Interactive comment on "Understanding and mitigating the impact of data gaps on offshore wind resource estimates" *by* Julia Gottschall and Martin Dörenkämper

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We thank Reviewer 1 for the careful evaluation and believe the suggested changes, implemented by us within the revision process, have improved the manuscript considerably. We also agree that the scope of the paper is rather narrow and could be extended in a subsequent or follow-up paper. In fact, our main focus has been to present our approach in an as reduced as possible form so that the associated procedure can be applied in as many cases as possible (in later studies). We believe that the extensions are straightforward to implement.

Please find our detailed answers to all the comments separately below.

Specific Comments:

[R1SC1]: P1L6-7 - impact on what? the error? if so, what kind of error? as it stands, it's ambiguous. The abstract should speak for itself

We assume the reviewer referred to the wrong line here (should be L4). We have added: "... in terms of a bias in the estimation of siting parameters".

[R1SC2]: P1L7-10 - again, it is unclear what "impact" means here, before it is clarified in P1L6-7

We agree and have added: "i.e. a reduction of the observed biases"

[R1SC3]: P5L26 - You have chosen to investigate the impact on mean wind speed, direction, and Weibull A and k, but I think it would also be interesting to additionally show the impact on power, be it power density, or estimated production for reference turbines.

Yes, we agree. We have added a corresponding paragraph to the Discussion section and reproduced Fig. 6 for the wind power density.

[R1SC4]: P5L26 - How was the Weibull-fit made? e.g. maximum likelihood, or WAsP-like moments-based fit that preserves the wind power of the histogram? or something else?

Thanks for asking for this clarification. We have added: "The fitting procedure is implemented as a nonlinear least-squares regression considering the complete wind speed range."

[R1SC5]: P6Fig3 - As I understand it, the Dantysk wind farm was constructed during 2014. Did you consider whether the Fino3 measurements were disturbed by the

emerging farm during days with flow from the east?

According to [1] the wind farm fed its first kilo Watt hour in December 2014. The first turbine was installed in April 2014 while the operation of single turbines did not start before autumn according to [2]. The time windows we have investigated covers data until June 30th, 2014. We have added a sentence to clarify this to the introduction of the FINO3 mast: "Less than a kilometer west of the FINO3 the wind farm DanTysk was constructed between February 2013 - April 2015. The erection of turbines did not start before April 2014 and operation not before December 2014. So the wind statistics of FINO3 should not be impacted by wakes of DanTysk."

[1] https://powerplants.vattenfall.com/dantysk
[2] https://www.offshore-windindustrie.de/news/nachrichten/artikel-26061-vattenfall-meldet-erste-turbine-im-offshore-windpark-dantysk-und-testet-neue-installations-technik.

[R1SC6]: P8 - Please also state what simulation duration and spin-up time was used with WRF

Simulation duration was 10 days (240 hours) plus 24 hours additonal spin-up time. We have added this information to Table 2 in the revised version of the manuscript.

[R1SC7]: P5L26 P8 - It would be instructive to show the bias of the reference data compared to the measurements and how it varies with time, especially how it varies with season. If the reference data bias varies with season, which is often the case, it will probably be one of the dominating factors in explaining the MCP errors, particularly when the gap falls in one continuous period like here.

We have done this analysis but not included it in the paper: we could not find a significant bias between the numerical data and measurements. Monthly mean biases (for FINO3 as an example here) vary between 0.38 and 0.50 $\mathrm{ms^{-2}}$ with the largest

C3

value for August and the smallest for April.

[R1SC8]: P10L7 - Please be more specific in detailing the method. I assume you:
– Use the modeled wind speed data as the predictor (x)
– Use the measured wind speed data as the predict and (y)
– group x; y pairs (in time) by 0.5 m/s bins of x
– calculate the mean and standard deviation of y in each bin
– make a piece-wise linear fit to the mean of y and use that as the correction function
Is this correct?

