RC1: 'Comment on wes-2024-21', Anonymous Referee #1, 19 Mar 2024

General comments:

- When using an in-text citation where the author's name is not part of the sentence, put the name of the author and year in parentheses to facilitate readability. See the in-text citation Copernicus guidelines.

- Corrected throughout paper.

- I understand that you're using a MATLAB framework to compute the STL long term trend component, short term trend component and seasonal trend. Would it be possible to elaborate on the methodology (driving equations, necessary data inputs or other)?

- Thank you for your comment. We acknowledge the importance of elaborating on the STL decomposition methodology. While the fundamental equation is referenced as per Cleveland et al. (1990), we have now included a concise explanation of the STL components (trend, seasonal, residual) and their significance within the context of our analysis in the manuscript:

"Following the methodology described by Cleveland et al. (1990), STL decomposes a time series into three components: seasonal, trend and residual. This decomposition is mathematically represented as follows:

$$Y_t = T_t + St + R_t$$

where Y_t denotes the observed data at time *t*, T_t is the trend component, S_t is the seasonal component and R_t is the residual component."

The elaboration has now been added to the paper.

Given the established nature of the STL method and the comprehensive details provided in Cleveland et al. (1990), we have opted to avoid a theoretical discussion to maintain the paper's focus and brevity. However, to address your query, we have explicitly stated in the methodology section that our STL analysis utilises weekly buffered time series data of the area under the curve for generator speed versus power. This ensures consistent and robust input quality for our analysis.

Specific comments:

Line 4: Add what PLC stands for.

- Corrected

Line 16-18: "Predictions suggest [...] various publications" This sentence lacks a bit of clarity, please reformulate.

- Reformulated

"Erosion has the potential to cause significant AEP losses, with some studies predicting reductions of up to 7%"

Line 34: Add what CMS stands for.

- Added

Line 67: I understand that the WTG type and site are confidential. Would it be possible however to indicate the average wind speed at the site and the nominal power of the wind turbine? That would make your results better comparable/ reusable in future related work.

- Information added

"However, to provide context for the results, the average wind speed at the site is approximately 8.6 m/s, the wind turbine has a nominal power between than 2 and 3 MW and is a horizontal-axis, three-bladed model."

Line 117-119: Do you know if a resolution of 10-minutes which is usually provided and stored by SCADA systems would have been enough for the time series of wind speed, nacelle direction, temperature etc.?

- This is a very good suggestion. We have not tested the TPI method with the standard 10-minute intervals commonly used by SCADA systems. However, we have submitted a paper: https://doi.org/10.5194/wes-2024-35 , that explores the impact of varied time averaging in the simulation environment. Future measurement studies could indeed explore this to compare its effectiveness against the higher resolution data used in our current findings.

Line 123-124: Do you mean the dynamic yaw misalignment by "the turbine control algorithm hysteresis"? It's maybe worth mentioning the "static yaw misalignment" on these turbines, that would result in a constant error in the wind direction.

- Improved text:

"Moreover, the use of nacelle direction as a surrogate for wind direction introduces additional complexity. This complexity arises from both the potential for dynamic yaw misalignment, influenced by the turbine's control algorithm hysteresis and the possibility of static yaw misalignment, which could result in a constant offset in wind direction measurements."

Line 213: Consider defining LOESS at its first occurrence (line 198).

- Amended

Line 262: Is 0.8 a probability or power?

- In the context of our study, "0.8" refers to the statistical power of the test, which is indeed a type of probability. It represents an 80% probability of correctly rejecting the null hypothesis when it is false, thus ensuring robust detection of true effects within the data.

  Furthermore, the method "Statistical Analysis" section has been improved for clarity. Please see extended response to Anonymous Referee #2's question.

Figure 3: Add a label for the y-axis.

- Regarding the y-axis labelling in Figure 3: In our design choice, we opted to position the labels for this particular plot as titles for each subplot to direct reader focus on the key trends depicted. In the belief that this aids in better understanding the data, but we are open to reconsidering this format based on your feedback to improve figure readability.

Other remarks:

- Have you considered applying the model on different study cases? It would be interesting to use data from other wind farm(s) to see if the how the model behaves with different assumptions.

- Thank you for suggesting the extension of the TPI method to additional wind farms. Indeed, we have already tested the TPI on turbines from another OEM and observed promising results. For further details on this, please refer to our article currently in pre-print and awaiting peer review, available here:

  https://doi.org/10.5194/wes-2024-49