General comments:

"Impact of Boundary Layer Height and Large-Scale Turbulence on the Efficiency and Loads of Offshore Wind Farms" aims to address two questions: How does boundary layer height affect wind farm efficiency? And how does turbulence of different scales affect turbine loads? While both questions are important, the manuscript should undergo major revisions to improve the clarity of the methods and results. Furthermore, the assumptions and methods require some additional justification to strengthen the findings. See specific comments and technical corrections below.

Specific comments:

Page 2: The uncertainty of model BLH is discussed here, but the uncertainty of calculating BLH from experimental data is not addressed. The definition of BLH from experimental data is still an open question, especially under stable conditions (see, e.g., Jozef et al. 2022).

Page 4, Figure 1: Are sites b and d co-located? It is difficult to distinguish the two symbols on the map. An inset of that region could help clarify their locations.

Page 4, Section 2.3: The reader is referred to Ivanell et al. (2025) for details of the numerical setup, but some information should be provided here to provide a framework for the reader. In particular, how is boundary layer height defined in the model?

Page 5, lines 113-114: The authors describe sites b and d as having "offshore conditions undisturbed by topography without the need to be far away from shore." Has this claim been demonstrated?

Page 5, lines 121-123: As mentioned above, the definition of BLH from lidar data is non-trivial. Please elaborate on the method.

Page 6, lines 131-133: These results are discussed before the results from FINO1. Please either rearrange the discussion, or remove the references to FINO1.

Page 6, line 134: This line references "frequencies below 10^{-3} Hz, but frequency information is not included in the Figure.

Page 6, Figure 2: This figure is not explained sufficiently. What information is the left panel adding?

Section 2.4: It would be much easier to compare turbulence characteristics for the sites if the same information were shown in the plots in each subsection. If it is important to show c, $\alpha\varepsilon^{2/3}$, Ψ, and Γ, then these plots should be included for all four sites discussed, along

with a description of the physical meaning of each parameter. If only a subset of these parameters are needed, then please provide the corresponding plots for all four sites.

Section 2.5: Not enough information is included in this section. In particular, how do the authors justify the use of a single measurement site to characterize the uncertainty over such a large region?

Page 10, Figure 5: Please include some discussion comparing measured and modeled BLH, as shown in this figure. In particular, the lidar doesn't appear to capture the shallowest boundary layers. How will this affect the results?

Page 11, lines 212-213: These two sentences are unclear. Are the authors arguing that lower wind speed show a stronger dependence on BLH? Does "most extreme BLH" mean "shallowest BLH"?

Page 13, lines 227-228: The meaning of this sentence is unclear. Please re-write.

Page 13, lines 232-233: Based on the plots shown in Figure 8, the results are extrapolated extensively. Why not run cases with a wider range of parameters?

Page 14, lines 237-238: The "Cp and Thrust methods" are not explained or described.

Page 14, lines 243-244: Why is the trend clearest in spring and summer periods? Is it related to seasonal changes in the diurnal cycle?

Page 15, line 256: Why is the dataset "limited to fulfill the winter and summer season"?

Page 16, line 263: How is Figure 11 similar to Figure 6?

Page 16, line 267: How are the first and third quantiles of the BLH bias defined?

Page 16, line 268: What does it mean that the quantile values were "applied" to the bin center?

Page 18, Figure 13: Why are both the upper and lower BLH estimates subtracted from the bin center? Shouldn't the upper estimate be added?

Page 19, Table 8: Please add more description to the table caption. "Uncertainty performance metrics" is not very specific.

Page 19, Section 3.5.1: Why is there no discussion comparing the three different types of turbulence shown in Figure 16?

Page 19, Section 3.5.2: The beginning of this section should be moved to the methods section.

Page 20, line 310: How is “wind turbine outside the wake flow” defined? Is this the same as front row turbines?

Page 24, lines 330-332: Please use more specific wording in these sentences. The meaning of “the variation in impact” and “the influence on the impact variation” is not clear.

Page 24, lines 334-338: Again, please be more specific. What uncertainty is described here? What are the units? The results of what at site B have a small overestimation?

Technical corrections:

Page 2, line 51: It looks like there’s a typo or word missing in this phrase: “offshore BLH radiosonde from a ship campaign”.

Page 9, lines 206-207: It would be clearer to say: “The distributions show lower BLH occurring more frequently at site B than site A…”

Page 14, line 242-243: It would be clearer to say: “…the farm blockage varies between the sites, where sites with a larger share of stable conditions have lower efficiency.”

References:

Jozef, Gina, John Cassano, Sandro Dahlke, and Gijs De Boer. “Testing the Efficacy of Atmospheric Boundary Layer Height Detection Algorithms Using Uncrewed Aircraft System Data from MOSAiC.” *Atmospheric Measurement Techniques* 15, no. 13 (2022): 4001–22. https://doi.org/10.5194/amt-15-4001-2022.