The authors wish to thank the reviewer for the insightful and helpful comments. Below and in the revised manuscript (as indicated) the authors have responded point-by-point to each comment.

Referee 1

The study evaluates the aerodynamic parked loads of a model-scale floating troposkein VAWT in a wind-wave basin under different conditions: a fixed tower base, floating without waves, and floating with waves. The influence of wind speed, solidity (via blade count variation), and rotor azimuth on the parked load is analyzed. In general, the paper presents a good approach and addresses an important aspect of floating VAWTs, an area that remains underexplored in the literature. However, several comments are provided below to enhance the quality of the paper, particularly in terms of the findings and discussions:

Response: Thank you for the insightful review and comments. The authors believe that addressing these suggestions has enhanced the quality of the paper.

Methods:

1. The authors highlight that using static airfoil polars is reasonable in the context of parked loads. However, this assumption holds only for the fixed-base system. For the other two cases (with the floating system and with floating system plus waves), the variation in the angle of attack could occur at a frequency high enough to impose unsteady load conditions. This aspect should be further discussed.

Response: Thanks for pointing out this critical issue. Use of static airfoil polars makes sense for the fixed-base system. For the two floating cases, we've performed some analysis of reduced frequency to address the point noted by the reviewer.

Reduced frequency is a parameter used to determine whether the inflow is unsteady and it can be defined as follows [1]:

$$K_i = \frac{\omega_{ptfm} C_i}{2\sqrt{(U_\infty^2 + r_i^2 \Omega^2)}}$$

where, ω_{ptfm} is the platform pitching frequency, C_i is airfoil chord, U_∞ is freestream velocity, r_i is section radius, Ω is rotational velocity of rotor.

According to Theodorsen's theory, a flow can be categorized as unsteady if $K > 0.05$. The reduced frequency (K) does not go above a value of 0.05 for both floating wind only and floating wind wave conditions for any of the wind speeds, as shown in Figure 1. The highest reduced frequency (K) of 0.0158 occurs in the 3B floating wind wave pitch case. As wind speed increases, the reduced frequency decreases. Specifically, for the 3B floating wind wave pitch case, the reduced frequencies (K) at wind speeds of 2, 3, 4, and 4.96 m/s are 0.0158, 0.0105, 0.0079, and 0.0063, respectively. This indicates that higher wind speeds result in a steadier inflow. Therefore, the inflow can be considered as steady. Notes have been added on lines 154-165 to provide this information.

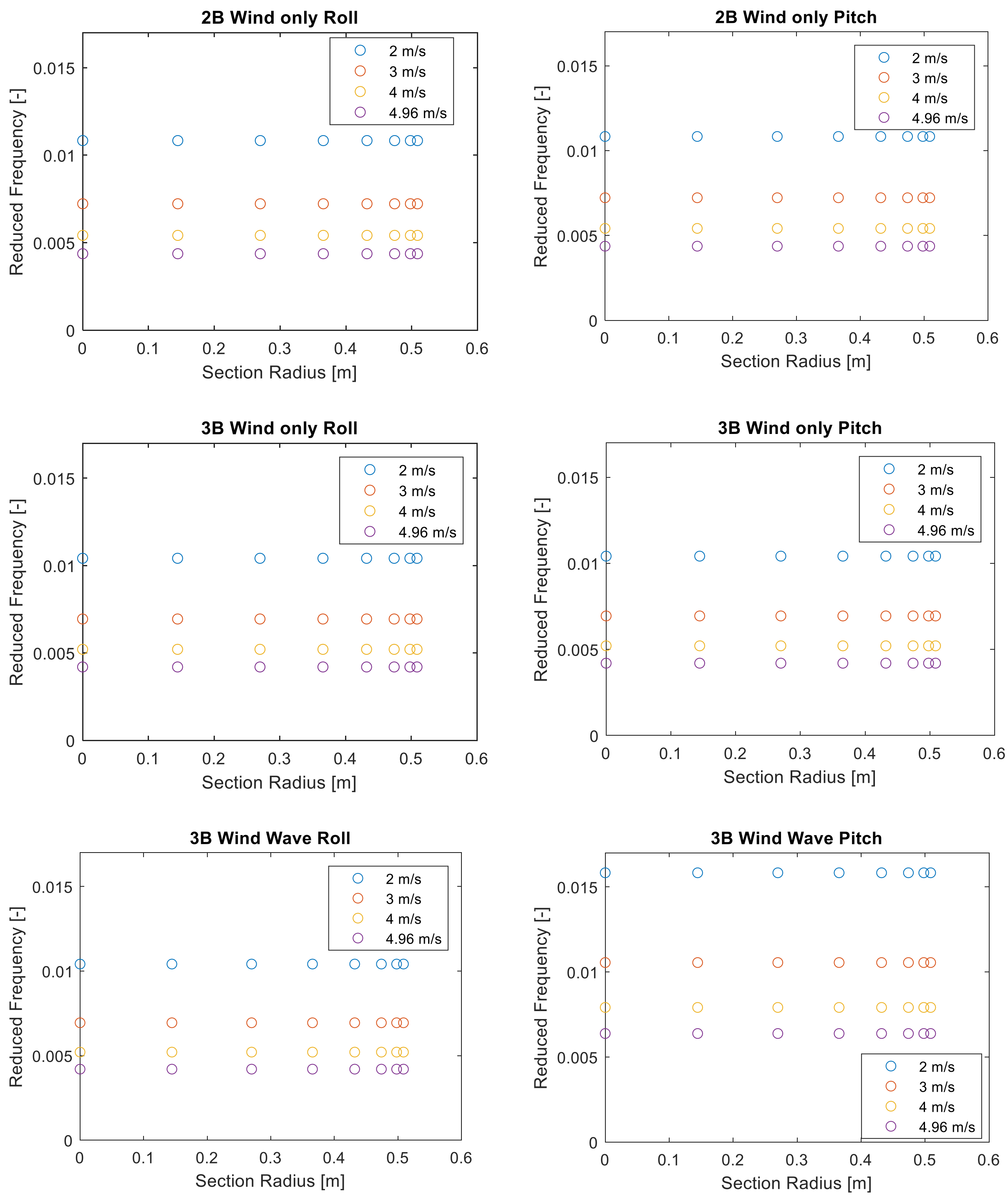

Figure 1: Reduced frequency for different platform and turbine operating conditions. Note: Section Radius refers to the rotor radius, which varies with rotor height.

2. There is a typo in equations (1) and (2); both equations are identical. Please correct this.

Response: Thanks for pointing this out. Equation 2 is related to tangential velocity (V_T). The equation has been modified and added in line 173.
Modified equation:
$V_T = T_X U_X + T_Y U_Y + T_Z U_Z$

3. Why not nondimensionalize all the parked load forces or even normalize them with respect to the rated forces? This would make it easier for readers to compare and interpret the results.

