

Wind Energ. Sci. Discuss., referee comment RC1
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Comment on wes-2021-50

Nicolai Gayle Nygaard (Referee)

Referee comment on "On the effects of inter-farm interactions at the offshore wind farm Alpha Ventus" by Vasilis Pettas et al., Wind Energ. Sci. Discuss.,
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The authors analyse the effect neighbouring wind farms on the offshore wind farm Alpha Ventus. They use a long period of meteorological measurements at the met mast FINO1 to assess the changes of the wind conditions due to wakes from neighbouring wind farms built in multiple stages. Similarly, they use operational data from a turbine in Alpha Ventus to analyse the impact of the inter-farm interactions on the loads.

The paper gives a good overview of the data and the results provide a solid foundation for future model comparisons. It is well written and easy to follow. The paper adds solidly to an important area of research.

As a general comment, I do not understand the inclusion of fitted shear exponents based on power law wind speed profile. In a waked flow the power law cannot be expected to apply, as the wind speed deficit in the wake modifies the wind speed profile. There are many examples of this in the literature. The authors even indicate this in line 274. Reporting a shear coefficient is meaningless if it results from a poor fit to power law profile. I therefore suggest that all discussions on shear are removed from the manuscript. Alternatively, the authors should add quantitative details on the quality of the fits along with the reported shear coefficients in Figure 9 and elsewhere.

The following specific comments should be considered:

- Include a reference to Ortensi, Frühmann and Neumann, Long-term Effects of Wakes from Offshore Wind Farms on Wind Conditions at FINO1, UL white paper, 2020
- L9: wind turbine performance typically relates to the power production. Since the paper is investigating the loads and how they are affected by the inter-farm effects using the term turbine performance is somewhat misleading
- L100: please include examples of the corrections applied to the FINO1 data (or a reference). This will increase the reproducibility of the analysis
- L123: please explain in further detail how the calibration of the nacelle yaw sensor was done
- L125: have the small corrections on the calibration factors been described elsewhere? Otherwise, please include further details
- L128: specify the appropriate thresholds, e.g. in an appendix
- L130: is there a directional pattern in the difference between the met mast wind direction and the turbine yaw direction? See examples of this in Schepers et al, Wind Energy 2012; 15:575–591
- L178: I agree that the wake from AV itself is expected to lead to an underestimation in the FINO1 wind speeds. But why not confirm that by comparing wind speeds in the affected sector in the periods before and after the construction of AV? The FINO1 mast has several years of measurements before the construction of AV
- L183: please be more specific when talking about significant data gaps. How large are they?
- L190: constant offset – this strictly speaking only applies if the wind speed deficit from AV is constant and the frequency of wind directions in the sector affected by AV is the same in all years
- L193: the AEP is the convolution of the power curve with the Weibull distribution (or more generally the wind speed distribution), not the product. Typically, the convolution is replaced by a discrete approximation summing the product of the two curves over all wind speed bins
- L230: please include a reference to theory supporting the statement relating TI in the wake to the thrust coefficient of the upstream turbine
- L236: what is a blizzard cage structure? Is it on FINO1?
- L247: why would the larger size of the wind farm MRK and its turbines be a factor? Make the argument clear to the reader
- Figure 7: why is there no shading indicating the sector affected by wakes from MRK?
- L305: the sector influenced by wakes from AV is described as 30-170 degrees on pages 8 and 11, why is it different here?
- L320: consider a better word than usage of the generator. I think you mean increased wear due to increased fluctuations of the generator speed
- L331: the authors state that yaw misalignment is common to a level of some degrees. Please be more quantitative: how common? How many degrees? Add references to support this statement
- L341: Monin-Obukhov theory is not a stability measure. Do you mean the Monin-Obukhov length? Nonetheless, I agree that similarity theory likely does not apply in the wake
- L356: the conclusion of coincidence between the direction of strongest inter-farm wakes and the pre-dominant wind directions is particular to this site. It is not a general conclusion
- L358: the weighting/accounting for inter-farm wakes is done routinely in the industrial application of wake models
- Consider adding references to other papers analysing wakes between offshore wind farms, for example Hansen et al, Journal of Physics: Conference Series 625 (2015)

