Reviewer comments for manuscript ACP-2021-598-R1

Wind lidars reveal turbulence transport mechanism in the wake of a tree

Summary comment

In this revised submission the authors have successfully addressed the majority of my previous concerns. The *Methodology* section has substantially improved: The experimental setup is well described and the data processing procedure is clear and reproducible. The *Results* section has also improved, but the manuscript would benefit from a more usable definition of the area of interest in the wake of the tree (mc1) and from a more rigorous mathematical treatment and notation (mc2 and several other mcs). Overall this is an interesting study that makes use of a truly unique experimental setup and data; the modeling community will be able to readily take advantage of its data and findings.

Minor comments

1. "We investigate this further by selecting grid points with high $u'u'$ comparing to the undisturbed flow" -> Why are the author's limiting their analysis to this region of the flow? The way the selection of this region of interest appears as quite convoluted and I would imagine that the modeling community would benefit much more from this analysis if the validity of the eddy viscosity assumption was assessed in the whole wake region, rather than in a thin (albeit dynamically important) layer. This is mostly a recommendation to improve the quality of the manuscript.
2. Related to the comment above. I find that several of the assumptions that the authors have put forth (i.e., streamwise gradients of vertical and cross-stream velocities are negligible) are not necessary to support their claim of validity of the Boussinesq hypothesis. Why, for example, not taking the full velocity gradient tensor and momentum flux tensor into consideration and verify the relative alignment of their eigenvectors? It would also be useful if the authors could report the magnitude of the velocity gradients in the streamwise direction when compared to the streamwise ones. This, again, is mostly a recommendation.

3. L201. strain -> strain rate (and elsewhere)
4. L215. Equation (3) is saying nothing about the stream-wise gradients of the vertical and cross-stream velocities, so this remark is not correct. In other words, if stream-wise gradients of the vertical and cross-stream velocities were not equal to zero, equation 3 would still be valid since it describes a relation between different quantities. Please rephrase.
5. Caption of Fig. 5. I recommend using index notation for the wind gradient vector as well, since otherwise it is difficult to relate gradients and corresponding momentum fluxes.

6. L229. The simplest parameterization for the eddy viscosity is assuming it is a constant. The mixing length is a level up in terms of complexity. Perhaps it is better to say "a relatively simple. . . "?
7. EQ4. Are the authors referring to the L2 norm of the velocity gradient tensor? In this case I would recommend using this symbol: $\|\cdot\|_2$ to avoid confusion.

8. EQ5. Since the authors are only considering $i = 1, 2$, I recommend writing out the full expression for hte momentum flux, i.e. $\sqrt{(u'v')^2 + (u'w')^2}$. Same elsewhere.