Response: Thanks for raising the point about normalization. Authors included both the dimensional and nondimensional parked loads in this version.

The nondimensionalized parked forces are defined as follows.

$$C_{Th} = \frac{F_{Th}}{\frac{1}{2}\rho\, A\, U_\infty^2}$$

$$C_{Lat} = \frac{F_{Lat}}{\frac{1}{2}\rho\, A\, U_\infty^2}$$

Where, C_{Th} is thrust force coefficient, C_{Lat} is lateral force coefficient, F_{Th} is thrust force, F_{Lat} is lateral force, ρ is density of air, A is the rotor area, and U_∞ is freestream velocity.

The revised manuscript shows both nondimensional and dimensional results. The nondimensional results are shown in Figures 15a, 17a, 18a, 19a, and 20 a for 2B locked with wind only, 3B locked with wind only, 2B floating with wind only, 3B floating with wind only, and 3B floating with wind and wave conditions, respectively.

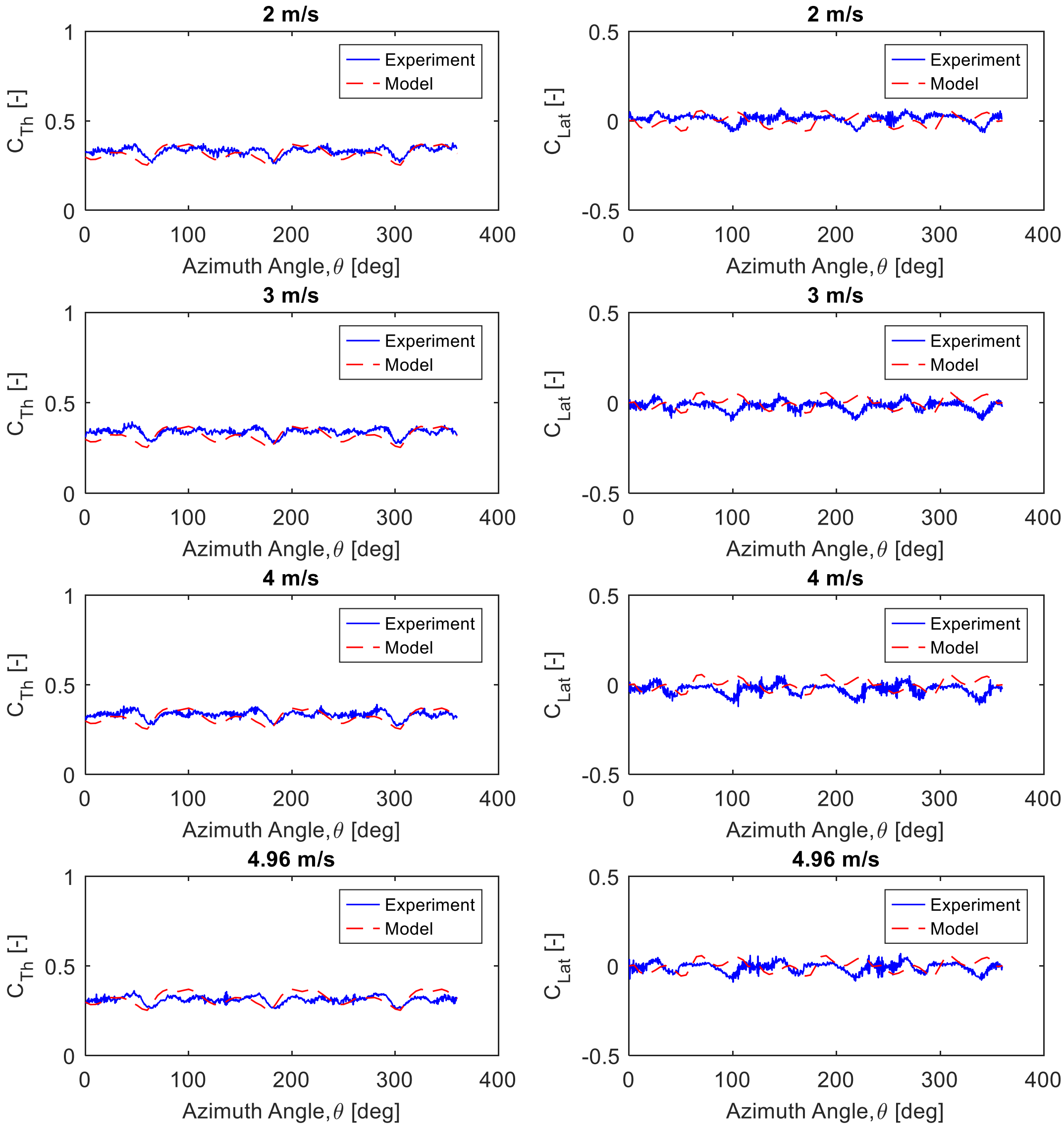

Figure 2: Nondimensional parked loads of 3B turbine for locked wind only condition.

