AC 1

"Applying a Random Time Mapping to Mann modelled turbulence for the generation of intermittent wind fields"

Khaled Yassin, Arne Helms, Daniela Moreno, Hassan Kassem, Leo Höning, and Laura J. Lukassen:

We would like to thank the reviewer for the valuable comments, questions, and suggestions. They helped us significantly. We agree that the manuscript needs improvement and revised it as described below. All your comments have been addressed below in blue. Line numbers refer to the marked version of the manuscript "marked.pdf"

This manuscript presents a time-mapped Mann model to derive a synthetic wind field model. Wind field modeling plays an important role in wind energy studies. In general, it is an interesting topic.

1) The writing needs significant improvement. Please use scientific expressions in the manuscript.

Thank you for this comment, we have improved scientific writing. This comment has been applied in several locations of the manuscript and can be seen in the marked version.

2) There are some state-of-the-art field investigations on the influence of turbulence on the wind turbine structural response. Please discuss your results with the field measurement results.

A new paragraph has been added in lines 78-85 in the marked version of the manuscript where a new state-of-the-art paper was added and described in detail. Also, another source was discussed in lines 428-430

3) line 100: Please provide more information on how to choose the two points. Any restrictions about the distance between these two points.

Eq. 3 is a theoretical equation, which means in general that there are no restrictions on selecting the two points. However, when it is applied to our case, it is limited by the data set of points that we have from our fields. An additional statement has been added to the manuscript to clarify this issue below Eq. (3) in lines 116-118 in the marked version of the manuscript.

4) Fig.1: please add error bars on the measurement results since you have 500-time series samples for analysis.

All the 500-time series were combined and then the statistics of the combined time series are shown in this figure. This means that the statistics are not generated by the average over the number of individual time series. An additional statement in lines 158-159 in the marked version of the manuscript has been added to clarify this issue.

5) Sec 2.2 & Sec 2.3: please make it more concise.

We agree with the reviewer that these two sections contain several mathematical equations and descriptions of the underlying model. However, we find it beneficial to introduce the reader to the Mann and CTRW model since our new suggested model is a combination of the two. Furthermore, most of the described equations are used later in the analysis of the wind fields and for plotting the results of this analysis. An additional statement in lines 98-100 in the marked version of the manuscript has been added to clarify this issue. We have also omitted the scaling factor equation from lines 196-198 in the marked version of the manuscript.

6) Fig. 8: The curves are shifted vertically for visualization. Please provide more detailed information.

In principle, the curves should be on top of each other since they represent the probability of the velocity increment. However, we think that this would not be clearly represented. Therefore, each plot is shifted from the others for better visualization. Accordingly, the Y-axis of this plot is not the scale of these plots. The resulting PDFs for the increments have been similarly displayed in previous contributions on the topic (see Vindel et al. (2008), Liu et al. (2010), Mücke et al. (2011), Böttcher et al. (2007), Morales et al. (2011)). An additional statement in the caption of Figures 1 and 8 in the manuscript has been added to clarify this issue.

7) Why did you select 10% as the turbulence intensity level?

In the IEC 61400-1 standard, Turbine class B (average class) should be designed at TI = 0.14 that occurs at 15 m/s. By taking the same standard deviation value, a mean wind speed of 20 m/s corresponds to $TI_1 = 0.105$ which we have approximated to $TI_1 = 0.1$ (which in our paper is TI_1 since it is related to the wind speed component in streamwise x_1 direction). An additional statement in lines 286-287 in the marked version of the manuscript has been added to clarify this issue.

8) Why did you choose a fixed pitch and fixed speed wind turbine for the simulation? Most current utility-scale wind turbines are variable speed and variable pitch regulated.

As indicated in Sec. 1, the main scope of this paper is to introduce the generation of an intermittent wind field from the Gaussian Mann field using time mapping. This aims to investigate the statistics of the resulting field, and to investigate whether this intermittency is transferred to the loads. Here, it was important for us to work out the pure effect of intermittent wind on loads explicitly without additional effects such as pitch and variable speed. You are right that in principle this is an interesting question to be answered. A deeper investigation of the effects of intermittency on different loads of a

variable speed and variable pitch wind turbine and in other wind conditions is subject to future work. An additional statement in Sec. 5 in the marked version of the manuscript has been added to clarify this issue.

9) The mean wind speed in Table 3 is extremely high (20 m/s). In most wind farms, the annual average wind speed won't exceed 12 m/s. Please explain and add cases with lower speeds.

Thank you for this comment. You are right that 20 m/s is rather high. On the other hand, at 20 m/s the wind turbine is above rated wind speed without variable pitch and variable speed. The 20 m/s was an exemplary case as an extreme case just to show the effects of intermittency. However, other wind speeds are not in the scope of this paper and could be investigated in future work. Therefore, an additional statement in Sec. 5 in the manuscript has been added related to this issue.

10) Please add wind shear as well in the FAST simulations as well. It may have a larger impact on the turbine structural response than turbulence.

We agree that shear can be an important factor. In the Mann model, there exists the option to add shear which incorporates stretching of the turbulent eddies. Adding shear to our Time-mapped Mann model requires more consideration to be made. It is not as straightforward as in the Mann model, since the intrinsic time domain (which corresponds to one slice in the Mann model) is mapped to the physical time domain non-equidistantly. One option could be to first add the eddy stretching to the Mann model and then apply our time mapping. But this would certainly influence the stretching of the eddies in an unpredictable way. The consequences would have to be investigated in more detail, which exceeds the limits of the present work. But since we also consider this important, we have added an additional statement to the outlook in section 5.

11) Please add more statistical information about 500 sample datasets in the Appendix, including but not limited to wind direction, wind speed, turbulence level.

An additional description in lines 154-158 in the marked version of the manuscript has been added to clarify this issue.