Wind Energ. Sci. Discuss., referee comment RC1
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Comment on wes-2021-106

Anonymous Referee #1

Referee comment on "Comparing and validating intra-farm and farm-to-farm wakes across different mesoscale and high-resolution wake models" by Jana Fischereit et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-106-RC1, 2021

SUMMARY

This work compares wake simulations from three different genres of models: mesoscale wind farm parameterizations, RANS models, and low-cost engineering models. This comparison also involves measurements from a meteorological mast and SCADA. This type of wake model comparison study is extremely valuable, and it requires a large amount of work to conduct. The major limitation of this comparison is the small amount of easterly flow under neutral conditions with 9–12 m/s winds, leading to a small amount of WRF data for this inter-model comparison. While this is unfortunate, several other wake modeling papers have been published with similarly small datasets, so it would be unfair to hold this paper to a different standard. The authors also acknowledge this limitation and urge some caution when interpreting these results. The manuscript also does a month-long comparison of the Fitch wind farm parameterization to the EWP. The manuscript is extremely well written, which makes it easier to understand the methodology and the results. Some major conclusions are (1) the mesoscale WFPs (especially Fitch) and the RANS models agree well about average intra-farm wind speed reductions, whereas the engineering models have weaker average intra-farm waking (2) similarly, the mesoscale WFPs and the RANS models predict similar median wind speed and power reductions due to farm-to-farm waking, whereas the engineering models tend to show negligible farm-to-farm waking (ZON being the exception) (3) the Fitch WFP tends to do better than the EWP throughout the study.

MINOR COMMENTS

* Throughout the manuscript, please update legends where necessary (e.g. Fig 3). WES guidelines state "A legend should clarify all symbols used and should appear in the figure itself, rather than verbal explanations in the captions (e.g. "dashed line" or "open green circles")." https://www.wind-energy-science.net/submission.html

* L11 and L449: possibly "reasonably" instead of "reasonable"
* L11-13: Please quantitatively state the bias of both Fitch and the EWP. The Fitch wind speed bias is only 0.12 m/s (or ~15%) smaller than the EWP bias, but based on the current writing, I assumed they had a much larger difference in my first readthrough

* L14-15: Please clarify that you are refering to peak wind speed deficits (because average deficits differ between PyWake and RANS)

* L36: "Pay off" is somewhat ambiguous
* L40-41: Fishereit et al. (2021a) detail a vast number of WRF WFP studies that simulate wakes inside of a farm (e.g. Shepherd et al. (2020) compares FIT and EWP). I am confused by the statement "only one study… evaluated intra-farm wakes with EWP". Perhaps a different definition from "intra-farm" is being used than as I understand it.
* L54-55: What is a "high-resolution" wake model?

* L70: While I understand why the power and trust curves are important, why is the rotor speed curve important?
* L104,L106: Missing parenthesis
* L117: Is there a particular reason to aim for 7% TI at hub height?
* L121: What is meant by "in full balance"? Time-varying WRF models show blockage effects, so steady-state is not required to study this effect
* L191: What is a Gaussian average?

* Sec 3.1: This doesn't necessarily have to be mentioned in the manuscript, but I believe a month-long WRF WFP comparison to met mast data is the longest WFP-to-mast comparison to date
* Figure 8: I am having a tough time understanding the vertical red and yellow bars. Do these mark the 9 and 17 timesteps with data?
* L237: In WRF WFP validation studies, we always struggle with two interrelated questions. (1) How accurately does WRF simulate the background flow? (2) How accurately does WRF model wake effects? Because the observational mast is very close to a turbine, it is technically not possible to truly calculate WRF's bias in background flow. However, it is possible to characterize bias during "strong waking" (as is done in L247) and "weak waking". Please quantify bias under these two conditions, defined as you see fit.
* L242: Please quantify "medium high wind speeds"
* Figure 10: The small map showing the location of the transect is an excellent feature
* L267: In contrast to what?
* Sec 3.2.2: "Average deficits" are often discussed, but they are not quantified anywhere. Please share these values throughout this subsection.
* Figure 11: It is difficult to distinguish between the models within each of the spikes. For example, I believe there should be orange spikes in panel b, but I do not see any. Consider shifting some of the models downward on the y-axis by 50D and note that this shift is being done to help improve legibility
* L304: Please roughly quantify "close to turbines"
* Figure 14: Thank you for showing both absolute and relative differences
* L329: Consider reminding the reader that these reductions are focused on only ~10 m/s winds for this inflow direction
* Figure 15: Please add an arrow that points to the left to remind readers that the wind goes in that direction

* L410: Please quantify the relative performance of FIT and the EWP
* L416: Please clarify "perform well relative to ?"
* L418-424: This paragraph reads very well
* L438: Thank you for urging some caution due to the small amount of data
* L449: It was nice to see that the three main aims from the intro were returned to. I will say, the 3rd aim (computational cost) feels like it is not discussed much throughout the paper. I would consider stating that this paper has two main aims.
* L475: Thank you for citing the Python packages!