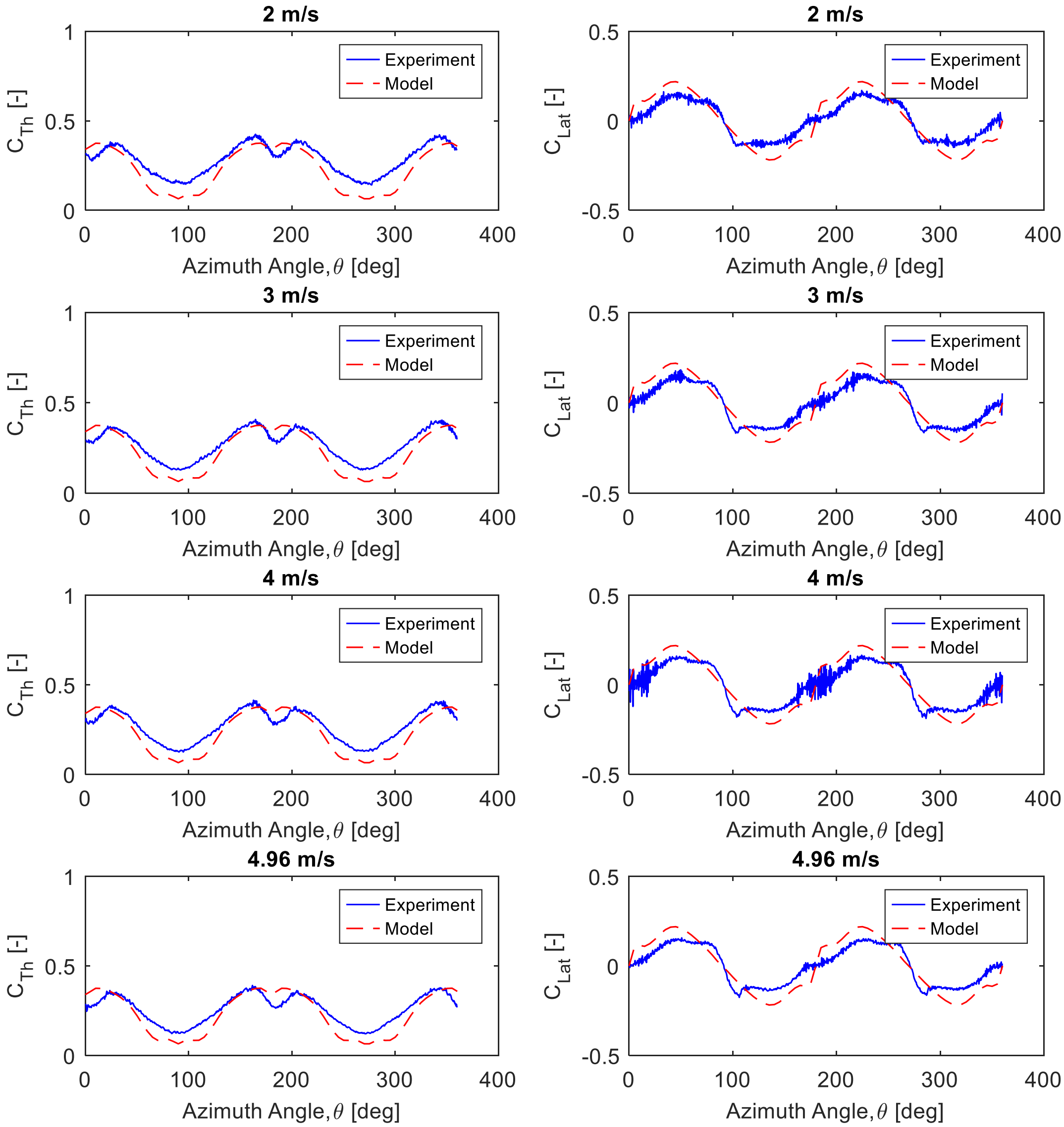

Figure 3: Nondimensional parked loads of 2B turbine for locked wind only condition.

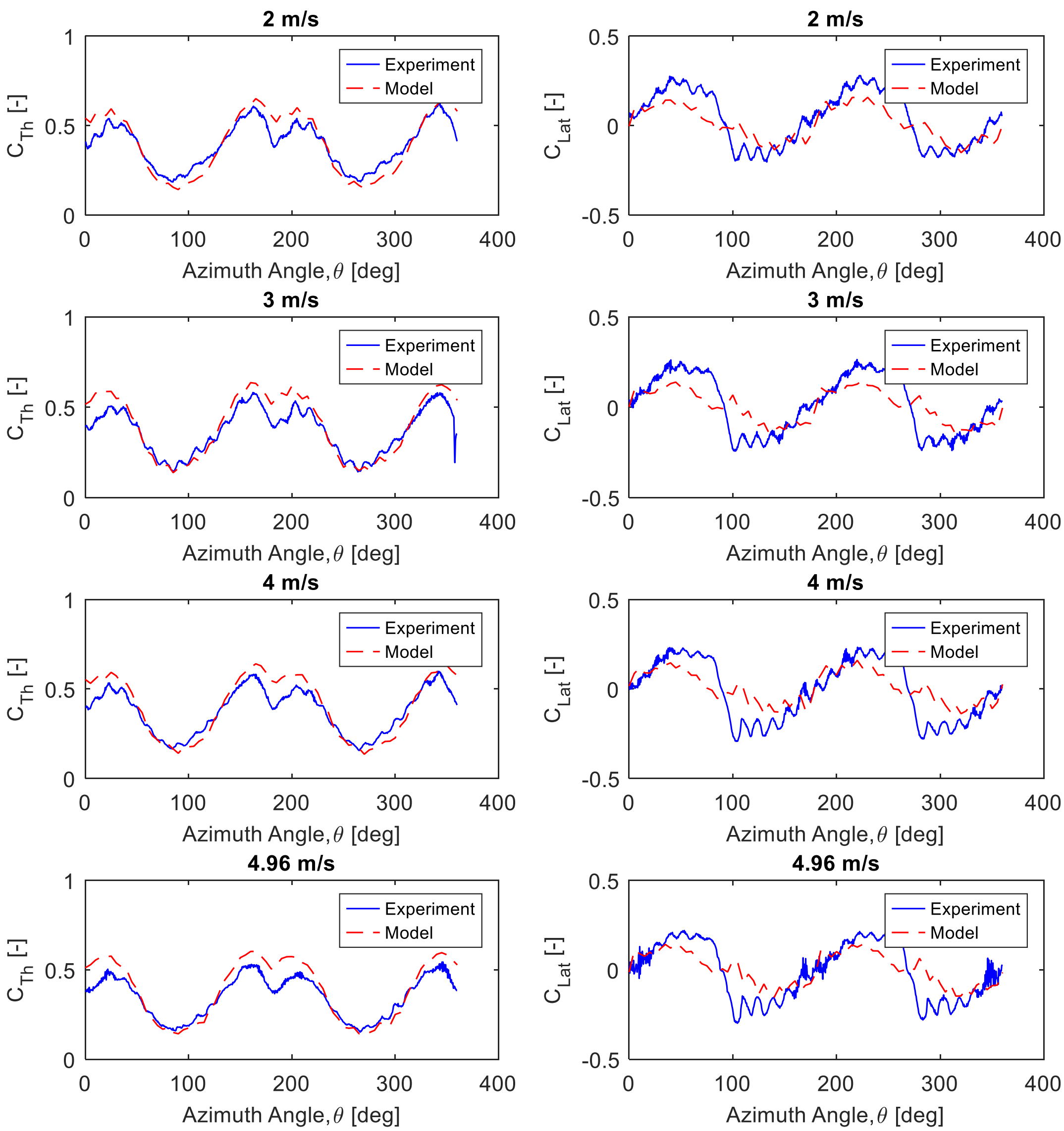

Figure 4 : Nondimensional parked loads for 2B turbine for floating wind only condition.

