WIND ENERGY SCIENCE DISCUSSIONS

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Interactive comment on "An alternative form of the super-Gaussian wind turbine wake model" *by* Frédéric Blondel and Marie Cathelain

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This paper presents a clear and well documented analysis of a super-Gaussian model for describing wind turbine wakes, especially trying to improve the accuracy w.r.t. the standard single-Gaussian wake model in the near wake. I think the paper is well written and feels very mature. However, there are still some weak spots that could be improved. Therefore I suggest a minor revision.

General comments:

- The paper highlights the differences between the super-Gaussian and single-Gaussian wake shape very well. However, the paper does not address another common way to describe especially the near wake behavior, which is the double-

C1

Gaussian shape. Recent examples on this are:

https://doi.org/10.5194/wes-5-237-2020

https://doi.org/10.1088/1742-6596/753/3/032039

It would be appropriate if the authors also mentioned this model and include a comparison to this particular approach in their work. For example in Figure 2 the double-Gaussian wake shape can be recognized for the actuator disk wake.

- Since the paper puts a clear emphasis on defining $n(x)$ as the nth order of a variable super-Gaussian shape, it would be very interesting to have a visualization of $n(x)$ for one or more cases.

- You conclude that the highlighted cases show a good agreement between the model and the measurements. I agree, you clearly demonstrate that your model approximates the wake shape better than the single-Gaussian does it. However, in most cases there is still quite a large error remaining. The conclusion on the performance might be formulated in a slightly more critical way.

Specific comments:

- P4, L83: The thrust coefficient is described as manufacturer data. While I agree that it is a design parameter, I suggest to elaborate more on the physical meaning of it and whether you consider it as a constant or a variable in your analysis.

- P4, L97: You state that 'an unknown variable, the order of the super-Gaussian n appears'. I would phrase it differently, since n was already introduced on P2. For the reader it is not unknown anymore.

- P7, L170: I assume you use a fit of Eq. (9) to determine the parameters a_s, b_s and c_s? I do not understand how the standard deviation can be omitted in this process. Could you elaborate on this? Also it would be nice to have some

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more information about the quality of the fit, maybe addressing the residuals or visualizing the fit.

- P7, L172: Related to the previous comment, how big was the data set that Niayifar and Porté-Agel (2015) used to determine their set of parameters? Maybe this can also (partly) explain the differences.

Technical corrections:

- Because there is only one author affiliation, the footnote notation using the number 1 is not necessary.

- P1, L3: Consider replacing 'made on' with 'of'.

- P1, L16/23/24: Consider replacing 'inter-distance' with 'separation distance'.

- P2, L26: I recommend to change 'two shortcomings, that are actually closely related, need to be alleviated' to 'two closely related shortcomings have to be alleviated'.

- P2, L31: Consider replacing 'evolves' with 'evolve', since the subject (wake velocity profiles) is plural.

- P6, L135: Consider replacing 'Minimizing numerically' with 'Numerically minimizing'.

- P6, L139: Consider replacing 'follows more or less' with 'closely resembles'.

- P6, L145; Consider replacing 'solution' with 'a solution'.

- P11, L230: Consider replacing 'inter-distance' with 'separation distance'.

- P13, L275: The brackets around 'A2' are missing.

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