

## **Review of the manuscript wes-2024-176 entitled “Exploring future production scenarios for the Italian offshore wind power” by D. Medici, A. Tonna and A. Segalini**

### **Overview**

The authors significantly improved the overall clarity of the manuscript. Following up my previous review, there are some details left to explain in the manuscript. The authors’ reply is highlighted in Italic.

### **Response to previous comments**

**Line 212:** When I read Sect. 5 for the first time, it was unclear to me why you ignored wake losses so far and then you decided to introduce them. Only at the end it was clear that this result is preliminary towards the Monte Carlo simulation. I would explicitly mention at the beginning of Sect. 5 that, just like the previously introduced score range, wake loss modeling (and layout optimization) are instrumental to the Monte Carlo simulation.

*The Monte Carlo simulations are generated to identify possible scenarios where some farms are built or not. Once a farm is built, its power production depends on*

- 1. the number of turbines: this parameter was kept fixed according to the planned capacity of the farm.*
- 2. the available wind resource: this information was created based on the historical data and did not change in the Monte Carlo simulation since no farm-farm interactions were accounted for.*
- 3. the farm efficiency and how that is decreased because of wake losses.*

*The first two factors are sufficient to get directly an estimated power production under the assumption that all turbines operate independently from each other. We actually ran the first Monte Carlo simulations without even including wake losses. The advantage of neglecting wake losses is that the power production does not depend anymore on the farm layout, simplifying the analysis. However, whenever many turbines are expected to be installed in a small area, wake losses cannot be neglected anymore. Since several aspects are considered in the layout definition, we thought that a simple layout defined by maximizing the minimum distance (without considering the wind rose and the associated wake losses) was a simple enough choice that gave a simple estimate of the wake losses. Once again, wake losses are not a necessary ingredient to perform the Monte Carlo simulation, but rather they enhance the accuracy of the estimate. We have performed in the manuscript a critical assessment of the optimization technique and we have clarified that in the revised version of the manuscript.*

**Reviewer’s response (RR):** I agree that neglecting wake losses reduces significantly the complexity when the Monte Carlo simulation is conducted, if the simulation is only a preliminary tool to estimate the probability of installation of a certain wind farm. However, even though I see the necessity of keeping the analysis simple at this stage, neglecting the wake losses is a limitation of this analysis that deserves to be mentioned in the text. The Monte Carlo analysis can stay as it is, just mention that wake losses are not considered at this stage.

**Line 254:** I would not label the cases where  $L_{opt} > L$  as “outperforming”. The optimization algorithm always (hopefully) outperforms the uniform spacing solution in terms of finding the best layout, otherwise it would be detrimental. I suggest to rephrase this sentence saying, for example: “where the optimization algorithms converge towards a spacing larger than the uniform solution”.

*A genetic algorithm is not a gradient method, and it is fully stochastic. We start with a population of possible layouts and iteratively generate new possible layouts and check the fitness function. The evolution can be quite long for so many degrees of freedom and consequently the stop criterion is given by a given number of iterations (500\*number of turbines). There is no guarantee that the algorithm has converged by then. If the bounding polygon is a square, the optimal layout is clearly only the one with uniform spacing. For other bounding boxes, it is expected that the uniform spacing is still the best although not realizable or easily identified. Therefore, the uniform spacing represents our target and most likely is the best performing condition. That is why we prefer to keep the text of the manuscript as is.*

**RR:** I see the authors’ point. However, labeling an optimization algorithm as “outperforming” with respect to another indicates that the former leads to a smaller cost function than the latter, whereas here it is used only to indicate cases when  $L_{opt} > L$ . I would avoid confusion and motivate these cases as characterized by a low number of turbines in the selected layout.