cross spectrum and how you get the REWS estimate from lidar data. Thus, the subsections seem to be not on the same level. For the understanding, it might be better to first describe the model and its component (2.2 S_RR, 2.3 S_LL, 2.4 S_RL) and then the model implementation and validation against simulation (2.5) and then the modification for field testing (turbine measurements).

AC Yes, we have split up section 4 into three parts and have restructured section 2.

RC 2.6 Eq. 20: Shouldn’t \beta be \beta_i?

AC This has been changed in the manuscript.

RC 2.7 p20, l1: Up to this point, it is not mentioned that both lidar systems provides 1 Hz data. Table one might lead to 2 and 4 Hz. So it might be not clear at this point why >90% is equal to 540 measurements).

AC The sampling rate (which is 1 Hz for both systems) has been added to table 1.

RC 2.8 Figure 1: \theta_{FF} and \theta_{FB}. In text on page 1: FF and FB are not in mathmode.

AC Mathmode is now is also used in the text on page 1.

RC 2.9 Captions of Fig. 9 and 10 don’t end with a period, others do.

AC This has been changed in the manuscript.

RC 2.10 Figure 3,6,7: unit in labels (partly) missing.

AC The units for the figures 3,6,7 have been added.