Wind Energ. Sci. Discuss., referee comment RC2
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Comment on wes-2021-40

Anonymous Referee #2

Referee comment on "Statistical impact of wind-speed ramp events on turbines, via observations and coupled fluid-dynamic and aeroelastic simulations" by Mark Kelly et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-40-RC2, 2021

Review of: "Statistical impact of wind-speed ramp events on turbines, via

observations and coupled fluid-dynamic and aeroelastic simulations"

by Mark Kelly, Søren Juhl Andersen, Ásta Hannesdóttir1

Summary/General comments:

The authors present the sensitivity of simulated NM80 wind turbine loads to prescribed offshore wind ramp events. A representative wind ramp sub-sample (ensemble of 8 cases) was acquired from 11-years of 1-Hz wind velocity data. Both single turbine and wind farm load response were investigated: single turbine load response was simulated by constrained Mann-model (CMM) turbulence simulations coupled to the aero-elastic model FLEX5 (single turbine) for each ensemble member, wind farm response was simulated by embedding the CMM ensemble members into an LES model of a 9 turbine wind farm (actuator line) coupled to FLEX5.

Main results are: ramp acceleration dominates the maxima of thrust-associated loads, with a sensitivity of ~3% per 0.1 m s-2 ramp acceleration magnitude, single and wind farm simulations showed the same sensitivities of loads to acceleration.

The paper is innovative and interesting, and mostly well written.

The article can profit/become more illustrative and easier to digest if the reader would be walked through one simulation case and the respective load response in more detail before diving into the multi-case space statistics. This could also help to consolidate the multi-case results and graphs presented.

I recommend this paper to be accepted after these very minor revisions.

Minor Issues/Specific comments:

- I suggest to present one simulation case with ramp speed exceeding rated speed (U>Vrated) and the respective forcing and the load response in more detail for better readability of the article. E.g. taking case 2, I would suggest to create a graph with two Y-axes, X-axis is time, left (Y1) axis: wind speed (e.g. from figure 9) and right (Y2) axis: M_brfw (case 2 from Figure 20). While the maximum flap-wise blade root bending moment is reached when the ramp crosses rated wind speed, the flap-wise blade root bending moment is reduced afterwards since the turbine goes into rated operation mode by pitching the blades out of the wind. Therefore, the mean bending moment across the ramp is lower than the pre-ramp mean bending moment. This clarifying example could also help to consolidate the multi-case results and graphs presented to the minimum necessary.
- Can you please elaborate on this conclusion (line 583-585) "The distance into farm where loads begin to increase depends on the ratio Upost-ramp/Vrated." You probably would like to add some explanation saying that the mean loads are increasing since Upost-ramp > Upre-ramp but Upost-ramp < Vrated. Thus, the smaller the ratio between (forcing aka case) Upost-ramp /Vrated the shorter the downstream distance after which the mean loads increase.

Comments:

- Can you comment on whether the offshore ramp events contain ramps that are representative of severe onshore thunderstorms with fast ramps/high acceleration rates?
- Can you please comment on the implication of your and related work to IEC 61400-1 Extreme operating gust (EOG) and Extreme coherent gust with direction change (ECD)
- The article would profit from showing comparisons of the simulated loads with loads measurements.