REVIEWER 2

Reviewer's comments appear in italics, **our responses appear in boldface blue text and new text included in the manuscript appears in *boldface italicized blue text***.

The study examines the impact of offshore wind farms on low-level jets (LLJs) along the east coast of the United States using Weather Research and Forecasting model simulations. The results indicate that wind farms reduce the frequency of LLJs and increase their height, with significant implications for regional meteorology.

The study is well-structured and written, and the results are clearly presented.

We thank the reviewer for their time and thoughtful consideration in reviewing our manuscript and their kind words, greatly appreciated.

My only concern is the lack of proper LLJ validation of the WRF by observation, as according to the WRF results 'LLJ nose heights' range from 328 m to 474 m and are well above the lidar range. This is addressed by the authors and cannot be resolved with the existing data set. For this reason, more care should be taken with the wording, and it should be made clear that the results are based on simulations, not real observations. For example, the title, passages in the abstract or the summary should be changed and phrased more appropriately.

Thank you for the thoughtful comment. We have changed the title to "Simulations suggest Offshore wind farms modify low-level jets" and have softened the language throughout to remind readers that we are interrogating a simulation dataset. Some examples, with underlining denoting the new softened text:

- **Abstract: "In the absence of observations or significant wind farm construction as yet, we compare one year of simulations from the Weather Research and Forecasting model with and without wind farms incorporated,"**
- **Abstract: "In the NOW-23 simulation dataset"**
- **Conclusions: "In this simulation-based study, we assess occurrences of LLJs in the US East Coast wind resources areas and how these LLJs are influenced by the presence of wind farms as they appear in numerical weather prediction simulations."**
- **Conclusions: "Modeled LLJs occur less frequently when wind farms are present in the simulations"**
- **Conclusions: "We also document how very low-level jets – LLJs with jet nose heights below 260 m – are significantly eroded by wind farms in the simulations.**

I have only minor comments, and if these are considered, the study can be a very valuable contribution to the offshore wind energy community.

Specific comments:

Abstract: The abstract of the submitted manuscript does not correspond to the abstract of the revised one. Please clarify.

We will ensure that the abstract in the Copernicus system corresponds to the abstract of the revised text when we upload a revised manuscript.

L.55 What is the Long-Ez aircraft ? Please explained

As Mahrt et al. (2014) explain, "The Long-EZ is a light pusher aircraft with the engine mounted on the rear of the airplane. It has the large main wing set back farther than that of conventional aircraft. The small, low-drag airframe and rear-mounted pusher engine reduce the influence of flow distortion, engine vibration, and engine exhaust for instruments that are mounted on the nose." In the atmospheric science community, this aircraft is somewhat infamous as a year after these observations, during another Long-EZ flight as part of the CBLAST experiment, the pilot and director of NOAA's Air Resources Laboratory Field Research Division died (https://www.whoi.edu/science/AOPE/CBLAST/TimCrawford.html, https://www.arl.noaa.gov/news-pubs/news-archive/arl-news-death-of-tim-crawford-august-7-2002/) although it was later determined Dr. Crawford's death was due to a stroke and not due to aircraft issues. The senior author realizes that she should not have assumed that the broader readership of WES would be aware of the Long-EZ.

We have modified the text to provide some basic information about the Long-EZ:

"Over two days south of Martha's Vineyard, Mahrt et al. (2014) observe low-level wind maxima associated with developing stable stratification; the altitude of the wind speed maximum is higher with stronger stability. (These observations were collected with the Long-EZ aircraft, a light pusher aircraft with a rear-mounted engine and a small, low-drag airframe.)"

L. 74 Here you could add also a study about the stability by. Platis et al 2021:

Platis, A., Hundhausen, M., Lampert, A., Emeis, S., & Bange, J. (2021). The role of atmospheric stability and turbulence in offshore wind-farm wakes in the German bight. Boundary-Layer Meteorology, 1-29.

Thank you, we have added this reference.

Fig. 4 Why do you see these line structures in the scatter plot? Does the 'Calculated' Data have a higher variability compared to RMOL of WRF ?

The "line structures" are artifacts given that the WRF values of RMOL do not vary continuously but are binned to regular intervals for values outside of |300| m-1 due to the iterative calculation method given in https://github.com/wrf-model/WRF/blob/master/phys/module_sf_mynn.F, function zolrib (near line 1984 as of July 2024). The calculated data does have higher variability as it is not forced to specific values or bins.

Sect. 3.4 What is the accuracy of the lidar measurements? Is it well above the 1m/s that you consider to be the LLJ criteria?

The measurement uncertainty for the lidar measurements is given as 3.3% of the wind speed, well under the 1 m s-1 threshold that we require for shear above the low-level jet nose. This uncertainty is given in DNV's assessment report "HUDSON CENTRAL AND HUDSON SOUTH LEASE AREAS OFFSHORE WIND FARM Energy Assessment Report, Document number 10124962-HOU-R-01", downloadable from the NYSERDA

datasite https://oswbuoysny.resourcepanorama.dnv.com/download/f67d14ad-07ab-4652-16d2-08d71f257da1.

