Review of the manuscript wes-2021-13, entitled "Investigation of the dissipation in the wake of wind turbine array", by I. Neunaber, J. Peinke, M. Obligado.

This manuscript leverages single-component hot-wire measurements collected through wind tunnel tests of downscaled wind turbine models to explore the potential of modeling the mean velocity deficit in wind turbine wakes and wake width through the classical theory of wakes for bluff bodies developed by Townsend and George. In the Introduction, this theory is qualitatively described, while the empirical model of the wake velocity deficit and wake width as a function of the downstream location is provided for both equilibrium and non-equilibrium turbulence in Sect. 2.1. The wake models used as a benchmark, namely the Jensen and the Gaussian wake models are introduced in Sect. 2.2. The experimental setup is reported in Sect. 3.1. A key part of the manuscript is Sect. 3.2, where the authors attempt to verify the requirements for the Townsend-George theory. Eventually, these requirements seem to be fulfilled in the far-wake of the case turbine 1, turbine 2, and only partially for turbine 2 -side. However, the proposed model will be applied to all three cases.

The results seem to indicate that the proposed model fits well with the experimental data, with the equilibrium case having a smaller error than the non-equilibrium case. The authors suggest considering a virtual origin for the application of wake models, which is not a novel feature for wind turbine wake models.

My main comments are:

- The clarity and sharpness of the statements and discussion should be largely improved throughout the manuscript. This is particularly important in Sect. 3.2 when assessing the requirements of the Townsend-George theory. The authors should report graphically or in a table for what range of the wake and flow case each requirement is fulfilled. It should be clarified when a complete equilibrium is achieved and when non-equilibrium turbulence is considered. The discussion about the wake turbulence properties is interesting, yet it seems elusive rather than conclusive. For instance, I was not able to find details why the core of the wake is considered in equilibrium turbulence state.
- The validity of the power law to characterize downstream evolution of the wake velocity deficit is not new (see e.g. the review by F. Porte-Agel et al., BLM, 2020 and references therein). I am not sure if this work actually provides more predictable capabilities, than what is known about the use of power laws for prediction of wake features.
- The use of a virtual origin is not a new feature for a wake model, see e.g. Ishihara T, Qian G. A new Gaussian-based analytical wake model for wind turbines considering ambient turbulence intensities and thrust coefficient effects. J. Wind Eng. Ind. Aerodyn. 2018;177:275-292, and reference therein. Connections to previous works should be provided about this wake feature.

More comments are reported below, which I hope might help to revise the current manuscript.

Comments:

1. L1-6, These statements seem more suitable for an introduction rather than an abstract. I would suggest sharpening the focus of the abstract highlighting the research strategy and the results obtained.
2. L16-17, you can clarify that wake interactions may occur only under certain wind conditions, namely wind direction, incoming wind speed and stability regimes. Wake interactions do not occur in a continuous fashion. Please add some references on this topic.
3. L35, Please clarify the following statement. What do you mean for "*…the shear layers surrounding the wake have me*t"?
4. L106, cross-check the equation for the momentum thickness. I believe the first term in the integral should be *U* rather than U_∞.
5. L110-120, can you provide concisely the difference in flow properties for an equilibrium and non-equilibrium turbulence?
6. L221, "*In addition, the Taylor Reynolds number is supposed to change so that the presence of equilibrium and non-equilibrium turbulence can be disentangled*." This statement is not really clear. Do you mean that status of non-equilibrium turbulence occurs when the Taylor Reynolds number varies with *x*? Please clarify.
7. Sect. 3.2.2 should be re-written and clarified. Express clearly the conditions for Re_λ and Re_L and state for each flow case under what wake regions those are satisfied.
8. Fig. 5. Please specify the locations where these velocity signals were collected.
9. L 265, "*The errors for L/δ were calculated using error propagation.*" Please provide more details on the mentioned error propagation method.
10. At the end of section 3, maybe where now there is a not-numbered section denote "Summary" I would add a table or a sketch summarizing the results of this analysis for each flow case, namely the five requirements and the wake regions where those are fulfilled.
11. Figs. 9, 11 and related text, I am not sure applications of the Jensen and BP models have been done properly. Typically, wake velocity fields are calculated for individual wind turbines; then, an overlapping wake model is used to predict the wake flow in presence of wake interactions. Is this the procedure you applied? Please provide details.
12. L 353, I am not sure you discussed the detection of a turbulent/non-turbulent interface for the wake. Please clarify, in case I missed this discussion.
13. L359-360, what flow properties did you leverage to infer that the wake center shows equilibrium turbulence.
14. Fig. 10 and related text (L355 - 360). This mentioned ring with enhanced values of C_ε is a bit elusive for all the three flow cases investigated. The region with higher C_ε is located at the boundary of the measurement domain, which makes it difficult to assess if this is actually a ring or an artifact due to the interaction between the wake and the background wind tunnel flow. Any comment clarifying this comment would be beneficial.
15. L 426-426, please specify for what wake region the five requirements of the Townsend-George theory are fulfilled for each flow case.
16. L 429-430, specify what feature of C_ε provides evidence for equilibrium evidence, in what wake region and for what flow case.
17. L454, please revise the text reporting that the Jensen model was formulated only considering mass conservation (JensenNO.Anoteonwindgeneratorinteraction.Risø-M1983)

18. L446, The use of a virtual origin for a wind turbine wake model is not a novel concept, see e.g. Ishihara T, Qian G. A new Gaussian-based analytical wake model for wind turbines considering ambient turbulence intensities and thrust coefficient effects. J. Wind Eng. Ind. Aerodyn. 2018;177:275-292, and reference therein.