

Wind Energ. Sci. Discuss., referee comment RC1
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Comment on wes-2022-80

Alessandro Fontanella (Referee)

Referee comment on "Optimization of wind farm operation with a noise constraint" by
Camilla Marie Nyborg et al., Wind Energ. Sci. Discuss.,
<https://doi.org/10.5194/wes-2022-80-RC1>, 2022

GENERAL COMMENTS

The topic of the article, which is the optimization of wind farm operation in presence of noise constraint, is meaningful for the research community and within the scope of WES. The ideas it conveys are useful to address the problem of noise emission; the article is also an application of an optimization for a discrete variable problem, and the approach can be used in other studies not related to the noise emission topic. The objectives and hypothesis of the research are clear and clearly outlined. The discussion of the methodology and the results is backed up with sufficient detail. The article is generally well structured.

For these reasons, I think the article deserves to be published in the WES journal. Prior to publication, I would like to ask the authors to address the comments below. I included in "specific comments" some suggestions that I think can make the article more effective. In "technical corrections" you can find a list of typing errors, the request to improve clarity of some sentences, or suggestions to improve the presentation quality.

SPECIFIC COMMENTS

- I would modify the title to cover the use of two sound propagation models of different fidelity. For example: "Optimization of wind farm operation with a noise constraint and two sound propagation models of different complexity".
- The abstract conveys the meaning of the article, but it doesn't give key results. The

abstract should present in brief the main results of the article and offer a short description of their interpretation.

- 56-60: "the aim of this paper is ... in the specific flow case". I think this does not cover the true aim of this paper. I would say the aim of this paper is to present a computational framework to optimize the operational mode of turbines in a wind farm in presence of a noise constraint. This is the main goal. Then, there is a second one, which is to show the eventual advantages of using a more complex and computationally expensive sound propagation model in place of a simpler one. The sentence "but could be transferred to layout optimization with noise constraints by considering the Annual Energy Production (AEP) of the wind farm instead of the power production in the specific flow case" is not clear. Instead of this sentence, I suggest you summarize the main elements of novelty of this article and explain its expected impact.
- Section 2. I think it would be beneficial to add a couple of sentences at the beginning of the section (below the main title) to introduce the structure of the computational framework; you should briefly explain how Topfarm and PyWake are combined and how the sound propagation model come into play. I would anticipate here the sentence at lines 186-187: "the modeling in the problem is divided into two parts: the wind farm wake modeling and the sound propagation modeling" and add some details to it.
- Section 4.2. I think you should add some details about the vertical wind profile used for these simulations, consistently with what is done in the next subsection.
- Section 5.3. In my opinion this section does not bring any new result, so it can be shortened, removing parts already covered before, and merged with conclusions.

TECHNICAL CORRECTIONS

- 6-7: the sentence "Thus, as the WindSTAR model introduces a higher complexity of the sound propagation computations, it likewise introduces a higher computational time" is redundant and can be removed.
- 21-23: "A method for effectively choosing at which operational mode each of the wind turbines should operate during varying atmospheric conditions is therefore needed". The link between operational mode and the atmospheric conditions is not clear. What do you mean with atmospheric conditions? You should name the parameters you are considering, like temperature, air density, ...
- 41: what do you mean with "meteorological conditions"? You should be more specific.
- 44-45: "Thus, the attenuation of the sound has further been shown to change with the stability of the atmosphere (Barlas et al. , 2018)". The link between this sentence and the text before it is not clear.
- 47: remove "immense".
- 51: "is along with the ISO 9613-2 model used for optimization in this study." Change with "is used along with the ISO 9613-2 model for optimization in this study."
- 55: replace "the model" with "it".
- 85: Frequency (f) is used in the equations above and should be introduced after eq 1.
- 108: "in the r-direction". Is it "radial direction"?
- 108: " a grid resolution of ...". I think you should define the coordinates system (what are the r and z directions?).
- 113 and 126: "too excessive" remove "too".
- 128: "to be uncorrelated and the average" is it "average pressure"?

- 132: "From which the attenuation of the sound will henceforth be referred to as the transmission loss, TL". This sentence is not clear and should be rephrased.
- 143-144: "While the ISO 9613-2 model can be evaluated on a laptop, the amount of physics included in the WindSTAR model require a cluster for the computations". Can you support this sentence with quantitative information (i.e., execution time for the same simulation with the two models)?
- 149: "which estimates i.e. the Levelized Cost of Energy (LCoE)" remove "i.e."
- 149-150: "Topfarm has among others previously been used" replace with "Topfarm has been previously used".
- 163: "presented" change with "presented here".
- 168: "PyWake is loosely coupled to WindSTAR and wrapped with the Topfarm optimization framework". This sentence is unclear and must be rephrased.
- 168: "Furthermore, the" replace with "The".
- 169: "Ct curve" replace with "Ct (thrust coefficient) curve".
- 169: "wind turbine type" replace with "wind turbine under consideration".
- 170: "an iterative downstream manner" unclear, try to use different words.
- 171: "(Bastankah et al. , 2014)" remove brackets.
- 172-176: "WindSTAR has previously been coupled ... in the presented work". I think these sentences do not add much to the discussion and can be removed. In case you want to keep them, you must explain more clearly the meaning of the sentence "However, the source strength is provided through the operational modes and the Qian wake model is further not yet available in the PyWake framework, but only loosely coupled with WindSTAR through an implemented Fortran version" and why this is important for the rest of the analysis.
- 193: remove "both model parts (red." and ")".
- Figure 1: Can you modify this chart to highlight differences between the approach based on WindSTAR and on the ISO standard?
- 220: I would reword the title, for example "Test cases for the optimization framework".
- 224: replace "has a size" with "consists of".
- 227: I think you can remove "In order to have dwellings in a near distance of the wind farm at which the noise constraints should be fulfilled".
- 229: add the sentence "Here, the noise constraints must be fulfilled" at the end of the paragraph.
- 230: remove "original".
- 235: "the sensitivity of the Lp" change with "the sensitivity of the Lp in a greater number of turbine operating conditions;"
- 235: "while the higher LW values of the larger turbine type introduce a larger need for optimization". Change with "moreover the higher LW values of the larger turbine introduce a larger need for optimization".
- 243: replace "These distances" with "These nondimensional distances".
- Figure 2 and Figure 3: I think it would be best to use the same limits for the x-axis in the two figures.
- 250: "considered outside of" replace with "not influenced by".
- Caption of Figure 4: "in the wake of (a) wind turbine".
- 260: "The wind turbine type" replace with "This".
- Caption of Figure 5: "CT sensitivity of WindSTAR obtained transmission loss" not clear.
- 287: "are used" is "is used".
- 294: "in the wake" add here "of an upstream unit".
- 302: "are representative to a hard" is "are representative of a hard".
- Figure 7, figure 12, figure 15: there are no units in the x and y axes labels.
- Figure 8, figure 10, figure 13, figure 14, figure 16: the two subplots on the left are not clear. I suggest plotting the lines in a 2D plot. The color (or line style) is enough to distinguish the 7 turbines.
- 343: "In general, it should for all optimization cases be kept in mind" change with "In general, it should be kept in mind for all optimization cases".
- Figure 9, figure 11, figure 17: the colormap should use a discrete number of colors

equal to the number of operational modes.

- 358: replace "this is" with "this occurs".
- 404-405: "Hence, the CT curves ... the wind farm". Not clear.