

# ***Interactive comment on “Global Trends of Large Wind Farm Performance based on High Fidelity Simulations” by Søren Juhl Andersen et al.***

## **Anonymous Referee #2**

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### General notes

This article brings a comparative analysis of wind farm performances (in terms of mean mechanical power and its variability) based on LES numerical simulations. In the continuity of the work of Andersen et al. (2015), these simulations are performed using 2 codes (EllipSys3D and PALM), 2 rotor modeling methods (Actuator Disk and Actuator Line) and two rotors (NREL 5MW and NM80). Different operating conditions (turbines spacing, mean wind speed, turbulence and shear...) were tested, leading to a total of 18 wind farms cases. The first part of the article results aims to highlight some trends in the influence of operating conditions while the second part aims to show a generalized analysis by aggregating all the results.

This paper brings interesting results which are of importance for the wind energy com-

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munity. The objectives of the study are well-posed and the methodology well described. High fidelity LES of wind farms is a state-of-the-art methodology and the obtained results constitute a step forward in the wind farm performances understanding. This topic, still needing further studies, is relevant for Wind Energy Science readers. Nevertheless, some points need to be addressed by the authors before publication.

### Specific comments

- 1. Introduction: The introduction makes the impression of being a list of summarized publications. Even if it is well written, some links between articles would be welcome.
- 2.2.1 Ellipsys3D: The aeroelastic coupling may deserve a one-line description to understand what is involved in the computations (even if it is described in the paper of Sorensen et al (2015)).
- 3. Simulation set-up: are the numerical grids cartesian structured?
  - 3.1.3 Summary of Numerical Methods: the number of differences between DTU, FW and UU methodologies may constitute a strong difficulty when comparing to each other, specifically between DTU and UU. Additionally to the differences given in Tab 1, why are the turbulence and rotor positions different (6R and 10R vs 13R and 30R) for DTU and UU, as well as the total simulation time (60 min vs 30 min)? Even if the authors try to limit their consequences, can the authors comment on this topic? An identical set-up with both codes would help to clarify the code influence for example.
  - 3.1.3 As the article deals with high fidelity LES and as it is clearly indicated that such computations are expensive, informations on the computational cost (time step, CPU hours per case, mean reduced computational time...) would be relevant.
- 4.1 Variability of LES: the 40% difference in mechanical power production observed in FW results are assumed to be due to lower turbulence and differences in shear and Coriolis effect treatment. Does the code difference can lead to such gap also?
- 4.1 Variability in LES: What are the LES filtering effects involved? The spatial filtering

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from the LES approach or the one due to statistical binning?

- 4.1 Even though both plot types is consistent, why the plot type goes from box plot to violin plot by changing the effect influence?
- 4.2.2 Surface Response: all the results presented here are very interesting as well as the type of illustration because gathering so many results is very challenging. I am more concerned on the analysis and moderate it in light of what I indicated for the 3.1.3 point. Can the authors can discuss that?

Technical comments

- Line 42: Stevens et al. (2015) is cited twice in the same sentence.
- Line 67: turbulence -> turbulent
- Line 77: as is -> as it is
- Figure 1: axes unit are missing
- Table 1: the columns need to be explained (U0, ambient TI, shear, turbine resolution)
- Line 202: turbine for are -> turbine are
- Figure 3: the box plots are unclear compared to Figure 2. The boxes are almost not visible.
- Table 5: units are given in the first row and shouldn't be given with the values
- Equation 4 is missing and why a and b are underlined in the relations just before?
- Figure 12: why an hexagonal binning? The white color indicates both a 0% occurrence and a lack of data. This should be more distinct.
- The rated power P0 should be namely written in the rotor description
- space before parenthesis are often missing in the text

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