Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2020-72-RC1, 2020

WESD

Interactive comment

Interactive comment on "Optimal tuning of engineering wake models through LiDAR measurements" *by* Lu Zhan et al.

Anonymous Referee #1

Received and published: 18 July 2020

Review of Manuscript # wes-2020-72 Title: Optimal tuning of engineering wake models through LiDAR measurements Author(s): Lu Zhan, Stefano Letizia, and Giacomo Valerio Iungo

In this paper, the authors use the LiDAR measurements collected for individual wind turbine wakes to determine the optimal values of the tuning parameters in four different wake models. The manuscript is well written, and the problem is well defined. Determining the tuning parameters in the engineering wake model using the field data is of great interest and use for the wind-energy community. The paper can be accepted. However, there are a few issues that should be addressed before that:

1. In figure 1, the layout of the wind farm is shown. However, it is not well explained that which turbines are considered in the analysis.

2. It is not clear from the manuscript that the extent of the wake measurements behind the turbine. In particular, the range of downstream distance (x/D) that is used in the optimization of wake models should be provided.

3. In the manuscript is mentioned that “About 10,000 plan-position indicator (PPI) LiDAR scans of isolated wind turbine wakes have been processed to provide the non-dimensional average velocity fields used for this study”. How are the wind-turbine wakes isolated?

4. In equation (9), the authors provided a relation for expansion rate (k) as a function of turbulent intensity (TI). Based on the results in Fig. 2, it seems that the data points are not enough to support that relationship. This point should be addressed in the paper.

5. Following the previous comment, there is no error bar in the measurement data. Error bars should be added to all figures.

6. The authors assumed that the wake growth rate solely is a function of TI. However, recent studies show the dependency of k to both TI and Ct. This point should be addressed in the paper.

7. In figure 4b, it is assumed that Ïţ is only a function of TI. However, in the original model, Ïţ is a function of Ct. The authors should elaborate on the dependency of this model coefficient to both TI and Ct. This is important since the authors report a wide range for Ct from 0.5 to 1.3 in the Gaussian model.

8. Following the previous comment, the authors showed the optimal value for Ct in the Gaussian wake model in Fig. 4c, which is larger than 1. This contradicts the 1D momentum theory. The authors should better elaborate on this point in the manuscript.

9. Fig. 5. Add the error bars to the measurement data.

10. In all figures with the discrete data (e.g., fig. 7), use dashed lines instead of full lines.

11. Line 218: the issue regarding the divergence of Eq. 12 has been solved in the following papers that can be mentioned in the manuscript.

Abkar, M., Sørensen, J.N. and Porté-Agel, F., 2018. An analytical model for the effect of vertical wind veer on wind turbine wakes. Energies, 11(7), p.1838.

Shapiro, C.R., Starke, G.M., Meneveau, C. and Gayme, D.F., 2019. A wake modeling paradigm for wind farm design and control. Energies, 12(15), p.2956.

12. It would good to provide the physics behind the optimization of the model coefficients in different wake models, and how different parameters contribute to the shape of the wake. For example, in the Gaussian wake model (Bastankhah and Porte-Agel) changing k* tries to match the width of the wakes while Ct tries to match the maximum velocity deficit. Hence, the best combinations of k* and Ct give the best fit to the velocity deficit profiles. You can provide a similar analysis for the other wake models.

Interactive comment on Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2020-72, 2020.

Printer-friendly version

Discussion paper