Thanks for pointing out that this method description was obviously not clear enough. We have rewritten this part as follows: "For the wind speed data, we – first – bin the wind speeds every $0.5\,\mathrm{m\,s^{-1}}$ based on the modeled data and calculate the average measured values in every bin. Second, we fit two linear functions for the wind speed ranges $[0, 5)$ and $[5, 20]$ $\mathrm{m\,s^{-1}}$. The resulting coefficients of the linear fits are then applied to correct the respective modelled wind speed and account this way for the systematic error between measured and modelled data."

[R1SC9]: P15 - As you mention, it may have been better to use the center point of the gaps as the reference time, as opposed to the period start. Especially when considering the season, since the central point better represents the time of the gap.

We do not think that this alternative approach may have been better – the situation that a (long) data gap takes place in two seasons would remain. Actually we think that the chosen approach is better because it links the gap to the failure reason (for which the starting date may be more meaningful than a centre point).

[R1SC10]: P16 - Can you offer a deeper explanation for why the gap-filling before longterm extrapolation leads to equally large errors as not gap-filling first? it seems counter-intuitive

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We added this explanation to the discussion in the revised version: "The fact that we have not optimised the MCP methods for our applications may also be the reason for the initially counter-intuitive observation that the gap filling procedure, applied to the short-term measurements, has no positive effect on the long-term extrapolated results (cf. Sect. 4). Another reason is the relatively short gap of only one month which is still within the availability of $> 90\%$ accepted by MEASNET."

[R1SC11]: P17L5-6 - How is the RMSE = 0:003 for the black curves calculated here? In other words, what is considered the "target" result? the mean?
Thanks for asking for this clarification. We have added: "where the mean value is considered as reference".

Technical Corrections:

[RC1TC1]: P2L10 - "threshold of amount of lengths of data gaps", perhaps just "threshold of lenghts of data gaps"?
Thank you. We have modified the text to "Up to a certain threshold of frequency and length of data gaps".

[RC1TC2]: P3L13-14 - "And with Section 6 we conclude our contribution." to me it sounds like you put the emphasis on ending the paper, rather than concluding on the results of the study. I would suggest rephrasing it.
Thank you. We have modified the text to "And, finally, in Section 6 we summarize the main conclusions of our study."

[RC1TC3]: P3L23 - "next" → "nearest"?
Changed accordingly. Thanks.

[RC1TC4]: P4Fig1 and P8Fig4 - Please make sure you adhere to the guidelines related to copyrights and distribution licenses for the background maps. See the author guidelines.
Thank you. We have added the reference for the data source (GSHHS) to both captions

[RC1TC5]: P5Fig5 and P15Fig10 - Please add panel labeling, e.g. (a), (b), etc.
Thanks for the advice. For Fig. 5 we have not added panel labelings since the three plots result in one illustration. For Fig. 10 we have added the labels.

[RC1TC6]: P7L23 - Please spell out "grid points (GP)" the first time it's used
Changed accordingly. Thanks.

[RC1TC7]: P7L23 - The "x" symbol seems like a regular x rather than a "times" symbol, e.g. like LATEX's made using: `$\times$`
Changed accordingly. Thanks.

[RC1TC8]: "P9L7 - Note that colons are recommended between hours, minutes, and seconds. Example from the guidelines: 25 July 2007 (dd month yyyy), 15:17:02 (hh:mm:ss)"
Changed accordingly. Thanks.

[RC1TC9]: P10L8-10 - The explanation seems more convoluted than it needs to be. Why not state that you used the piece-wise linear fit as the correction function?
This is the same position as RC1SC8. Please have a look at the clarification we suggested there.

[RC1TC10]: P15L14 - "both" → "but"?
Changed accordingly. Thanks.

[RC1TC11]: P18L6 - Incomplete sentence. "At this it should also be"...
Changed accordingly. Thanks.
We have removed the "At this" to make it a meaningful sentence. Thanks

[RC1TC12]: P18L13 - Should "so" be removed here?
Changed accordingly. Thanks.

[RC1TC13]: Everywhere: please use the abbreviation "Fig." in running text, as per the Author guidelines
Changed accordingly. Thanks.

[RC1TC14]: Everywhere: I would suggest adding a space, e.g. with LATEX, between units, e.g. m s-1 rather than ms-1
Changed accordingly everywhere. Thanks.