Wind Energ. Sci. Discuss., referee comment RC2
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Comment on wes-2022-46

Anonymous Referee #2

Referee comment on "Breakdown of the velocity and turbulence in the wake of a wind turbine – Part 1: Large-eddy-simulation study" by Erwan Jézéquel et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2022-46-RC2, 2022

General comments:

The paper presents an in-depth investigation into the specific mechanisms behind the mean velocity and turbulence following a wind turbine in a fixed frame of reference. The study breaks down the contributions and discusses the importance of each term within a stable, neutral, and unstable regime. By discussing the relative importance of each component's contribution to the mean velocity and the turbulence, conclusions on what needs to be considered when modeling can be made and can be discussed specific to the stability regime.

The importance of the terms that contribute to the mean velocity and turbulence are found based on a large eddy simulation with an actuator line method. The study investigates the wake of a single wind turbine from near-field x/D=1 to far-field x/D=8 locations. The referee believes the current work is of interest to those modeling turbine wakes and should be considered for publication after revisions. Comments are specified below.

Specific comments:

There are a points in the introduction when a citation should be included to validate the statement of the authors, for example, line 27 sentence beginning 'Most analytical models..'

The coordinate system should be explicitly stated, perhaps placed in figure 1, to orient the reader initially.

Why does the study only look at the wake until 8D downstream (Computational cost, based on current farm arrangements, etc.?)

Line 267 – The authors discuss errors in the unstable case only at x/D = 8 (at 6%) but leave out the error at x/D = 3, which is touched on as a location where the neutral boundary layer flow case shows reasonable overestimation at 2%. Comparisons should be discussed at this location as well as farther downstream at 8D because this effects turbine placement downstream.

Lines 225-229 – If velocity is stored at a rate of 1Hz, then are the first and second order statistics averaged over, for example for the stable case, only 60 snapshots? Uncertainty of the turbulence breakdowns and convergence is not discussed.

Lines 225-229 – More information needs to be included on how the contributions of sub-grid scales are quantified and in turn negligible as the authors suggest.

Figure 7 shows the RSME of the maximum axial turbulence, is there an explanation for the max RSME value to be at x/D = 5 for the neutral case (is it also observed in other cases)? Also, no quantitative information is provided for the other two stability cases, only trends of the data and order of magnitude.

Technical corrections:

Line 94 – opertor => operator

Line 96 – …U_MF allows to re-write Eq. 1… => …U_MF allows one to re-write Eq. 1…

Line 134 – …in Sect. 2 is applied… => …in Sect. 2 are applied…

Line 321 - …turbulence is going back its unperturbed value.. => …turbulence is going back to its unperturbed value..