Reviewer 1

This is a well written paper which addressing a topic of interest which has been little explored. I would suggest that it can be published with some minor changes:

We thank the reviewer for the time they spent reviewing our work and for their supportive suggestions and comments. Our replies are inserted below into the reviewer's comments.

- Line 229: not sure what is meant by the 'bi-modal velocity deficit distribution'. Please elaborate.

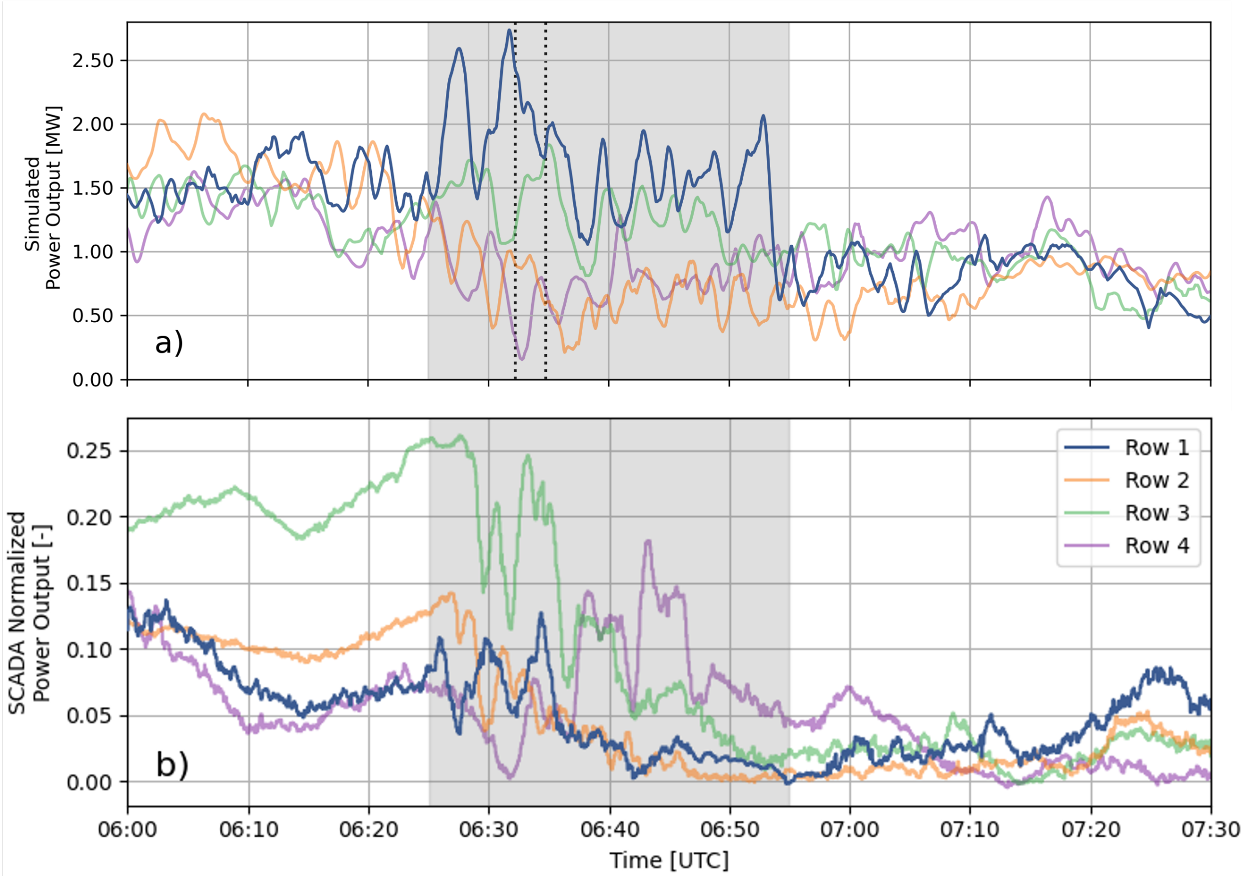
We have clarified this sentence by referencing studies analyzing wind turbine wake characteristics and by specifying that the near-wake structure refers to the velocity deficit distribution prior to any turbulent mixing (lines 234-238 in the revised manuscript):

