Response to comments from editors and reviewers

Part 1: Multifractal analysis of wind turbine power and the associated biases (npg-2024-5)

preprint in Nonlinear Processes in Geophysics from 02 Feb 2024
Editor's decision received on

The authors would like to thank the reviewer for evaluating the paper and providing a detailed feedback. We appreciate the positive feedback and have tried our best to incorporate them in the updated manuscript. Hopefully the modifications are in accordance with the reviewer's expectations and quality of the journal.

Please find below our point-by-point response to the comments (Reviewer comments are shown in black and author responses are in blue).

Anonymous Referee #2, 25 Mar 2024

This work arises from the difficulty of analysing by means of a multifractal approach the empirical turbine power, since the production of wind turbines is limited by a maximum or nominal power. An adequate theoretical framework of wind behaviour is crucial for understanding its effect on wind turbine power. On the other hand, it is known that the existence of instrumental limits causes biases.

In this work, authors employ the universal multifractal formalism for characterizing the small-scale fluctuation in wind power production and for highlighting the aforementioned biases and their influence on statistical analysis of turbine power.

To my mind, the work is very pertinent. It is very well argued. The objectives are achieved with a robust methodology, and thus my recommendation is to accept the paper. Some minor suggestions are made below:

Thank you very much for taking the time to read and review our manuscript. We greatly appreciate the very positive feedback and encouragement. Please find our response to the points raised below..

- On line 127, page 5 appears that the sampling frequency is 15 s. It is suggested to clearly indicate if this is the sampling resolution of the variables.

  This is the sampling frequency of Turbine power and local wind velocity measured by turbine. The sampling frequency of latter is now specified in text.

  Other variables were measured at a finer frequency than this, however since they were analysed along side P_t, the resolution of 15 s was kept for power available P_a. A line is added to clarify this when P_a is introduced.

- One of the main objectives of this work is to analyse several biases due to wind measurements. On line 130, page 6 the text reads: 'There are instances where the turbine failed to produce any power and had to consume energy for its basic operation. This results in negative values in data, and for realistic analysis, they were considered as zero'. It could be interesting if the authors could provide some light about the effect of applying this criterion.

  This is indeed an aspect we try to address. In current output based analysis using UM which in currently used format deals with positive fields, interpretation of the exact effect is out of scope. We have tried to address this indirectly by considering those negative readings as zero whose effect is rather well known (Gires et al., 2012). However, for the theoretical aspect only the effect of upper threshold is considered here to avoid complexity, and because it was not yet addressed in the literature. Following your remark, this is clarified in the manuscript now.

- On line 172, page 7 add a space between the full stop and the sentence that initiates as 'For a conservative...'. The same is said on line 246, page 12.

  Thank you. Updated both places.

- On line 207, page 9. It is suggested to clarify what are the parameters q_s and q_D.

  The parameters are expanded to convey exact meaning.

- Figure 4. Please replace the current format of the date in the title of the Figures (2021_05_00_00_00__2021_05_26_23_59_30) with a more understandable date format.

  Thank you. The figures are now updated with a more legible format.

References

Gires, A., Tchiguirinskaia, I., Schertzer, D., Lovejoy, S., 2012. Influence of the zero-rainfall on the assessment of the multifractal parameters. Advances in Water Resources 45, 13–25. URL: https://www.sciencedirect.com/science/article/pii/S0309170812000814, doi:https://doi.org/10.1016/j.advwatres.2012.03.026. space-Time Precipitation from Urban Scale to Global Change.