RC2: 'Comment on wes-2024-49', Anonymous Referee #2, 22 Jun 2024

This article showcases a practical application of wind turbine blade erosion detection using a combination of aero-elastic simulations and real-world SCADA data. To me the article definitely has the potential to meet the journal's scientific standards but in its current form the balance between application and scientific content leans too much towards the application and in some sections the language even tends to be a bit promotional

Hence a more complete description of the methodology is essential for a proper evaluation of the scientific merit of the article.

More specifically: I agree to the comments of the first reviewer but in addition the following recommendations should be considered

- The current study can hardly be understood without knowing the previous reference presented in Malik and Bak (2024a). A brief summary of their key results would be beneficial for readers unfamiliar with that reference.

➢ In response we have revised and expanded the Introduction and Methodology Section 2 of the article. We have included concise summaries of key results of previous studies, as indicated by yourself and comments of the first reviewer.

- While I understand the need for confidentiality regarding specific turbine and site details, some generic information, such as the turbine size class (e.g. multi-megawatt offshore) is essential to put the findings in context and understand the general validity of the approach. Perhaps the interpretation of the results differs significantly for a study involving kilowatt-scale turbines compared to multi-megawatt offshore installations? I now read between the lines in section 2.1.2 that the turbines are off-shore and in the conclusions I read that they are Multi MW. Please disclose this information upfront. This is also needed to interpret the absolute numbers in section 2.1.1. (outer 9 m of the blade, roughness numbers etc).

  Related to this: What is a typical Reynolds number? To me the aerodynamics of erosion depends heavily on the Reynolds number.

➢ Thank you for your valuable feedback regarding the need for contextual information about the turbines studied. We have addressed this concern as follows:

  - Added mention of "offshore multi-megawatt wind turbines" to the abstract to provide immediate context.
  - Included "multi-megawatt" between 3 and 4 MW description in the introduction to clarify the scale of turbines investigated as well as average wind speed of approximately 9.49 m/s to address your very fair comments.
  - Replaced absolute numbers with relative percentages (e.g., outer 15% of blade length instead of 9 m) to maintain confidentiality while providing meaningful context.

  Regarding the Reynolds number, we acknowledge its importance in erosion aerodynamics. The text has been updated to reflect this, additionally we have provided the range of the turbines being between 3 and 4 MW and the average wind speed of the size being approximately 9.49 m/s.

It is the authors' intention that the process should be replicated for other turbines such that the results of the method are relevant for the specific turbine under investigation. As such, although the method is intended to be replicated, the results may vary for other turbines. Therefore, while we have restrained from sharing more specific turbine parameters than the ones we have additionally provided, this should be considered a positive aspect of our approach. It encourages readers to reproduce the method for their own turbines in collaboration with OEMs.

Our goal is to promote the inclusion of erosion/performance-sensitive sensors during manufacturing or the retrofit of such sensors, fostering collaboration between academics, operators and OEMs to enhance performance monitoring across diverse turbine models and operating conditions.

- The study relies on results from HAWC2 simulations. While HAWC is a well-validated aeroelastic modeling tool, a scientific sound approach requires an assessment of validity and possible limitations of the modelling approach for the current situation. Specifically, it would be helpful to understand whether any known inaccuracies identified in e.g. Boorsma_2024_J._Phys._Conf._Ser._2767_022006.pdf (dtu.dk) might impact the findings. The same holds for the accuracy of the airfoil aerodynamic model used, particularly bearing in mind the potentially high Reynolds numbers (above 10 million) for which limited validation of modelling approaches for eroded airfoil have been carried out

    - We have made relevant reference to this paper and explained the limitations of the multibody study. Thank you for your comment.

- Justify (or reframe from) unfounded statements to avoid a tendency of subjectivity. For example, line 53 states “this study leverages the turbines’ own wind speed anemometers, which are often overlooked due to uncertainties”. I think many people do see the value of turbine anemometers for various applications so please justify this statement or add a more objective phrasing e.g: "The importance of turbine anemometers, to support erosion detection has been demonstrated” or something like that.
    - Text updated: *“Furthermore, this study leverages the turbines' nacelle-mounted anemometers, which are otherwise not suitable for power curve documentation due to measurement uncertainties as per IEC 61400-12-1 (\cite{international2017iec}) standard. This standard recommends wind speed measurements at 2.5 rotor diameters upstream.”*
    - The text has been fully reviewed to remove aspects of subjective statements and remove promotional aspects. We hope this improves the readability of text, the comment was much appreciated.

- Check whether all concepts been introduced and put in context, e.g. what is Shell A and Shell B at line 116. Also the partial and complete coverage of 4.5 m is not placed in context.

    - The specific type of LEP coverage is not disclosed for Type A LEP while Type B LEP is a shell type. The sentence has been rephrased for clarity.

    - The sharing of blade lengths was an oversight on the authors part and has now been updated in relative, percentage, terms.

- The text should be checked on clarity, completeness and readability. For instance, the vertical axis of Figure 9 currently lacks a label specifying the quantity. Additionally, the numerous abbreviations throughout the text are confusing. It would be helpful to include a list of all abbreviations with their definitions.

➢ The text has be been reviewed throughout for clarity and readability and removal of subjective statements.
➢ Regarding the vertical axis of Figure 9: the caption has been updated.
    - Text has been added: "*the integral, with units of Power·Wind Speed (W·m/s), is indicative of this turbine's performance trajectory and shall be referred to as Turbine Performance Integral (TPI)*"