Wind Energ. Sci. Discuss., referee comment RC2
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Comment on wes-2021-105

Anonymous Referee #2

Referee comment on "Evaluation of the global-blockage effect on power performance through simulations and measurements" by Alessandro Sebastiani et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-105-RC2, 2021

General Comments

The authors evaluate how global blockage affects turbine power performance measurements. They evaluate these effects using measurements and idealized simulations. The main conclusion of the paper is that global blockage produces a bias in power performance testing when performed using an array of turbines with small turbine spacing. This work is an interesting and useful addition to the scientific community, but there are a couple of points that should be addressed before publication.

Major Comments

1. Line 35: The physical mechanism that produces wind plant blockage is not yet well understood and there is still not an accepted mechanism. Some simulations suggest an adverse pressure gradient, but others don't. Also, the upstream reverse pressure gradient is very sensitive to atmospheric conditions and LES code.
2. Section 2.2.1: The author mentions that having the wake outside the refined region of the mesh alters the power output by ~1%. This is the same order of magnitude as the differences in power production due to blockage. Can the increase in wind turbine power be in part due to having the induction zone and wake outside the refined region of the mesh? Were any sensitivity studies done for the choice of the simulation domain with regards to having the induction zone outside the refined region?
3. Section 3.2 and Section 4.2: The author suggests induced velocities in the wake region produce higher power production relative to an isolated turbine. The induced velocities in Figures 6 and 7 are in the order of 0.8% at y = 0D. It is unclear how these small induced velocities downstream result in an increase in power production, when at the same time hub-height wind speeds are smaller than in the isolated case. Also, might these induced velocities be a numerical artifact since turbine measurements do not evidence this increase in power production? This issue should be investigated further before drawing

strong conclusions about enhanced turbine performance.
4. The authors conclude that wind turbine power output can be enhanced when turbines are aligned in a row. This is a very strong statement that has many caveats. Measurements show the increase in turbine power is only for the downstream turbine in the row. And the simulations are highly idealized (neutral potential temperature, uniform wind speed, unconstrained flow, no turbulence). Please modify.

Minor Comments

- Section 1: improve literature review in paragraph 1.
- Line 60: It would be nice to have a number/order of magnitude to give more relevance to this work.
- Line 89: are you considering a neutral potential temperature profile? Please specify.
- Section 2.2: I understand there is no need to describe the simulation setup in great detail, but it should be noted that there is no bottom boundary for the surface and thus the flow is completely unconstrained.
- Line 116: Clarify that you also want to test how the location of the turbine within the domain may influence the results.
- Line 167: Clarify. Based on Figure 3, it seems the largest variation in turbine power for T5 is for θ = 45 deg rather than θ = 0 deg.
- Line 174: In many numerical codes, the GAD parameterization distributes the forces over multiple grid cells along the streamwise direction. Are these grid cells contained in the region where the incoming wind speed for T3 is higher than in the isolated case (<0.2D)?
- Section 3.3: Why a standard deviation of 41 deg?
- Line 230: Please include the equation for the power-law wind profile for completeness.
- Line 258: Please clarify if the differences among the mean power values is between measurements and simulations, or between the different inflow angles.
- Line 279: The author mentions SCADA measurements confirm the numerical results. It is unclear which numerical results since you mention the induced velocities in the paragraph immediately above, but the existence of these induced velocities is not confirmed by the measurements. Please clarify that measurements only confirm the overall trend in change in power when compared to a turbine in isolation.
- Figure 10: Confidence intervals rather than a standard deviation may provide more information to the reader.