

# Review comments to “Slow wake recovery and low turbulence behind wind farms parameterized in mesoscale simulations”

The manuscript has been improved, particularly in its choice of wording. Replacing the term “under-resolving gradients” is a positive step, as the previous formulation was misleading, as noted by the other reviewer. I also welcome the revised phrasing in the title and discussion, which now presents a more neutral tone and avoids overstating the findings. However, the newly introduced term “underestimated” is still not appropriate for this context. Since the revision primarily involves changes in wording, my comments focus on this aspect. I have only a few remarks which once addressed, I would be satisfied for publication. I commend the authors for all their efforts so far, and I believe the manuscript is close to being publishable. All line numbers below refer to the revised version.

## Major comment

The authors have replaced “under-resolved” with “underestimated.” Although this is an improvement, the new term remains misleading. Coarse mesoscale simulations inherently represent gradients at their own resolution, while finer-scale gradients, as captured by LES, are simply not resolved by the coarse simulations. Consequently, such gradients will always appear underestimated or under-represented when compared to higher resolution results. This is an expected consequence of coarse gridding.

The authors state that the coarsened LES is used only as a diagnostic and does not represent the true dynamics governing wake recovery. While I agree, the ultimate goal is for the NWP-WFP simulations to reproduce the behaviour of the **coarsened** LES by *parameterising* the underlying dynamics observed in high resolution simulations. In its current form, the NWP-WFP framework does not adequately capture these effects.

For these reasons, the term “underestimated” should be avoided except when explicitly comparing NWP-WFP simulations with **coarsened** LES. For example, Section 3.5 could be retitled “Coarse resolution effects in the wake of ...”, and Section 4.1.1 could refer more generally to “Coarse grid effects.” These are only suggestions and the authors may propose better alternatives, but the key point is to avoid potentially misleading terminology.

Finally, Fig. 10 should include the coarsened LES results to show the comparison with NWP-WFP simulations and to illustrate how spatial averaging smooths local gradients.

## Minor comments

1. The inclusion of LES results for the staggered layout is welcome, as it provides an additional perspective beyond the aligned (worst case) configuration. However, treating the staggered layout as an equivalent reference introduces inconsistencies. Throughout the results section, the comparison between WFP and LES focuses primarily on the **aligned** layout, which yields unfavourable results for the WFP in terms of wind speed, TKE, and power. In several

instances, the authors counter these discrepancies by stating that agreement improves when using the staggered LES as a reference. This comparison is not valid, as it involves different layouts.

Such statements should be removed or instead be framed as observations, possibly followed by hypotheses regarding the WFP behaviour. If the authors wish to compare against staggered LES results, then corresponding WFP simulations with a staggered layout are really required. Although the authors may argue that this would not alter the conclusions (which I expect) or that will produce same results as the aligned layout (which I doubt), consistent configurations should be maintained for methodological rigour.

This issue also affects the quantitative statement in lines 383–384: “Subtracting the wind speed change of the two LES with both the coarse and fine NWP-WFP cases, a difference of  $0.15\text{--}0.60\text{ m s}^{-1}$  is found.” It appears that the staggered LES may have been used to define the lower bound, which is not appropriate. This statement is also reflected in the abstract (lines 11–12) and should be revised to rely solely on aligned configurations. Affected passages include lines 11–12, 283, 331–334, 344–345, 359, 383–384, and 427–428 (the latter partially makes an observation).

2. Upon re-reading, Section 3.2 is not sufficiently convincing in its current position. The discussion there requires prior context on wake behaviour and TKE distributions from both WFP and LES simulations to interpret the power results. At this stage, concepts such as near-farm wakes and farm-induced TKE have not yet been introduced, but they are used in that section. I suggest moving this section later in the manuscript, for example after Section 3.3, once the wake dynamics have been described.