Review of manuscript

Article title: Experimental investigation of the effect of wake steering on the noise emission of a commercial wind turbine

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Revision 0 (initial submission)

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In this study, the authors investigate the impact of wind turbine yaw misalignment on the noise emissions of a utility-scale onshore wind turbine. Using a circular array of 24 sound level meters (SLMs), a field campaign was conducted spanning four days that measured the acoustic impact of wind turbine operation in yaw-aligned and misaligned conditions. A nacelle-based and ground-based lidar were used to measure the wind speed, and wind speed measurements were synchronized to sound level measurements. The field measurements revealed asymmetries in noise emissions between the downstroke and upstroke sides of the wind turbine in yaw-aligned conditions, as well as between the downwind and upwind sides. In yaw-misaligned operation, a small but statistically significant increase of 0.6 dB(A) was observed, which contradicts previous studies that reported no change in noise emissions or a drop in noise emissions when a turbine is yaw misaligned. Overall, the experimental field campaign provides a useful and curated dataset to the flow control community. However, the postprocessing methodology includes several confusing decisions regarding time synchronization, wind and background sound measurements, and outlier detection. Furthermore, the main conclusions of the article contradict previous field campaigns on the same subject, with minimal discussion on possible sources of discrepancies leading to the contradictory results. Specific comments are outlined below.

Major comments

1. The primary result the authors claim is that the overall A-weighted sound power level (OASWL) of the yaw misaligned turbine is higher than its yaw-aligned counterpart, flow conditions remaining the same. However, this result contradicts that of previous studies, and the discussion regarding dicrepancies is very limited (one sentence at L449). The authors should thoroughly explore differences in their campaign that could lead to a contradictory result (distance to rotor, size of turbine, wind speed ranges, amount of data, pre/postprocessing strategy, etc.).

2. Throughout several steps of the data postprocessing, it is stated that data are "visually inspected" (e.g., L115). This is also mentioned in the outlier detection (see next comment). Additional details should be provided regarding the data processing methods.

3. The outlier detection uses a threshold value of 10 dB to filter out observations relative to a ±50-second running median. However, figure 10 showcases the deficiency here: one spike in SPL (around 21:14) is removed as an outlier, but a very similar looking spike around 21:42 is not removed. What is the sensitivity of the results to the outlier removal strategy? How do the results change if other values for the running median window and/or dB threshold are modified? And how were the values in the study selected?

4. The study would benefit from a specific discussion regarding the measurement of the freestream wind speed. For example, what is meant by "the resulting wind speed signal [from the ground-based lidar] was too noisy and did not correlate well with the SCADA data"? Typically, SCADA data are output in 10-minute frequencies, however the study here seems to aim at 10-second time intervals. Do the various methods agree well in yaw-aligned flow, or when the background noise measurements are active? If not, then that would raise concerns for using different measurement channels throughout different experiments (yaw-misaligned vs yaw-aligned vs off).

5. Section 3.3.1: Is wide variation in SLM background noise physical, or could be due to calibration error in the SLM? If it is physical, then this suggests there are much larger variations (upwards of 4 dB) in small variations in location around the wind turbine (<100 m), compared with relatively small differences (order 0.5 dB(A)) in noise due to asymmetries and yaw misalignment.

Point comments (in order as they appear)

1. Figure 1: As I understand it, this decision matrix describes acoustic curtailment for a specific four-turbine wind farm. How general is this decision matrix? Additionally, the times of curtailment center in the evening and nighttime hours, while this experiment is performed only during daytime hours. How might that affect the results or conclusions?

2. L94: the terrain inclination varies between 29° and 31.5°. Perhaps I am misunderstanding how inclination angle is computed, but this does not seem "very simple and flat". Clarity would be appreciated.

3. L126: It may be worth noting that high windspeed events (i.e., above-rated conditions) and high turbulence conditions are less important to WFFC applications. What were the wind speeds during this period of no testing?

4. Figure 4: How is vertical shear computed?

5. Figures 6-7 may be combined into one figure to save space. Furthermore, the names of the SLMs should be changed in figure 7 and throughout (e.g., figure 8) to more useful names (such as "SLM #XX" as used throughout the text).

6. Regarding the clock drift correction, what is the point of steps 1-3 (section 3.1.1), when step 4 seems to align all of the time signals with the turbine operation/SCADA clock?

7. L212: Was the dB offset correction to SLM #06 calculated during turbine operation, or only during background noise measurement periods? If the offset correction was computed for the entire time history, then it seems like that could bias the results.

8. L251-254: Please clarify the method for measuring wind direction at hub height. What "external sensors" are referred to in L253? What averaging or interpolation methods (if any) are used to meeasure the hub height wind direction with the ground based lidar?

9. Table 3: The yaw angle uncertainty/error is missing from the sources of error. Previous field campaigns (e.g., McKay et al., *Wind Energy* (2013)) have noted significant discrepancies in turbine alignment from the incident wind, due to slow-reacting controllers and turbulence.

10. For this audience, it would be useful to have a brief discussion clarifying between OASPL (pressure levels) and OASWL (power levels). Why is OASPL shown in figures 14-18 but then OASWL shown in figure 19?

11. L383-384: How does the discussion of airfoil camber/asymmetry relate to the data collected in this experiment and/or this wind turbine model?

12. L394-395: where does the increased uncertainty at higher frequencies come from? As I understand it, the uncertainties in table 3 are all constant with frequency/octave band.

13. Figure 19 and surrounding text: the uncertainty bars overlap significantly, yet the p-value is small. Why is this?

Minutiae/typos (in order as they appear)

1. L24: A citation to Meyers et al. *Wind Energy Sci.* (2022) would be particularly relevant here.

2. L51 and throughout: what does TWAIN stand for? Is it an acronym?

3. L89, L104, and throughout: some writing is too informal for an academic publication.

4. L144: Please be more specific than "Unfortunately some sensor defaults introduced a loss on data in some conditions."; this sentence (and others like it in the manuscript) should be omitted.

5. Figure 5 caption and elsewhere (L155, L276): "10-seconds sample" → "10-second sample"

6. The opening paragraph in section 3 is fully described in figure 12; consider moving figure 12 earlier and rephrasing the intro text in section 3.
7. L301: to clarify, is the OASPL also binned on wind speed, in addition to relative position and yaw angle?
8. Figure 16, y-axis: “OAPSL” → “OASPL”
9. L472: The acronym SWL is never used in this manuscript.
10. L476: “first of his kind” → “first of its kind”
11. L476: “WFC” → “WFFC”