

Wind Energ. Sci. Discuss., author comment AC2
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Reply to RC2

Mark Kelly et al.

Author 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-AC2>, 2021

Thanks to the reviewer for their constructive comments.

In response to the "minor issues" in RC2, we reply:

- Following the reviewer's suggestion, we have added a figure and short "walk-through" for one case.
- Regarding the comment about the conclusion sub-point (line 583-585): the major bullet-point above this sub-point already states that $U < V_{\text{rated}}$ and it is already understood that $U_{\text{post-ramp}} > U_{\text{pre-ramp}}$. The reviewer's statement about shorter distance downstream is not necessarily correct; we wrote about the basic dependence on the ratio $U_{\text{post-ramp}}/V_{\text{rated}}$ because it can depend on the wake situation and does not necessarily correlate with distance into the farm. However, given the reviewer's input, we have changed the wording of the major bullet point above this to specifically include "(again crossing rated speed)", and also changed the text in this sub-point to include "where this happens", referring to the major-point in line 582.

In response to the "comments" offered by the reviewer, we respond:

- These events are offshore, mostly associated with (cold) frontal passages—i.e. the advective transition across a "line" seen on typical weather maps. Onshore thunderstorms may often be associated with (cold) fronts; however, the accelerations therein tend to be related to downdrafts and local cells, having a different character.
- As shown in Hannesdóttir & Kelly (2019), the amplitude of ramp events does not exceed the IEC's "ECD" prescription for wind speed, but may do so for directional changes.
Regarding the EOG: it is difficult to definitively comment on a direct implication, because the 61400-1's EOG prescription depends on the site-specific extreme and mean speeds ($0.8V_{e50}, V_{\text{hub}}$) or turbulence, and imposes a 10.5s rise-time; further, ed.4 of the 61400-1 allows one to replace the analytical "hat" form with stochastic simulations for DLC3.2 (start-up).
- The authors agree that comparison with measurements would be beneficial, and was originally intended in the project, but this was unfortunately not possible. Doing so would be worth a separate article, but such measurements were not available. If more manufacturers would share loads measurements over long operational periods (>1y), thus capturing a statistically significant number of load-driving events, then we could certainly find out more.

