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Geoscientific Model Development Discussions

Interactive comment on "Observed and simulated turbulent kinetic energy (WRF 3.8.1) overlarge offshore wind farms" *by* Simon K. Siedersleben et al.

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Summary

The authors of the manuscript studied the atmospheric boundary layer above offshore wind farms for three cases. Co-located aircraft measurements are available and horizontal wind speed and TKE are measured. In particular their sensitivity study of different setups regarding the horizontal and vertical resolution, influence of turbulence source terms, and turbulence advection. Having high resolution reference measurements makes this work useful as it can go beyond stating differences between model setups. The manuscript is well written and concise. I recommend publication but have

some minor points that could make the manuscript easier to follow for the reader.

General comments

- It is hard to follow where the wind is coming from in the plots. The flights are neither cross wind nor along the wind direction but at an angle. This needs to be clarified earlier as it took me until page 14 to understand this. E.g. Fig 8: It is not really clear where the wake is.
- Synoptic forcing is mentioned but not clearly defined where it is taken from.
- The naming of the simulations does not make it clear which cases have been simulated. I would presume that all cases would be simulated with all the simulation setups in Tab 2, which would correspondent to 99 different simulations. Has this been done?
- Please check references to Figures carefully, I noticed some that seemed to reference the wrong Figure but might have not caught them all.
- Please increase the size of Fig. 4 and 5. They greatly helpful understanding the paper but are hard to read.
- In the Discussion you give recommendations that can be understood as quite general. They are based on one case, where WRF got the background flow correctly. Please stress this fact more as it poses a clear limitation. A reader who scans the Abstract and Discussion would benefit from this.

Specific comments

- P3, L15 - 17: This sentence is confusing and I am not sure what is meant.

- P5 l33 to P6 L1: The thrust coefficient is related to the thrust of the wind turbine not the energy.
- Fig. 2. Simulations are mentioned (CNTR) but not introduced beforehand. This might confuse the reader.
- Eq. 1. In the text at P7 L 4 to 7 you explain what V_H and V_{ij} are. How is V_H different from V_{ij}?
- Fig. 3: Similar issue as before. It is unclear what the simulation setups are at this point.
- P9, Tab 2: Add which cases are simulated. What is the difference between CNTRa, CNTRb, and CNTRc?
- P10, L1-7: How was stratification determined here? The measured wind speed profile does not suggest much shear and the potential temperature profiles shows very little variation.

  Some problems with Figure references (6g is wind direction but temperature is referred). Fig. 1 is referenced but probably Figure 6 meant.
- P10ff: Which simulation from Tab. 1 are presented here? What resolution?
- Fig. 7: It is hard to make out differences in the wind speed with the chosen wind speed scaling. Please split it by case to make it easier for the reader.
- Fig. 8: It is not intuitive to the reader to follow if a wake effect is expected outside of the wind farm region. It would help to add another shade to where a wake effect would be expected. This is linked to the first general comment.
- P18, L1: Reference to Figure 12. L5: "TKE only $0.3m^2s^{-2}$ lower than the observed mean". Is this the mean over the wind farm location? L6: Which area with

high shear? Are the referenced Figures correct? L10: Within Figure 13 there is no measurement for easy comparison. It could be helpful to define an average TKE over the wind farm and present this consistently for all simulations and the observation.

- P19, L7: Is the EWP from Volker et.al.2015 used here or is the turbulence production term turned off in the Fitch parametrization? Please clarify.

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