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Comment on wes-2022-46

Anonymous Referee #1

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-RC1, 2022

In the manuscript the authors study the development of a wind turbine wake is studied in a moving reference frame. To be specific, the mean velocity and turbulence in the fixed field of reference are broken down into different terms, which are analyzed in the moving reference frame. In the present work the authors show that including the cross-terms improves the results. The effect of the cross terms is relatively modest given that analytical wake models generally have various simplifications. It is argued that this analysis is relevant to extend models like the DWM, which is submitted as a second paper, but not discussed here. Overall, such modeling efforts are relevant for the community to get improved insights. In any case the presented analysis does provide additional insights into the development of a wake. Although the statistical convergence of the data seems limited and uncertainty analysis is limited. These aspects should be improved.

- Line 228-230: "are not taken into account in this work, nor is the sub-grid turbulence. The latter is negligible in the unstable and neutral cases but can reach more than 10% in the stable case." --> How did you determine the sub-grid turbulence, and what day you mean by negligible? That seems a bit of a strong statement.
- Line 314-315: "I wonder how accurate that is". How reproduce-able are your simulations? The turbulence in turbulence simulations is not necessarily exactly reproducible. The statistics can of course be reproduced, but not necessarily its instantaneous realizations.
- Figure 8,9,10,12: "Your results do not seem to be that well converged". Additional discussion on the uncertainty in your data is required.
- Given that you want to use the results for model development, should you not determine the developments of the different terms further downstream the wind turbine. Now you only go to x/D=8.
-- 375: the statement seems rather bold. Only 3 cases are presented, and the added turbulence intensity for the three cases is not really the same. Looking at figure 12; A difference of 3 to 4 percentage points on 16 percent turbulence intensity.
- Line 391: How about figure 10? It is not quite clear what the statement "that it is reachable given the shapes." Just before you state "in the wake with the term (V) could be found yet." I tend to agree with the latter statement. I do not see any particular patterns
- Figure 12: How does the rotor added turbulence in the moving reference frame compare

to what you would get in the flxed reference frame. What is your uncertainty in these results? There namely seems to be significant rotor added turbulence outside the wake.

* Typos
- Line 94: translation "opertor" --> "operator"; "time-dependant" --> "time-dependent"
- Velocity in the wake --> you are not actually showing velocities, but streamwise turbulence intensity.