Review of Manuscript "Validation of an interpretable data-driven wake model using lidar measurements from a free-field wake steering experiment" by Sengers et al. (wes-2022-118)

The manuscript by Sengers et al. presents the (free-field experimental) validation of the DART model which was introduced by the authors before. Model predictions with a focus on wake steering of a single turbine are compared with both the experimental data, comprising measurements of two scanning lidars and the turbine data, and the Gaussian-Curl Hybrid (GDH) model as reference.

Overall, the manuscript meets its defined objectives and describes the findings in a well comprehensible manner. However, I have identified three main deficits, I will briefly summarize (as major issues), followed by a list of minor points which should be addressed before a publication of the manuscript.

Major issue #1: As I understand it, the manuscript contrasts from the earlier publication(s) by using free-field data for validation. The used measurement campaign has however, as stated by the authors, several shortcomings. These are described but their impact on the results is, in my view, not sufficiently discussed and quantified, respectively. A more detailed uncertainty quantification, elaborating on these impacts, may be very useful to underline the findings of the study.

Major issue #2: The main findings of the presented study focus on the accuracy of wake characteristics and the comparison to results of the reference model. What I am missing is a more detailed discussed how these findings impact the possible application of wake steering in terms of the introduced control strategies in wind farms. I suggest to add another sub-section in the Discussion (section 5) which addresses this, the implications (qualitative and quantitative) on an application. In addition to seeing the need for this discussion, I also think the current section 5 is rather short and should be elaborated on.

Major issue #3: Though clearly written, I think the presentation and first of all the structure of the manuscript should be improved. Section order / levels and titles should be revised and in some cases made more consistent. More concrete suggestions in the list below.

Minor issues (in order of their appearance in manuscript):

l. 26 – "test turbines" instead of "testing turbines"

l. 27 – Referring to "simulations and wind tunnel experiments", I think it would be helpful to shortly describe in some more detail related pros and cons (of these) in contrast to a free-field experiment.

ll. 29 – Please describe in one more sentence how "erroneous yawing" may interact with wake steering more explicitly.

ll. 73 – Do we need explicit wake steering for such an experiment or is it just about the variation of yaw angles? Please comment on this.

ll. 75 – How do you define the difference between "validations and comparisons"? Please comment.

l. 79 – What does "This" refer to?

ll. 79 – I suggest to use commas for this list.

l. 84 – Please write a short introduction to this section, also introducing the sub-sections.

ll. 94/95 – Can you elaborate on this, why only a fixed yaw offset in this sector?

ll. 112 – I do not think this title fits optimally to the other titles. Again, I also suggest to add a short introduction to the following sub-sub-sections. And why do you not use numbering (2.2.1, ..) for the following paragraphs?

ll. 114 – This sentence ("A pulsed ..") needs to be rewritten. Please check again what you want to say.

l. 115 – "horizontal plane" is only true if you use a single PPI with zero elevation – please be more explicit here.

Figure 1 – The colour scheme is not optimal here (in particular, as you are not showing the colour bar as legend). Could you use less blue?

l. 137 – Please detail the link between U_eq and P_av.

l. 138 – Delete one "with".

l. 139 – Why do you give the equation for PE but not APE here? This is rather confusing as you write about APE before.

l. 140 – "reconstruction" of what?

l. 142 – ".. were not tested, as this would remove .." This is only true if you require a symmetry. Please comment on this.

l. 145 – "hold" instead of "holds"

Figure 3 – In my print it is not really "yellow" – please check, and maybe use another colour.

Figure 3 – Why was the "second cluster [..] omitted"? I think this is neither sufficiently described in the figure caption nor in the main text.

l. 167 – Please explain briefly why you have "slightly different azimuth angles".

l. 174 – Please mention here again that the ground-based lidar is also a scanning lidar of type 200s.

l. 187 – Here you could introduce the abbreviation "met".

Figure 5 (and others) – Difference symbols are used for veer in figures and text – "del" and "delta", respectively.

l. 239 – Again, I suggest to add some introduction text to the section.

l. 251 – "their" instead of "it's"

l. 278 – There is only one sub-level (3.1.1) – please revise section structure.

l. 300 – I believe this should say "for this particular experiment" rather than "in the free field".

Figure 8 – As above, use "delta alpha" as in main text.

Figure 10 – Please introduce the colour code for (a).

Figure 11 – The "yellow" text is very difficult to read – please select another colour.

l. 437 – There should be some introduction to the following sub-sub-sections.

l. 444 – "20%" of the original dataset – suggest to add this detail here.

l. 480 – Add some introduction to the section here.

ll. 480 – As pointed out above, this section should be elaborated on. Currently it only addresses the limitation. I suggest a more in-depth discussion of the application here.

Appendix A – I do not think this appendix is really needed.