> "When using 20~m grid spacing, and prior to the turbulent mixing in the far-wake region, the near-wake structure importantly still retains the characteristic bimodal distribution of the velocity deficit (also described as a double-Gaussian velocity deficit in Keane et al. (2016) and Schreiber et al. (2020)). The bimodal distribution is due to blade geometry and aerodynamics, as well as nacelle effects as seen in experiments, observations, and modeling (Wang et al., 2017; Vermeer et al., 2003; Carbajo Fuertes et al., 2018)."

- Figure 12b: it would useful to include the measured power output for rows 2-3 also. I understand that there may be commercial confidentiality issues, but presumably if the values are normalised as for row 1 there should not be a problem?

Figure 12 now includes the measured power output for rows 2-4. We have added the following discussion comparing and contrasting the simulated and measured power including all four rows on lines 420-429 in the revised manuscript:

> "The simulations and SCADA data both show clear effects of the gravity waves in the power signal for row 1, but for rows 2-4 (especially rows 3 and 4), the gravity wave effects are more extreme in the SCADA compared to the simulation results. A potential reason for this difference is that the observed gravity waves could contain more energy than those predicted by the model. In the model, the gravity waves near the surface are dissipated as soon as they encounter the first row of the wind farm. In reality, the more energetic gravity waves are likely able to entrain momentum from above such that their effect is felt more strongly throughout all four rows. Considering the good agreement between the simulated and observed power signals for row 1, the model is able to capture the leading edge of the gravity wave passage but likely overestimates the dissipative effect of the wind farm on the gravity waves. Lastly, it is important to note that subtle differences in the wind direction can cause large power fluctuations due to waking because of the configuration of the farm (as discussed in the following paragraphs)."



- Figure 13: make it clear that the values are simulated (I presume)?

This has been clarified in the figure caption and at line 432 in the revised manuscript.

- Line 512: it is not obvious that there are patches with little or no turbulence in the TKE1.5 scheme which are much different to the other schemes. Maybe this could be highlighted on the plots?

An inflow region has now been highlighted in Fig. A1 and separately shown in Fig. A2. Along with the zoomed in plan slice of hub-height wind speed in Fig. A2, hub-height vertical velocity is also included to give the reader another visualization of turbulence that highlights the differences between the closures.

- Line 566: edit the superfluous text from the acknowledgements

The superfluous text has been removed.

There are a few typos:

Thank you for catching these mistakes. They have all been corrected.

- Figure 2 caption line 2: should be 'outlined', line 3 should be 'is outlined'

- Line 146: the Obukhov lengths should have units of metres
- Line 180: should be 'number of particle'
- Line 266: should be 'parameterization'
- Line 374: should be 'maximum' (I think?)
- Line 453: should be 'microphysics'
- Line 477: should be 'turbines are less…

References:

A Keane *et al* 2016 *J. Phys.: Conf. Ser.* **753** 032039 **DOI** 10.1088/1742-6596/753/3/032039

J Wang *et al* 2017 *J. Phys.: Conf. Ser.* **854** 012048 **DOI** 10.1088/1742-6596/854/1/012048

Schreiber, J., Balbaa, A., and Bottasso, C. L.: Brief communication: A double-Gaussian wake model, Wind Energ. Sci., 5, 237–244, https://doi.org/10.5194/wes-5-237-2020, 2020.

Carbajo Fuertes, F., Markfort, C. D., & Porté-Agel, F. (2018). Wind Turbine Wake Characterization with Nacelle-Mounted Wind Lidars for Analytical Wake Model Validation. *Remote Sensing*, *10*(5), 668. https://doi.org/10.3390/rs10050668

Vermeer, L.J., Sørensen, J.N. and Crespo, A. (2003) Wind Turbine Wake Aerodynamics. Progress in Aerospace Sciences, 39, 467-510.
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