Reviewer 3

This paper reviews the effect of a thunderstorm-downdraft generated atmospheric bore and associated gravity wave on a downstream wind farm in central Oklahoma. The wind farm was located in the American Wake Experiment (AWAKEN) field campaign domain. Overall, the paper is well written, the methods cogently presented, and conclusions sufficiently supported by the analysis. It would be interesting to see what effects, if any, the wind farms had on the downstream propagation of the bore/gravity wave, but perhaps the topic for another paper. A brief discussion of the "forecastability" (short-term) of such events, particularly in the context of power production, would have been illuminating (although other PECAN/AWAKEN papers are addressing this?). Specific comments:

We thank the reviewer for the time they spent reviewing our work and for their supportive suggestions and comments.

The PECAN papers are much more focused on forecastability of bores and other nocturnal convection events as the goal of their field campaign was to improve forecasts for weather and climate models. Many of their studies dig into the necessary ingredients to initiate nocturnal convection (Weckworth et al. 2019, for example). The following sentence has been added in the introduction at lines 64-65 in the revised manuscript to point the reader to the relevant references for forecastability:

> "For additional discussion on nocturnal convection initiation and the forecastability of MCSs and bores, in general, see Weckwerth and Romatschke (2019) and Weckwerth et al. (2019)"

However, the PECAN papers do not specifically analyze wind turbine power forecasting as it relates to bores, which would be a good avenue for future work.

Tomaszewski and Lundquist 2021 studied how a thunderstorm outflow boundary was modified after it propagated through a large wind farm. They found that the wind farm (>100 turbines) did slow down the outflow boundary; however, the effect on precipitation was minimal. In our study, it is unclear to what extent the effect of the turbines have on the propagation of the gravity waves. In response to a request by another reviewer, the SCADA data for additional rows has been included in the revised manuscript (Fig. 12) and the signal of the gravity waves is more notable in rows 3 and 4 in the SCADA data compared to the simulations. The simulations indicate that the farm weakens the gravity waves in the rotor layer; however, in the SCADA data, the waves maintain their strength throughout all four rows. This is likely because the observed gravity waves are more energetic compared to the simulated gravity waves. Please see lines 420-429 in the revised manuscript:

> "The simulations and SCADA data both show clear effects of the gravity waves in the power signal for row 1, but for rows 2-4 (especially rows 3 and 4), the gravity wave effects are more extreme in the SCADA compared to the simulation results. A potential reason for this difference is that the observed gravity waves could contain more energy than those predicted by the model. In the model, the gravity waves near the surface are dissipated as soon as they encounter the first row of the wind farm. In reality, the more energetic gravity waves are likely able to entrain momentum from above such that their effect is felt more strongly throughout all four rows. Considering the good agreement between the simulated and observed power signals for row 1, the model is able to capture the leading edge of the gravity wave passage but likely overestimates the dissipative effect of the wind farm on the gravity waves. Lastly, it is important to note that subtle

differences in the wind direction can cause large power fluctuations due to waking because of the configuration of the farm (as discussed in the following paragraphs)."

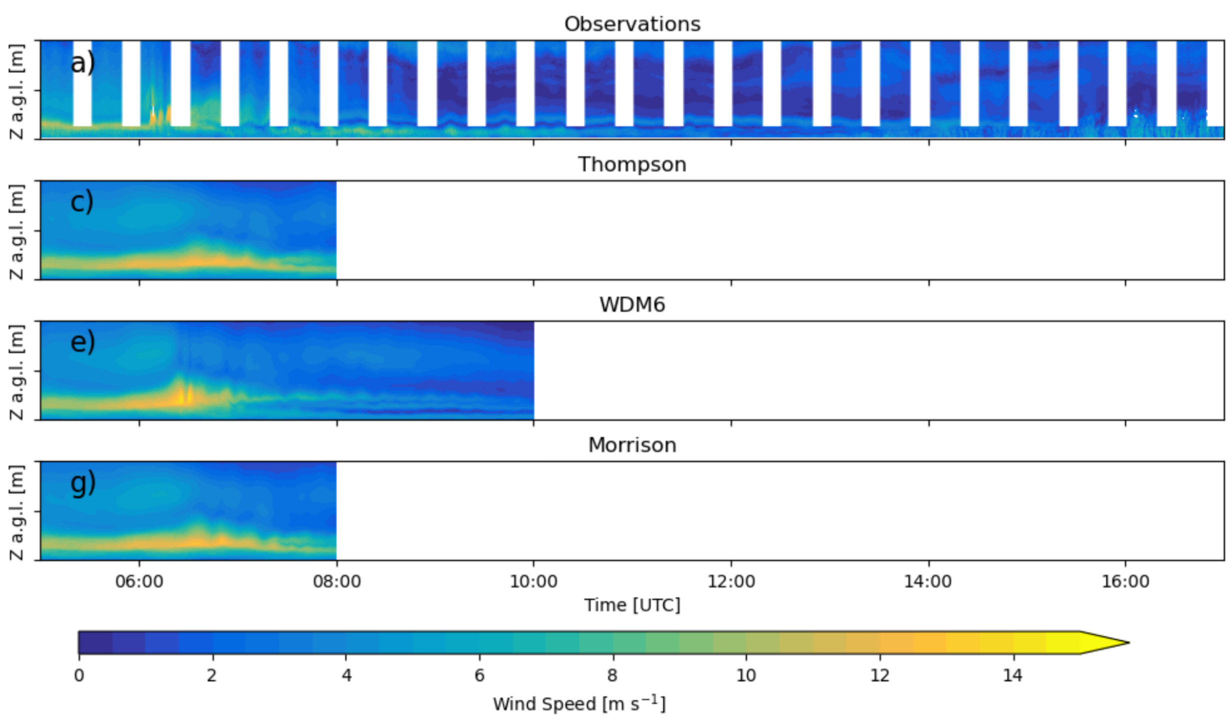
Figure 1: may help to have a larger map (perhaps on the scale of the state of Oklahoma) to provide some geographic perspective. I understand the need to capture the location of individual wind farms/turbines, but this is shown in Figure 4.

Figure 1 now includes a map of the continental United States with a red star highlighting the AWAKEN region within Oklahoma.

Table 3, and lines 365 et seq.: although it is demonstrated the gravity waves eliminated the LLJ, did the jet subsequently recover given there were several more hours until sunrise, and the "After" window only covers the period immediately after the waves have passed? This would also relate to the general vertical thermodynamic structure, and, of course, power production at the wind farm.

Thank you for the question. The jet did not recover before sunrise. Included below for the reviewer is a modified Fig. 7 extended up until well after sunrise (6:15am local time or 11:15 UTC). Only domain d01 was run for longer than the 'after' analysis period with the setup using the WDM6 microphysics scheme run the longest until 10:00am. Qualitatively, the results from domain d01 agree with the lidar observations with the jet not recovering much after the "after" period specified in the manuscript. The following sentence has been added to the manuscript at line 382-383:

> "However, in both observations and the model, the LLJ itself does not recover beyond the 'after' analysis period prior to sunrise (not shown)."



References:

Weckwerth, T. M. and Romatschke, U.: Where, When, and Why Did It Rain during PECAN?, Monthly Weather Review, 147, 3557 – 3573, https://doi.org/10.1175/MWR-D-18-0458.1, 2019.

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Tomaszewski, J. M. and Lundquist, J. K.: Observations and simulations of a wind farm modifying a thunderstorm outflow boundary, Wind Energ. Sci., 6, 1–13, https://doi.org/10.5194/wes-6-1-2021, 2021.