Wind Energ. Sci. Discuss., referee comment RC1
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Comment on wes-2021-30

Anonymous Referee #1

Referee comment on "Investigation into boundary layer transition using wall-resolved large-eddy simulations and modeled inflow turbulence" by Brandon Arthur Lobo et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-30-RC1, 2021

This study presents the results from wall-resolved large eddy simulations of the flow over a blade a relative high Reynolds numbers. Such simulations are very challenging and computational expensive. The work is performed with a code that is specifically developed and validated for such simulations in previous work. Clearly, the work is relevant and important as the understanding of the flow development over wind turbine blades can help improve wind turbine blade design. The work falls within the scope of the journal.

Similar simulations, for a different blade, have been presented by the authors in previous work. Therefore, I believe that a more detailed comparison to the present simulation results with the previous findings of the author would be very useful as it can provide more insight in how blade design may affect flow separation over wind turbine blade. Also comparison to for example X-foil, to see what the difference in the results obtained from different simulation approaches, or comparison with the measurements from the intended modeled experiments (Reichstein (2019)) can be very useful.

Some additional specific points are indicated below.
* In line 202 the authors mention that the simulation is matched the test section using the recent experimental study by Reichstein (2019). However, surprisingly, the simulations are not actually compared these experimental data. It would be nice to add this comparison.
* How do the simulation results compare to what may be obtained from, for example X-foil.
* A more detailed comparison on the differences with the work of Breuer (2018) and Breuer (2019) and Breuer and Schmidt (2019) should be provided. So in this study another turbine blade is used, but how does this affect flow around the blad. The first point in the conclusions (line 526) shortly touches on this point. However, a more detailed comparison should be provided.
* From figure 1 and corresponding discussion it is not directly clear that the results are converged with grid resolution as the authors claim. Apart from the visual inspection the authors should provide a comparison of the actual values computed from the simulations to document uncertain in the key quantities of interest in this study.

* The refined grid results in figure 1 seem to show some high frequency component around the mid blade. Can the authors comment on that.
* I personally prefer the visualizations as provided in Breuer 2018 over the ones used here; or add some grid so the location / geometry of the blade in this and other figures is clearer.
* Line 271: Why not use input from the Reichstein (2019) experiments?
* Please be clear what "dimensionless units" you refer to; now this is not always clearly defined.
* Figure 2: Please compare to -5/3 spectrum.
* Shape factor is not defined in this paper, unless I missed it.
* Line 313: A good correlation ==> There is actually a difference in these locations.
* figure 5: uf ==> u'
* Line 380-400: You compare your findings with Diwan and Ramesh 2009, which as far as I remember are experiments over flat plates. Can you comment on the relevance of these experiments / what we learn on the importance of the blade curvature effects on these phenomena.
* I believe some more detailed explanation on figure 9f is missing
* Conclusions: You mention importance of studying effect atmospheric turbulence, however in this study you used isotropic turbulence
* Overall the manuscript is well written, but the presentation of the data in the figures can be improved in some places

* The presented conclusions, in a way, are in line with what is known already from literature. As stated previously, I believe the manuscript findings can be strengthened by either comparing to the experimental study by Reichstein (2019) / results from an analysis method like X-foil (to show the benefits of the high-fidelity simulation approach used here), and/or compare in more detail with the previous findings from simulations Breuer (2019) and Breuer and Schmidt (2019) in which a different airfoil was considered. What could also be highlighted more is that, in comparison to these previous studies, a more elaborate spectral analysis is performed. The importance of these results can be highlighted more.