L 169 How long did a LLJ Event last? How did you consider this in the data analysis, also regarding Fig. 4 to calculate the percentage of LLJ ? How is the no. of LLJ related to the possible of 8784 hours (Fig.7) ? Please clarify.

As of yet, we have not considered duration of LLJ events and instead treat each time's wind profile (and surface stability assessment in Figure 4) separately. We have added a clarifying sentence

"We treated each time profile separately and did not consider the duration of LLJ events or require continuity of LLJ events."

The number of LLJs on the y-axis of Figure 7 is out of a possible 8784 hours, for a general frequency on the order of 25%. We have added a % axis to Figure 7 to clarify this.

Table 6: The sum of the NEbuoy stable, unstable and neutral is 100,1 % . Please correct this (probably a rounding error).

Thank you for catching this - we corrected both the "All Times" and "NWF Times". We later modified our threshold for neutral conditions to be consistent with other papers coming from this dataset so that all the numbers changed, but we have double-checked to ensure there are no other rounding errors.

Sect. 4.2 Have you studied the dependency of stability on the wind direction?

This is an interesting question and, yes, we have looked at this in another associated study (Quint, Lundquist, Bodini, Rosencrans, 2024). In that study, figures reproduced here, stable cases almost entirely consist of southwesterly winds.

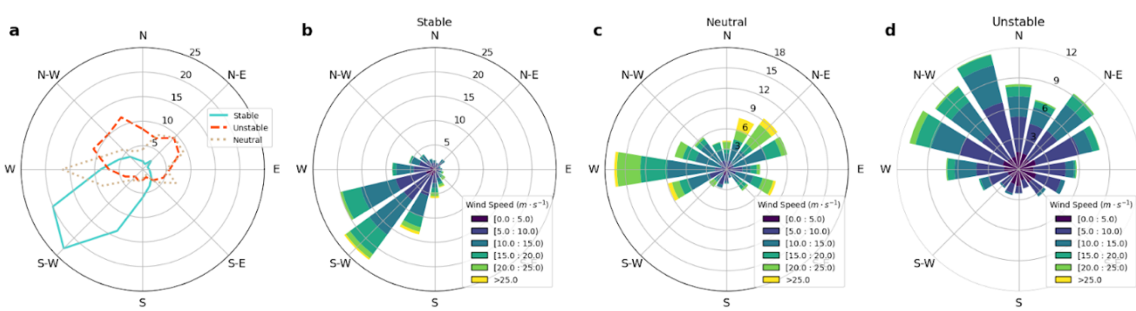

Figure 6. (a) The frequency of each 22.5-degree wind direction bin for each stability classification. Wind roses for stable, neutral, and unstable conditions are shown in Panels b, c, and d, respectively. In all panels, radial distance from the center refers to the percentage of values in each 22.5 degree bin.

We have added a sentence to Section 4.2 to acknowledge this variability and reference the other study:

"As noted in Quint et al. (2024), stable conditions in this region occur almost always with southwesterly winds (their Figure 6)."

Fig. 12 . Why does the overall wind speed around 10 m/s appear to be at hub height 5 % more often than at 230 m ?

If the reviewer is asking why the probability distribution in Figure 12 for the "southLA" region suggests that relatively slow winds (10 m s-1) occur more often at 130m than at 230m, we would point out that at lower altitudes, slower winds tend to occur more often. In contrast, for the 18-26 m s-1 bins, these faster winds occur more often at 230m than at 130m so that the area under the 130m curve is the same as the area under the 260m curve.

Sect. 4.6.4 Why is the wind veer highest in the summer months? Please give an interpretation and/or discussion.

Yes, we should have included a discussion of this pattern, which is related to the seasonal variation in atmospheric stability. Summer months have more frequent occurrences of stable conditions, and stable conditions tend to have more wind veer due to frictional decoupling. We have added text to Sect. 4.6.4:

"This pattern is related to the seasonal variability in atmospheric stability. Summer months have more frequent stable conditions, and stable conditions are associated with more veer (Lundquist, 2020), especially offshore (Bodini et al., 2019, 2020)."

Sect. 5 What wind speeds did the lidar measure? Do they compare the modelled values?

Yes, strong winds were observed by the lidars west of the Vineyard Wind area with similar wind speeds and wind directions as simulated, although this deep LLJ (with a nose well above 250 m) could not be fully observed by the lidar platforms. We have included a figure from the lidar observations to address this question and rephrased the discussion.

References

Quint, D., Lundquist, J. K., Bodini, N., and Rosencrans, D.: Meteorological Impacts of Offshore Wind Turbines as Simulated in the Weather Research and Forecasting Model, Wind Energ. Sci. Discuss. [preprint], https://doi.org/10.5194/wes-2024-53, in review, 2024.