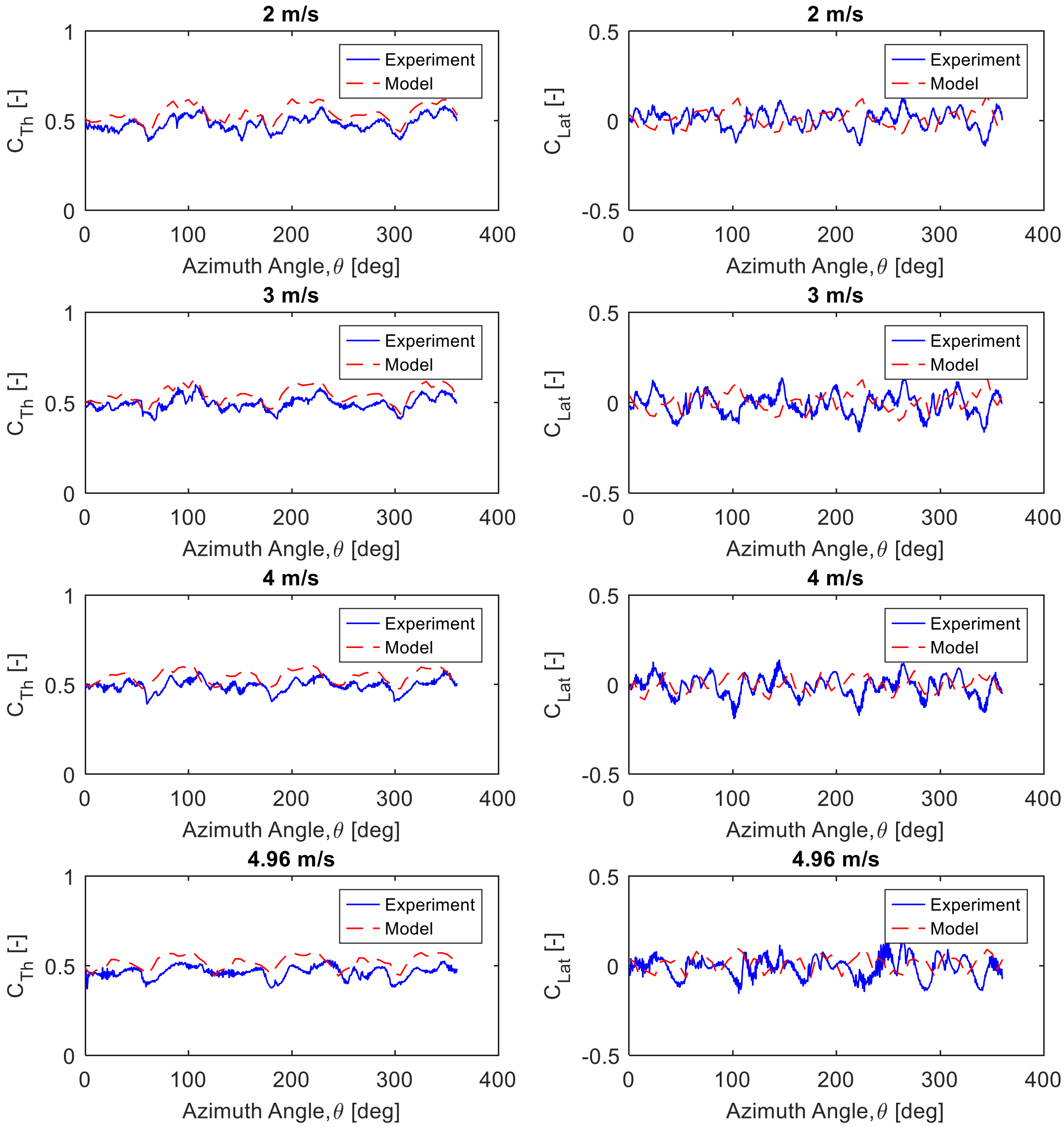

Figure 5: Nondimensional parked loads for 3B turbine for floating wind only condition.

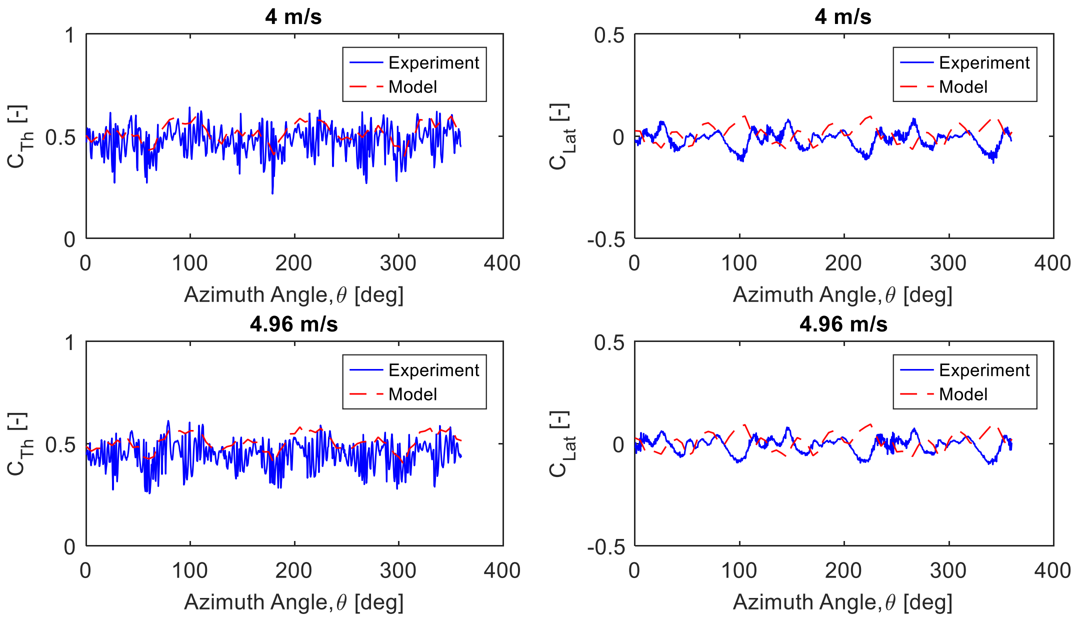

Figure 6: Nondimensional parked loads of 3B turbine for floating wind wave condition.

Results and Discussion:

4. Why not compare the experimental measurements directly against the UTD semi-numerical model, instead of presenting them in two separate graphs? How can the reader assess the accuracy of the numerical model if the results are not directly compared?

Response: Thanks for mentioning direct comparison between experimental and semi-numerical results. Authors reproduced the plots in the same graphs as follows and are now presented for non-dimensional and dimensional cases.

The direct comparison between experiment and semi-numerical model results for dimensional results are presented in the revised manuscript in Figures 15b,17b, 18b, 19b, and 20b for 2B locked with wind only, 3B locked with wind only, 2B floating with wind only, 3B floating with wind only, and 3B floating with wind and wave conditions, respectively.

