Response to CC #1 (Andrew Black)

Comment on amt-2022-73

Andrew Black

Community comment on "Behavior and Mechanisms of Doppler Wind Lidar Error in Varying Stability Regimes" by Rachel Robey and Julie K. Lundquist, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-73-CC1, 2022

What interesting research, and seemingly powerful tools to use for years to come!

Figures 12 and 14 really bring the simulation data and lidar error to life. Could these be presented earlier in the paper? Perhaps swapping sections 2.1 and 2.2, and showing the 2D cross section of LES data with lidar beam overaly in the beginning to allow the reader to visualize the dataset.

On input from another reviewer, we have reordered some of the material to develop the random variable error model in Section 2. We've brought Figure 12 up along with it (now Fig. 4), so while not quite as early as you suggest, it hopefully allows for the reader to build intuition about the dynamics at play.

The ridgeline plots are very compelling. Could you add one that includes the all of the 10-minute averaged data? This would illustrate the reduction in errors through time averaging you describe.

While we decided not to take more space for a ridgeline plot of the 10-minute average, we have updated our discussion and figures of the effects of time-averaging to better show the trends at work. We have incorporated violin plots of the error distributions at different averaging intervals ranging up to 10 minutes, which performs a similar visualization. (Fig. 15)

In figures showing statistical moments by height, the x-axes are scaled to the data. In some cases, this highlights interesting trends, and they should remain, but I wonder if auto-scalaing obscures a conclusion: the errors are small. Deciding when errors are significant, and when they are insignificant is a key part of this paper.

Good point. When regenerating the figures, we've tried to strike a balance between making use of the panel space to clearly distinguish the trends and picking an appropriate scale that doesn't over-magnify small values (especially in the near-zero biases).

p15, L351 "inflection point" p176, L374 "will converge" Done, thanks!

In Section 4, did you consider illustrating some of the error trends as functions of atmospheric parameters like instantaneous (or 10-minute) wind shear, turbulence, etc? Perhaps you could pick only one measurement height to do this instead of the full profile, and then illustrate various errors as functions of upstream errors.

This is a lovely idea and we wish we had the data to try to visualize those dependencies. Unfortunately, the limitation in the number of LES test cases and their uniformity means the simulated flow fields don't span much of the atmospheric parameter space. We hope that by diagnosing the mechanisms behind the error, the reader can extrapolate likely behaviors in other conditions not included in our simulations.

In Fig 14, add color-coded trendlines for each stability class (instead of only the dashed white line). The positive bias in the low speed Strong CBL seems to be a key finding. Highlight it as best you can. Could you show the same graph but perhaps for the most and least biased heights?

Thank you for encouraging us to revisit this figure with more scrutiny. All else being equal, the error expression for the wind speed suggests that a higher wind speed should repress the positive bias (according to $1/|U_h|$). Having separated the trend by stability (Fig. 12) (and height, not shown), we do not feel we

can discern the expected trend from the other factors changing implicitly with wind speed within the LES test cases. We have adjusted our statement of this behavior accordingly (L685-692).

Section 4.5 illustrate the rapid decay of error with time averaging, it's very steep and interesting for wind energy folks who only ever think of 10-minute averages.

How can your illustrations complement your conclusions most strongly? In some cases you might want to clearly focus on one height instead of showing the whole profile.

Forgive me if any of my comments are addressed elsewhere in the paper. There is a lot to digest. This paper is so thorough and really excellent.

Thank you for the positive feedback. We have found the thoughts on how to better visually highlight the dynamics at play useful in revising the manuscript to best communicate the results from the virtual model.