Wind Energ. Sci. Discuss., referee comment RC2
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Comment on wes-2022-7

Anonymous Referee #2

Referee comment on "Quantifying the effect of blockage for wind farm layout optimization" by Ethan Young et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2022-7-RC2, 2022

The authors are trying to address the issue of wind farm blockage by defining some new blockage metrics and using a finite-difference based adjoint-solver in conjunction with a CFD model to optimize a wind farm layout with respect to blockage. Whilst the topic and methods employed by the authors are extremely relevant to wind farm optimization, the overall structure, quality and scientific value of the paper does not justify its publication and should be rejected. This is not to say that an improved version of the paper should not be reconsidered, however the necessary changes would probably lead to a very different paper. A resubmission should be considered after addressing some major flaws of the current version addressed in the following paragraphs.

To me it is currently unclear what the authors are trying to answer. Please try to formulate a research hypothesis and structure your paper around it. Currently, it is unclear what question the authors are trying to answer, is it whether a metric can be devised for blockage or whether one can optimize the wind farm layout for blockage or is it the optimization framework which is being verified? If they are trying to optimize the wind farm why would one use the metrics proposed by the authors and not directly optimize for power? Why for a single wind direction and wind speed? Afterall blockage is a very small effect – as the authors are also realizing once they start to optimize for power directly – so why should one optimize for a measure of wind speed upstream of the wind farm? This would require an upstream wind speed measurement to give a direct relationship to the power production in a wind farm, but this is not the case as pointed out by many other researchers working on blockage (maybe not spotted by the authors as the reference list is rather limited). The larger blockage at the most upstream turbine also means that less power is extracted by the first row of turbines, energy that can then be extracted by downstream turbines in the wind farm, very similar as in induction control of farms.

A major problem with the optimization is not the procedure itself, that is rather interesting and holds large potential - and maybe that is where the focus should have been - but the metrics devised by the authors. They do not sufficiently justify and verify their choice, why should one use these measures. Why not the disc-averaged velocity, a much more

relevant quantity with respect to power production, the ultimate goal of any wind farm optimization (ignoring constraints like water depth, cable length …)? The flow upstream of a turbine is always just a proxy for power production, however it is the induction in the rotor plane that matters. The velocity upstream is not a good indicator in wind farms or any location where we have flow evolution.

Finally, the authors need to work on the reproducibility of their work. They do not even state explicitly that they are solving the RANS equations. There is no numerical domain description or methodology, no grid study, no explanation of the Gaussian kernels they use to represent the ADs. It is also unclear how they are setting the thrust at the rotor inside the wind farm? If the thrust coefficient of downstream turbines is actually influenced by upstream turbines (the case when not using constant CT' everywhere) then it is hard to conclude on what the effect is of adding downstream turbines as this will completely depend on the turbine type and wind speed as CT is changing between turbines. If it is not constant it is hard to derive any general take-aways from the reported metric evolution with number of turbines. It also remained unclear why the authors chose to optimize for a single wind direction and wind speed (the description is very limited so actually unsure if this was the case)?