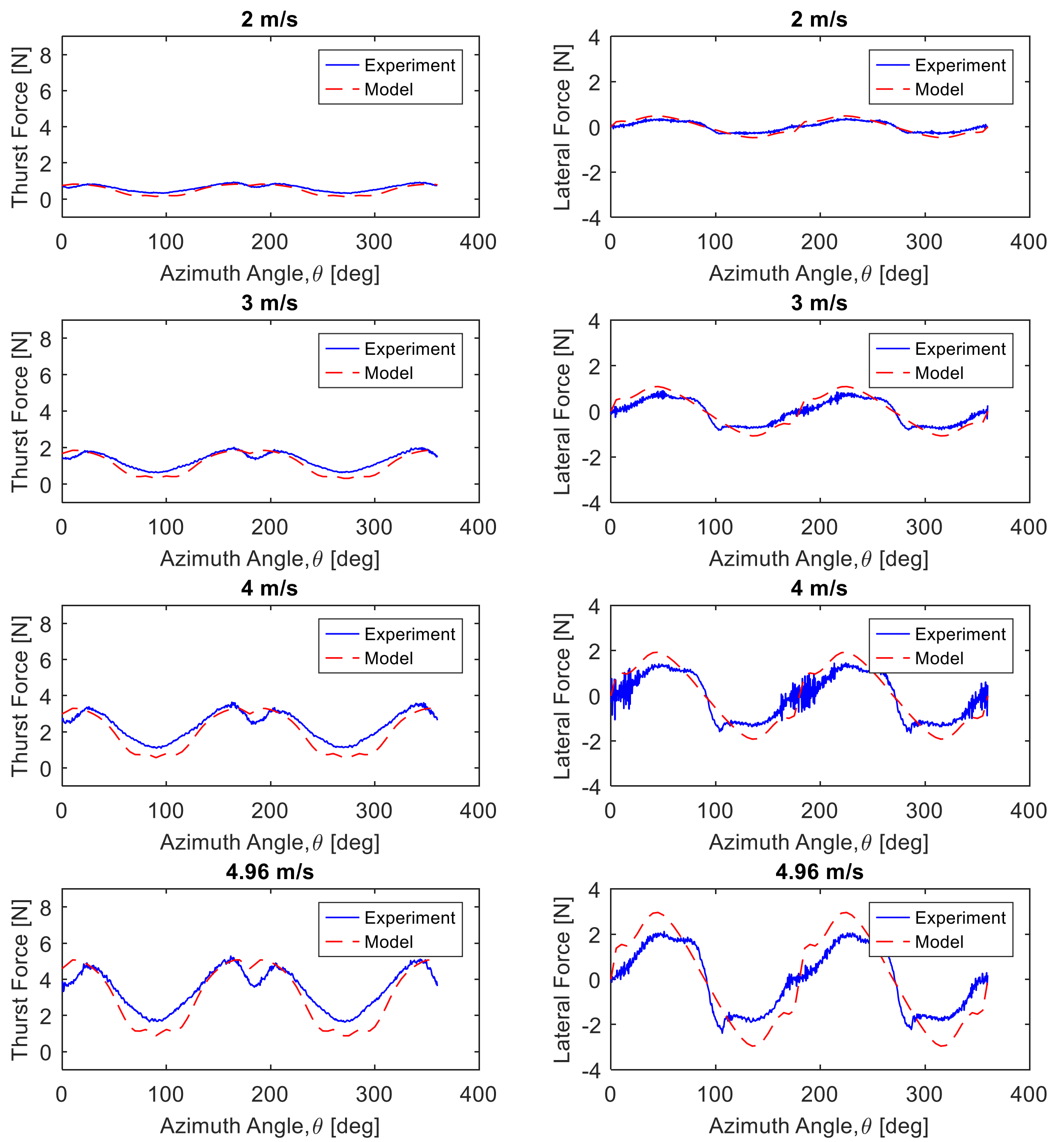

Figure 7: Comparison between experimental and semi-numerical parked loads for locked wind only tower base conditions of 2B turbine. The continuous lines represent experimental loads, where the dashed lines represent semi-numerical loads.

