Reviewer comments to the submission *Wake properties and power output of very large wind farms for different meteorological conditions and turbine spacings: A large-eddy simulation case study for the German Bight*

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This work investigates the main characteristics of the flow within a cluster of offshore wind parks and their wakes under different atmospheric conditions. In particular, it studies the interaction the wind farm with the surrounding Atmospheric Boundary Layer (ABL) in relation to the atmospheric stability, the ABL height as well as the distance between turbines and the overal size of the park (set by the number of turbines). The study is carried in the German Bight, an area of current and future development for wind projects in the coast of the north sea. Every park in the cluster is outlined following *priority areas* of future development of wind projects. The flow is resolved using LES and the Actuator Disk (AD) is employed to represent the rotors which are placed in a staggered configuration, using two different spacings between rotors that are typical of offshore parks. A study of the power performance of the park in function of the power density available in the different stability and turbine spacing conditions is also presented.

The study is very relevant in the field as it shows the variation of the impact that the ABL stability features has on the flow development within and around very large parks compared to smaller ones. These variations are exemplified by the direction of turning of the wake of the park, the extension and recovery of the velocity and turbulence intensity behind the park as well as the distribution of the available power density in the wind. It presents a detailed analysis of the role played by the atmospheric conditions in the apperance and evolution of the flow within the wake and its consequences in the development of the surrounding ABL flow with focus on the features of the park wakes. It should be noted the very large computational demand to achieve these results: each simulation comprises 2088 wind turbines with mesh sizes ranging from $\sim 7.4 \times 10^9$ to $\sim 1 \times 10^{10}$ cells, which is indeed remarkable (so it will be very informative to reveal the computational expense). I recommend this work for publication but please provide an answer to the following questions and comments:

- L89 "it is possible to prescribe a surface heating ..." is this just a choice or a necessity, in view of the issues with the direct prescription of the surface flux as described in Basu et al. (2008)?
- L94, Could you please briefly comment why the overestimation and how this is fixed? Also, would the use of a different distribution length along the smearing direction help to remedy this (a different value of the standard deviation than $1\Delta x$ in the Gaussian distribution)? I think it is useful to provide these details here (even crucial in the case of the overestimation) as the reference you provide is not in English. Also note that in the archive of Meteorologische Fortbildung at the following link, the issue of the reference you cite appears as from 2015 instead of 2016: `https://www.dwd.de/EN/ourservices/pbfb_verlag_promet/archiv/archiv_promet.html`

- L127 and Table 1: should one assume that 225 deg is the wind direction at hub height obtained with a u_g at direction alpha as shown in the table?

- L133, why have you chosen to use a uniform cell distribution in the horizontal plane? This question arises from the fact that if cell stretching was used away from the turbines, the savings could have been used to achieve a higher refinement either around the rotor and wakes or for the near ground zone, where the mesh requirements for a well-resolved LES are higher.

- L134, why is this resolution enough? In the absence of a numerical or experimental evaluation, please provide an argument. This element is crucial as the recovery of the individual wakes depends on the amount of TKE resolved within and around.

- L134 (and L204), also with regard to the cell resolution, please comment on its the adequacy in terms of the amount of subgrid TKE with respect to the total. In other words, how "well resolved" is the LES, especially for the wake region? L204, please describe how the subgrid convergence study demonstrated that 20 m was the adequate cell resolution in the horizontal directions.

- L165 and results section: it is mentioned that blockage from the parks is observed to reach the recycling plane, did the authors observe any dependence of the blockage with respect to the size of the domain (regardless of the fact that the boundary conditions at the sides are periodic)?

- L168, it's not totally clear how the height limitation set to the recycling of turbulence helps to avoid the increase in the BL height, is the subsidence mentioned in L90 not sufficient? However, it is clear that this region represents only a small portion of the total domain length, albeit still large (10 km).

- L194, please clarify the usage of the concept "steady state". It seems that in some instances the authors use these words when referring to a flow that has achieved *statistical convergence* such as in a developed BL which could be confusing with a flow that is indeed steady-state and as such, lacks transient features such as those reproduced by LES.

- L230,235, could the issues pointed at by Basu et al. (2008), such as those related to the estimation of the friction velocity, be added to these arguments?

- L378, is it possible to provide an example (or a threshold) of a park size where, following these arguments, the turning would occur in the clockwise direction?

- In Figs 5 and 6, scale is inverse with respect to the other (red to green and green to red), please maintain consistency to denote low to large values in scaling. Furthermore, it is rather common to see blue to red to depict small to large values (e.g. subfigure (f) in figures 4, 6 and 7), so to use blue in the middle can be somewhat disconcerting. Is this perhaps a choice to highlight the wakes behind the clusters?

- L386, the TKE does consider the subgrid scales. Since the resolution is relatively coarse to resolve the flow around the rotors, a sizable part of the TKE is potentially found within the subgrid scales. Please provide an argument regarding why only resolved scales should be considered in this analysis.

- Figure 7, label in vertical scale should be z.

- L505, how is the power computed for each turbine?

- L608, it is remarked that for the SBL-300-7D case, the $W_{gpg,wt}$ component is dominant but in the Fig. 10(e) it seems that W_{vkef} is about the same value throughout except only within the two gaps between farms.

Technical corrections

- L121, typo, replace “can not” for “cannot”
- L162: I suggest to remove first comma
- L308, typo, it should be “effect” (it says affect)
- L637, typo, “of” instead of “if”