

Interactive comment on “Offshore wind farm global blockage measured with scanning lidar” by Jörg Schneemann et al.

Emmanuel Branlard (Referee)

emmanuel.branlard@nrel.gov

Received and published: 21 December 2020

This is a thorough paper which presents measurement data of the global blockage effect using a scanning lidar. The authors have carefully accounted for uncertainties in the measurements, and found that blockage effects were mostly found in stable atmospheric configurations.

I have some general and specific comments, I hope that addressing some of them can improve the paper. Here are my general comments:

- The authors mention low and high thrust coefficients throughout the paper without defining the range that have been used.
- Some additional uncertainties may be worth mentioning:

C1

- The logarithmic law assumes an "undisturbed" atmosphere, without a wind farm. The induction may affect the profile and hence the extrapolations performed in this study. I wonder if this can have an important impact and might be a bit of a chicken and egg issue since the profile use to extrapolate might depend on the induction effect.

- Uncertainty in the C_t curve (using the NREL5MW instead of manufacturer's curve)
- The number of samples used for averaging (but it is roughly the same for all scenarios, so that shouldn't affect your conclusions)
- It was not clear to me how the thrust coefficient was computed (which wind speed is used as a reference), and I wonder if this can have an effect on the categorization of the cases. It might make sense to use the average C_t over a set of turbines close to the lidar to make sure this C_t is representative of the farm (though this introduce further issues for the determination of reference wind speed for waked turbine..).
- There is likely a relationship between the wind direction, the wind farm layout, and the blockage effect. Scenario 4 has a fairly different wind direction than the others. To be fair, given the layout, it could be expected that the blockage effect would be smaller for this wind direction. It might still be worth mentioning/investigating. Also, the wind direction fluctuations within a measurement period might affect the averaging of the flow field, and potentially reduce the observed blockage effect. Maybe the variability of the wind direction could be reported?

I believe you make a strong point that the blockage effect is mostly seen in stable conditions, but I hope that addressing some of these comments will further lift any doubts. Again, congratulation for the work. I'll be looking forward to a revised version of the paper.

Emmanuel Branlard

Here are my specific comments:

I.52: I leaves this up to you, but since most of your references are fairly recent, I

C2

wonder if you'd consider replacing the one you have on that line by the older version of this paper from 2015: "E. Branlard, A. R. Meyer Forsting, Using a cylindrical vortex model to assess the induction zone in front of aligned and yawed rotors, Proceedings of EWEA Offshore Conference, Copenhagen, 2015".

I.131: It took me a bit of time to figure where the BorWin cluster was and of which farms it consisted. Maybe you can make it clearer on the figures or the text.

I.189: Out of curiosity, shouldn't the curvature of the Earth also affect the projection of the horizontal velocity?

I.200: What is meant by the "normalization of all grid points" ? Could you precise this further?

I.210: You must have selected a reference wind speed to compute the thrust coefficient, can you mention how/where you picked this reference speed?

I.234: I'm not good with color names but I wonder if "light red" can be replaced by a different name, or the color replaced.

I.309: The streaks are quite interesting. Do you think the streaks could be related to the blockage, the wake of neighboring wind farms, or they might disappear with more samples?

I.310: The abbreviation OSS is only used here and was not introduced before.

Figure 3: I was surprised to see that the uncertainty does not increase significantly further away from the measurement. Is it because of the homogeneous assumption? Doesn't the uncertainty along the LOS increases with distance?

Figure 4: the caption mention that the conditions are "low thrust", but section 3.2 mention that the farm is not operating. This is somewhat confusing. Does the caption needs to be updated?

I.418: The upscaling assumes a profile shape. Could it be that blockage will result in

C3

vertical profile different from the one assumed and hence affect the results?

Interactive comment on Wind Energ. Sci. Discuss., <https://doi.org/10.5194/wes-2020-124>, 2020.

C4