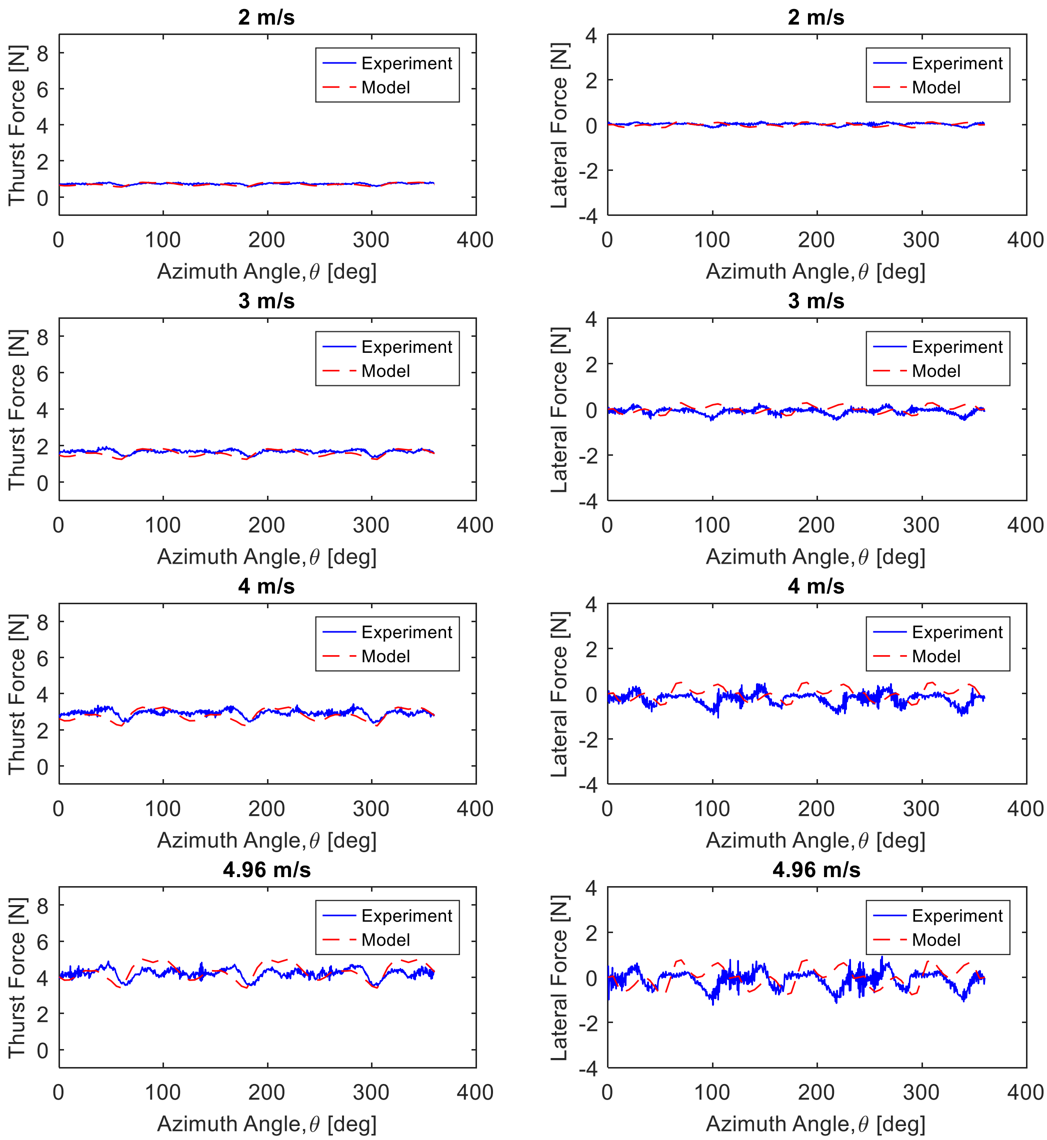

Figure 8: Comparison between experimental and semi-numerical parked loads for locked wind only tower base conditions of 3B turbine. The continuous lines represent experimental loads, where the dashed lines represent semi-numerical loads.

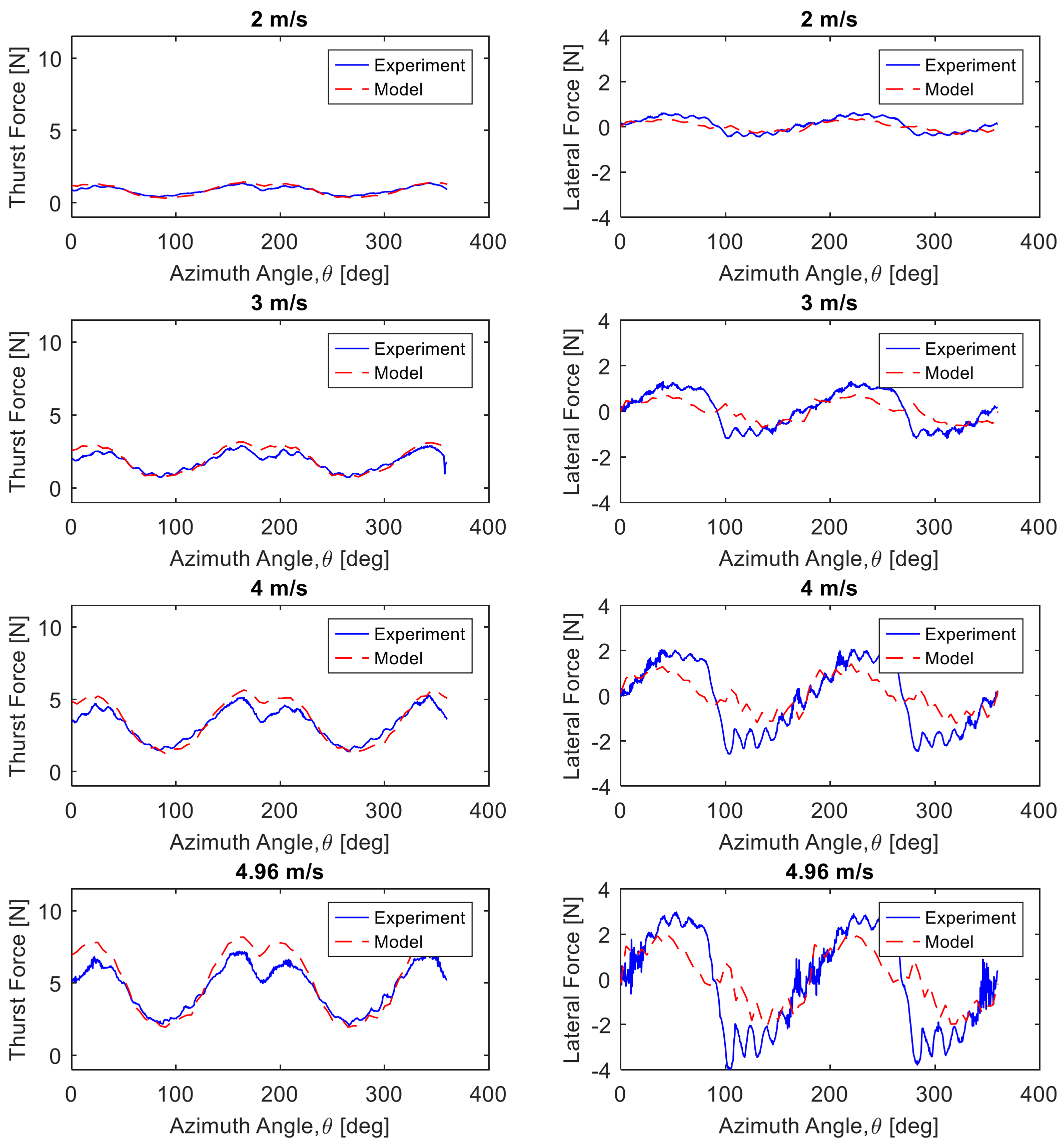

Figure 9: Comparison between experimental and semi-numerical parked loads for floating wind only tower base conditions of 2B turbine. The continuous lines represent experimental loads, where the dashed lines represent semi-numerical loads.

