Authors' response to reviewer 3

We thank the reviewer for the valuable comments and suggestions, which we consider very important and help us sharpen and improve the manuscript. Here are our responses to each comment.

The authors response is shown in green.

General comments:

Line 11: What about for large waves? What are the conditions that produce the largest loads?

Only the environmental conditions of the Gran Canaria site are used in the paper. The Gran Canaria site has a mild environmental condition with fifty years extreme waves with $H_s = 5.11$m. Therefore we stated through the paper that this response is at mild sea conditions.

Line 12: Are you saying the models are now verified? What do you mean by verified?

Line 203: Again, what do you mean by verification? Do you simply mean assessment or investigation?

Line 300: I would not use the term verification. Either assessment or investigation. Verification is defined as determining that there is either no error in the modeling theory implementation, or that your simulation result is adequately converged. That is not the focus here.

Thanks a lot for this feedback. We agree that this is a misuse of the word verification and we have modified the paper according to your suggestion.

Line 21: Relative to what baseline?

Thanks for this comment. It is now clarified in the text

Line 55: New version of OpenFAST now allows for flexible substructure (platform) as well.

We are aware that NREL are updating SubDyn to model flexible floaters. However, to the best of our knowledge it is not publicly available yet.

Line 99: Aren't your tower natural frequencies above the linear wave-excitation region?

Thanks for the comment, this is a very interesting question. The sum QTF may be able to excite the first coupled tower frequency, this is expectedly by a small amplitude, since wave-driven excitation of the tower will have to happen through motion-excitation of the floater, which is modelled as a rigid structure. This is supported by the findings [1]. The explanation is added at the end of section 2.2.

Moreover, the tower loads will always be dominated by the wind loading especially due to the higher thrust forces on the 15 MW reference turbine, which further supports the neglection of the sum frequency wave forcing.

Table 9: For Activefloat, can you explain how your static equilibrium has a large negative pitch, but positive surge?

Static equilibrium is found with the mooring system attached. Both floaters have a negative pitch due to the big overhang of the tower top, causing a negative moment. In the absence of wind and waves, the surge motion is only affected by the mooring line forces, having a positive surge means that the mooring lines are pulling the platform in the positive x direction. This explanation is now added to the paper.

Table 10: Is there concern with the coalescence of the heave natural frequency for Activefloat with waves?

The heave natural period is much higher than the peak wave period (T_p) in the Gran Canaria islands which is between 6 s at normal operations and 9 s at extreme conditions, hence the heave natural frequency lies outside of the wave frequency range. We have not seen any concerning responses in any load case, and we believe there is no coalescence. Figure 1 shows Activefloat's heave natural frequency with the vertical line, and the wave frequency range for $T_p = 9s$.

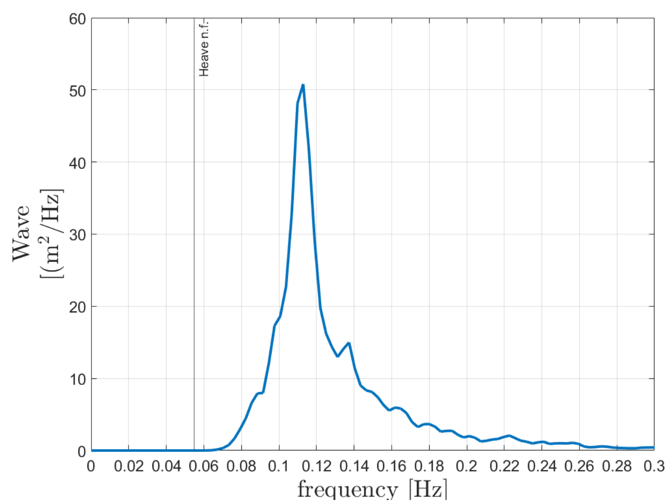

Figure 1: Irregular wave frequency range $T_p = 9s$

Line 233: I'm not sure one would encounter negative damping during a step wind event, but rather during operation as the turbine is oscillating in surge/pitch and the controller is reacting to the oscillating perceived wind speed.

The steps in a step test induce a change in thrust and will induce a transient settlement into the new equilibrium. The step test is therefore a good first check that negative damping does not happen due to sudden changes (steps) in the wind speed. The purpose here is to check that negative damping does not happen at any wind speed, and not during the ramp from one wind speed to the other. Therefore, after each step in the wind speed, the steady wind field for 200 s is used to check that the controller does not add any negative damping to the system before stepping again to a higher/lower wind speed. If the controller is not tuned the negative damping effect can still happen with steady wind fields. Since we can not see any resonance or negative damping in both the step wind simulation and also in all the other load cases with turbulent wind field, we came up with the conclusion that the controller does not add negative damping to the system. We updated the manuscript to include this statement.

Line 239: And without wind. The wind forces may override the wave-drift forces when present.

Thanks for the comment. The text is now updated.

If after 3000 seconds, the WindCrete is still not in equilibrium for regular waves, is 1800 seconds a sufficient amount of time for transient removal?

The regular waves simulations were done without setting the correct initial conditions, hence the WindCrete platform does not reach steady state. This is now corrected and the load case is redone to decrease the transient time, and the platform reaches steady state in less than 1800s. For all the other simulations with wind fields, the initial conditions used are corresponding to the platform equilibrium position when a steady wind field is acting on the turbine.

In Figure 9 and 10 for the response to irregular waves in the absence of a wind field, we use the same starting initial conditions for both load cases and run the simulation for 5400s. This is enough for the purpose of comparing the responses of the platforms to irregular waves with and without second order forces. Moreover, we believe the effect of the transients on the motion response is minimum when compared to the first and second order wave forces, hence removing the first 1800s is enough to give credible results.

Line 260: and since the natural frequency lies in the linear wave excitation region.

We updated the text to this "and since the natural frequency lies close to the wave excitation region" as we have shown earlier that the heave frequency is close to the wave excitation but it doesn't lie within the wave frequency range.

Would be useful to state the wave properties in each figure caption.

The captions are now updated to include wave properties.

All minor changes for spelling mistakes and structure are now implemented in the text.

References

[1] Sébastien Gueydon, Tiago Duarte, and Jason Jonkman. Comparison of Second-Order Loads on a Semisubmersible Floating Wind Turbine. In *Volume 9A: Ocean Renewable Energy*, number 5, pages 1–12. American Society of Mechanical Engineers, jun 2014.