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Interactive comment on "On the impact of non-Gaussian wind statistics on wind turbines – an experimental approach" *by* Jannik Schottler et al.

Anonymous Referee #2

Received and published: 13 September 2016

General comments:

This manuscript investigates the effects of non-Gaussian wind conditions on the performances of a scaled horizontal axes wind turbine. The study is experimental. It uses one set of field measurements, synthetic data created using the software TurbSim and wind tunnel measurements. The idea behind this study is very interesting. However, the study does not try to relate any of the analysis to the real atmospheric conditions. Although they show results from one filed campaign, it is not clear what the implications of their study are. That is, the authors talk about non-Guassian wind statistics without saying what kind of atmospheric flows (winds) are non-Gaussian. For instance, synoptic winds in atmosphere have Gaussian statistics.The Discussion section is more a

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Discussion paper

summary than the critical discussion of the study and its implications.

Taking into account the good objectives and motivations behind this research, on one hand, and a large number of specific comments I provided below, on the other hand, I assign moderate to major revisions for this manuscript. Please see my specific comments below.

Specific comments:

1. You should not have footnotes in Abstract. Abstract should be a stand-alone section without references to the rest of the paper.

2. P1, L11. "The dynamic wind interacts. . ." What is a dynamic wind? This might imply that there is a static wind, which I never heard of. Wind is movement of air, thus it is dynamic by definition. Why not saying "Wind interacts. . ."

3. Not sure what is your rule to italicize words. I have nothing against italicizing the important words and terms, but in your manuscript you are using it for that purpose, as well as for the names of some instruments, modules, etc. I suggest you use it only to highlight important words.

4. Citations in the text should be from oldest to the latest. For example, P1, L1 has citations that are in a random order; similarly citations at the end of P1 are also randomly listed. Please correct that throughout the text.

5. P1, L20. When discuss the non-Gaussian characteristics of wind, you should mention some of the atmospheric phenomena that create those winds; like downbursts, for example, which are quite frequent in Europe and elsewhere. Gust fronts are other phenomena associated with non-Gaussian winds. There are several papers by Giovanni Solari and his group on that subject. For instance, De Gaetano et al. (2014) demonstrated the non-Gaussianity statistics of some non-synoptic winds (see Figures 2, 3 and 4 in their paper). Papers like this would strengthen your study, as they show that there are some atmospheric phenomena that generate non-Gaussian wind statistics.

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De Gaetano P, Repetto MP, Repetto T, Solari G. 2014. Separation and classification of extreme wind events from anemometric records. Journal of Wind Engineering and Industrial Aerodynamics 126: 132–143. DOI: 10.1016/j.jweia.2014.01.006.

6. Symbols in your equations are not the same as symbols in the text. Your u'(t) in the text does not look like u'(t) in equations. It is not italicized in the text. Please be consistent and correct these. (I gave an example of u'(t), but this holds for all of your symbols).

7. What is the reason behind using the wind speed interval between 7 m/s and 8 m/s and not some other or perhaps wider interval?

8. You jumped right away to advanced statistical techniques, i.e. structure functions without showing some basic statistics. Please plot wind speed histogram of field measurements and fit it with Gaussian distribution. Synoptic winds show high degree of Gaussianity (please see the reference I provided above and some of the papers cited in that reference). Therefore, it is strange that your filed data are highly non-Gaussian. Thus, I would like to see a histogram and PDF of field measurements. It will also demonstrate that, while wind speed distribution is (maybe) Gaussian, the wind speed increment does not have to be Gaussian. I believe that further contributes to your paper.

9. Table 1 cuts a sentence in half. Please organize the text so that you don't have these discontinuities. It decreases the readability of your manuscript.

10. P2, L78. If I am correct, you are using only the interval [7, 8] m/s. That being said, what extreme events are you referring to when you say extreme events are not reflected correctly using standard model.

11. P6, L1. Why is this spatially averaged wind speed more appropriate to describe the wind speed conditions than a single point measurements? Please explain.

12. P6, L910. This sentence has too many semi-colons. Please reformulate this

sentence in order to remove these unnecessary semi-colons.

13. P6, L27. Why did you decide to use only a single hot wire signal for the comparison in Section 4.2 and not the spatially averaged data that you used for flow characterization?

14. What are the uncertainties and errors in all your measurements (wind tunnel, filed measurements, thrust, etc.)? Uncertainties in measurements should be well documented.

15. In Figure 6, is the time series of wind speed synthetically created or is it from the wind tunnel measurements (or maybe field measurement)? Either way, that time series looks very artificial to me. Also, you said that your field measurements are in the interval [7, 8] m/s, but your wind speeds in Figure 6 are around 5 m/s. Is it due to the scaling or something else? Please explain.

16. P10, L6. What is the purpose to analyze scales that cannot be produced in your wind tunnel? That length scale cannot be replicated inside of your chamber.

17. Your Table 2 is very confusing. What does the number 0.067 represent? That is, what is the column between "rotor diameter" and "order of blade length"?

18. P11, L3. ". . . analysis, two different, purposely created. . ." Please reformulate this sentence. Sounds strange.

19. P17, L15. Vortex shedding, i.e. frequencies at which vortex shed is defined by the Strouhal number, which in turn depends on the Reynolds number. That being said, how is that shedding does not depend on fluctuations in inflow? Please elaborate. If needed, please take a look at Zdravkovich's books on flow around circular cylinders.

20. P17, L16. Based on the circular cylinder example, how did you conclude that some aerodynamic effects might be excluded due to low frequency filtering? You use a "Thus" at the beginning of that sentence and I do not see how that claim results from the previous discussion. Please explain.

21. The last sentence in the Discussion section is confusing. To me, it sounds like you are saying that the focus of this study is to analyze what is presented in the study, which is redundant. Please reformulate or explain what information you want to convey in that sentence.

22. I believe you should emphasize more on the importance of your study in the Discussion section. Try to relate your findings, at least qualitatively, with the real atmospheric conditions. Also, what would be the application of your study? When can we expect non-Gaussian velocity increments and when are they Gaussian in real atmosphere? Moreover, are they ever Gaussian? All these questions could be addressed in Introduction and/or Discussion. Providing answers to those and similar questions would greatly improve the readability and contributions of your paper.

23. P18, L1. "Our results show. . ." Please reformulate this sentence. Not clear what you want to say.

24. Lastly, I advise the authors to find a native English speaker to proofread the manuscript.

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