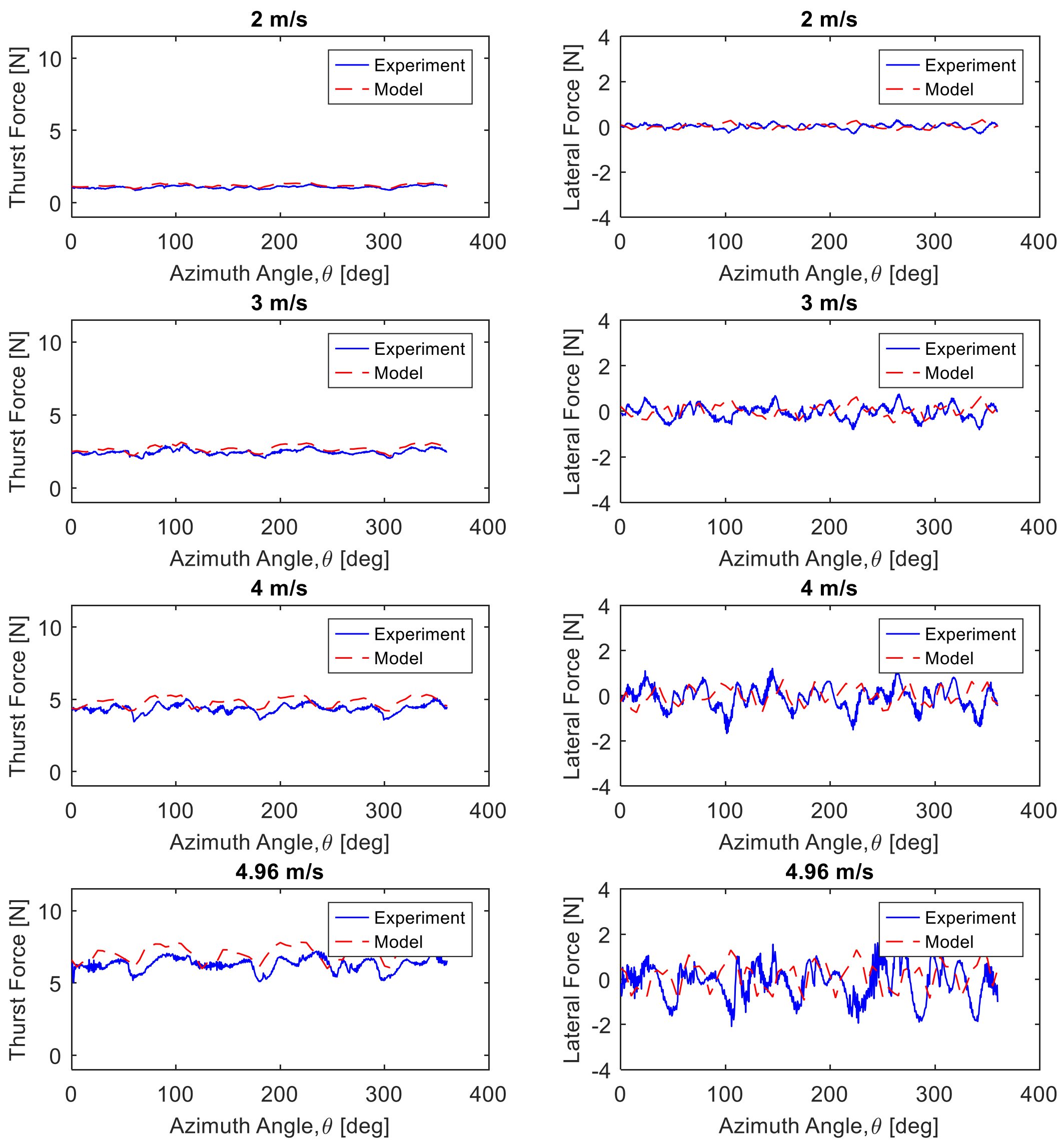

Figure 10: Comparison between experimental and semi-numerical parked loads for floating wind only tower base conditions of 3B turbine. The continuous lines represent experimental loads, where the dashed lines represent semi-numerical loads.

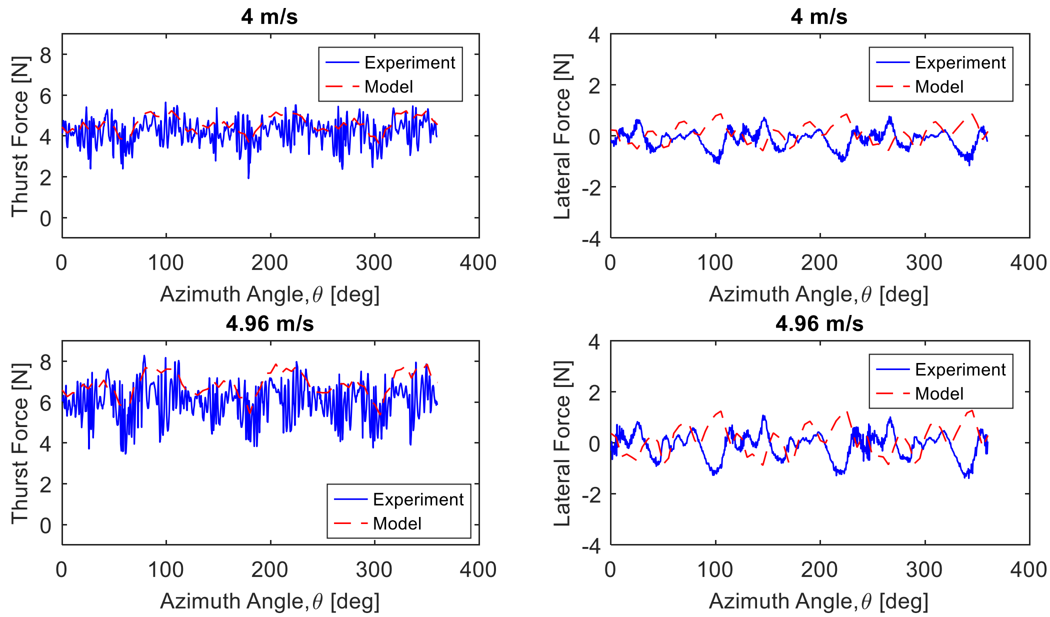

Figure 11: Comparison between experimental and semi-numerical parked loads for floating wind wave tower base conditions of 3B turbine. The continuous lines represent experimental loads, where the dashed lines represent semi-numerical loads.

5. I believe it is crucial to show the influence of tower tilting on the angle of attack variation, either in the case of floating alone or floating with waves. These changes are likely to impact the estimation of the aerodynamic loads and should be addressed in the analysis (at least reporting the values might give a reader a sense on how unsteady are the loads).

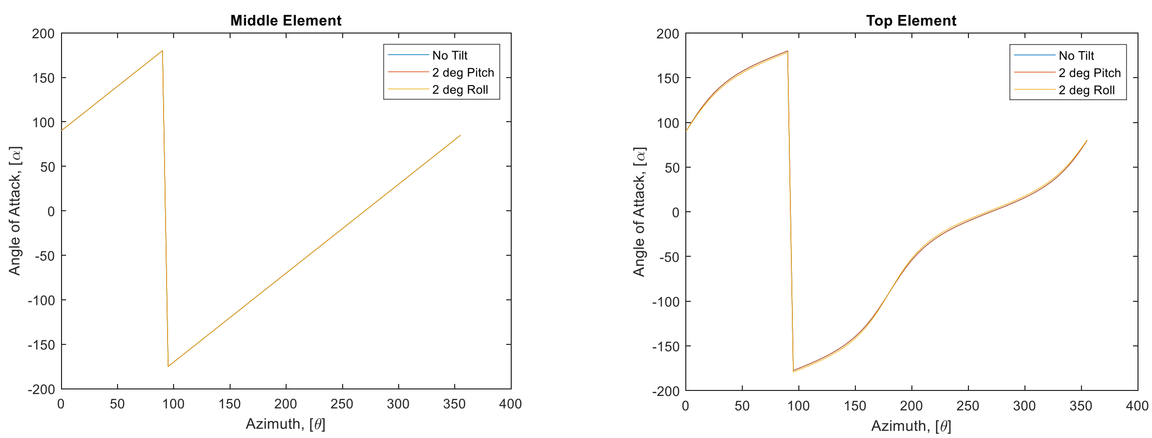

Figure 12: Variation of angle of attack with respect to azimuth for 1st blade of 2B turbine. The compared cases are no tilt, 2 deg pitch, and 2 deg roll.

Response: In the experiment we did not record any data for angle of attack. However, authors would like to show tilting effect on angle of attack for the case of a static pitch angle of 2 deg (average pitch at 4.96 ms^{-1} for floating wind only case). The influence of tilting on angle of attack is very minimal which is shown in **Error! Reference source not found.**. The data presented here corresponds to the 1st blade of 2B turbine at 4.96 ms^{-1}, where the 0 ° azimuthal position represents the blade's direct wind ward position.

6. The general division of sections could be improved. In both the abstract and the introduction, the study compares the fixed tower system with the floating system and the floating system with waves, highlighting how results vary as complexity increases. However, throughout the results section, these comparisons are not directly made. It would be beneficial to address these differences directly within the results section.

Response: Thanks for pointing out the issue of general division of section. Section 3.1.4 of the initial manuscript provides description and comparison of the parked loads among different operating conditions (wind-wave-platform conditions) such as locked with wind only, floating with wind only, and floating with wind wave conditions.

7. In case of floating tower with wind and wave: "the numerical model neglects the dynamic nature due to floating wind and wave effect" please elaborate with more details, why the model neglects these effects, what are the implications on the model predictions and how can it improved?

Response: The existing model is not formulated to predict the dynamic nature of pitch and roll motions and respective dynamic thrust and lateral loads due to coupled wind, wave, and floating platform effects, although it does handle static pitch and roll motions. A prediction of pitch and roll motions requires integrating aerodynamic, wave, hydrodynamic, platform and mooring dynamic models. A code such as WAMIT [2], or an open source code Capytaine [3], can be used to model the hydrodynamics and then coupled with mooring and aerodynamic models to predict the platform dynamics [4]. Such a model can be used for pre-test motion prediction. Here, the authors have restricted their study to the current semi-numerical parked load model and comparison with the experimental data. Ongoing research is focused on developing a coupled wind-wave-floating dynamics model for both parked and operating cases, which will be presented in the future. This note has been added to the manuscript in lines 378-384.

Conclusions:

8. The statement in the conclusion that the numerical model is validated and optimized is unclear, as the numerical model was not directly compared with experimental measurements throughout the paper. Additionally, other data from the numerical model, such as the variation in the blade angle of attack, should be presented. This is important for assessing the assumption that unsteady load corrections were not needed for the aerofoil polars.

Response: Thanks for those insightful comments. The data from the numerical model is directly compared with the experimental data in the revised version of the paper. The comparison shows that the semi-numerical tool well predicts the magnitude of parked loads, azimuthal dependence on loads, and the effects of wind speed, and solidity for all the operating conditions. Additionally, this tool accurately captures the tower shadow at the 180° azimuthal location. However, the model is not formulated to predict the dynamic nature of pitch and roll motions and respective dynamic thrust and lateral loads due to coupled wind, wave, and floating platform effects.

Due to limitation of the CACTUS tool, we were unable to analyze the variation of angle of attack (AOA) for dynamic tilting cases of the turbine. However, we conducted a comparison of the angle of attack by statically tilting the turbine at 2 degrees—representing the mean pitch angle at 4.96 m/s for the floating wind-only condition—against the no-tilt case. While the middle element showed no variation, the top element exhibited slight changes. This behavior occurs because, for a parked turbine, the AOA is solely influenced by the free-stream velocity, with induced velocity and rotational velocity assumed to be zero.

We also performed a reduced frequency analysis for the floating platform cases. The analysis shows that the inflow is not unsteady. Therefore, the assumption of 2D static airfoil makes sense.

9. The paragraphs starting at lines 359 and 364 are identical and appear to be replicated by mistake.

Response: Thanks for mentioning this. Authors removed the replicated paragraph.

10. In the wave+floating parked load scenario, the numerical model has some drawbacks as reported in the results section. This issue is not highlighted in the conclusions.

Response: Thanks for pointing out this. Authors really appreciate this point. We added the drawbacks also in the Conclusions in the 4th bullet point of the summary of the paper lines 414-416.

11. The sentence "This study has advanced our understanding of the experimental parked loads on VAWTs and their impact on turbine performance" seems to describe the main objective of the paper. The numerical model, while useful, should be considered a tool to gain insight into unmeasurable quantities after validating the load measurements. It might be better to frame this as the central goal of the study.

Response: Thanks for outlining the main theme and offering a thoughtful suggestion. The authors believe that the paper is already built on "advancing our understanding of experimental parked load of VAWTs" theme. To further clarify that the abstract and introduction sections are slightly revised. Additionally, the statement" semi-numerical park load model is a tool to gain insight into unmeasurable quantities" has been added to conclusion of abstract (line 16) and to the main contribution part of introduction (line 65).

References

1. Matha, D., Cruz, J., Masciola, M., Bachynski, E.E., Atcheson, M., Goupee, A.J., Gueydon, S.M.H., and Robertson, A.N. (2016). *Modelling of Floating Offshore Wind Technologies* https://doi.org/10.1007/978-3-319-29398-1_4.
2. Lee, C. H. and Newman, J.N. (2006). *WAMIT® User Manual, Versions 6.3, 6.3PC, 6.3S, 6.3S-PC* at WAMIT, Inc.
3. Ancellin, M., and Dias, F. (2019). *Capytaine: a Python-based linear potential flow solver*. J. Open Source Softw. *4*, 1341. https://doi.org/10.21105/joss.01341.
4. Gao, J., Griffith, D.T., Sakib, M.S., and Boo, S.Y. (2022). *A semi-coupled aero-servo-hydro numerical model for floating vertical axis wind turbines operating on TLPs*. Renewable Energy *181*, 692–713. https://doi.org/10.1016/j.renene.2021.09.076.