The paper uses two WRF-LES simulations of a large, generic wind farm to investigate how and why wind-farm blockage varies with surface layer stability. The underlying physical mechanisms are explored based on a detailed analysis of the streamwise momentum budget components. Interestingly, the paper shows that the adverse pressure gradient upstream of a front-row turbine is nearly identical to the pressure gradient upstream of a standalone turbine, and the difference between single-turbine induction and wind-farm blockage stems from the vertical momentum advection. The paper is well-written and has a clear structure. I appreciate that the paper has one clear research objective, and accordingly the analysis of the wind farm simulations focuses solely on the upstream flow behaviour in order to address the research question. I am a bit puzzled by the claim that this paper investigates blockage in the absence of gravity waves, and I do have some related questions about the numerical setup. Please find below a list of comments and suggestions.

Main comments

1. One line 66, the authors claim that they investigate wind-farm blockage in the absence of gravity waves. How exactly do you ensure that there are no gravity waves in your simulation? I think this is quite a significant assumption and should therefore be discussed in more detail.

2. The LES uses a two-domain configuration with one-way nesting. Can you give more details about the domain nesting? How large is the outer domain compared to the inner domain? What boundary conditions are imposed on the inner domain? If this is an inflow-outflow type domain, is there a transitional period to impose (blend) the inflow wind speed? What is the outlet boundary condition (simple outlet condition or again blending towards the parent solution)?

3. How is the grid resolution chosen? The authors mention that a finer grid is used in the more stable case, but how did you determine that the employed grid resolution is sufficient?

4. An implicit Rayleigh damping layer of 1000 m is used to avoid wave reflection. How do you know this leads to sufficient damping? Did you check for wave reflections? Other LES studies typically use Rayleigh damping layers of 10 km or more (see, e.g., work by Allaerts and Meyers, or Lanzilao and Meyers), so 1000 m seems quite small to me.

5. How does the power of the entire wind farm vary wind stability? I imagine this will also affect the amount of blockage.

6. Why do you call the net-upward vertical motion in the region upstream of the wind farm a secondary circulation? I don't fully understand why you see this as a circulation (any similarities with other flow scenarios?). Note that this upward flow displacement has been noted by others in the past (see, e.g., Allaerts and Meyers 2017).

7. Line 265 "Larger vertical shear of the horizontal velocity in the moderate stability case contributes to the increased vertical momentum advection compared to the weak stability case." I think this is the most important finding of the paper, but it is not entirely clear to me how vertical shear affects vertical momentum advection. Can you please elaborate?

8. Appendix C: It is an interesting approach to assess the presence of gravity waves by means of the phase shift between pressure and vertical velocity signals (note that it is not clear at which height the signals are obtained, or are they averaged over heights?). However, I'm not entirely sure whether these phase relations still hold when you have wave reflections. When there are wave reflections, these lead to standing wave patterns and I can imagine that for those cases the phase relationships change. Did you look at vertical cross-sections of pressure and vertical velocity throughout the entire numerical domain?

Other scientific comments

1. Line 139-140 "The balance between turbulence production via shear below the LLJ's nose and temperature stratification result in a shallow stable boundary layer" and line 145-146 "The balance between turbulence production via shear below the capping inversion and temperature stratification result in a deep stable boundary layer." You seem to suggest two different physical mechanisms. Are you saying the stable boundary layer is shallow or deep depending on whether buoyant destruction is balanced by shear production below the LLJ or below the capping inversion? I don't think this is a proper description of what happens physically.

2. Line 143-144 "After 3 hr, temperature stratification close to the surface reduces the vertical transport of momentum above 400 m, and a LLJ starts forming (Figure 5f,g)." This goes a bit fast, please explain. How does the stratification close to the surface affect transport above 400m and lead to a LLJ?

3. Line 220-221 "Whereas the v-velocity transports momentum to both sides of the turbine, the w-velocity primarily transports momentum upwards." How do you know that w-velocity primarily transports momentum upwards? Did you check this? You can't make this conclusion only based on Figure 11.

4. Line 237 "Vertical momentum advection is the primary forcing mechanism ... ." Figure 13 shows that the pressure contribution is also significant. I agree that only the vertical momentum advection is affected by stability, but you make it sound like the pressure gradient force is insignificant. See also lines 297-298 "The pressure gradient force is also present upstream of the wind plant; however, the primary mechanism decelerating the flow is the vertical advection of horizontal momentum." I don't think this is true. I'd say the flow deceleration is due to the combined effect of vertical advection and pressure gradient force.

Minor/technical comments

1. Figure 3: Please mention how the effective grid resolution is determined. Is this from visual observation, or is there a certain method to calculate the effective grid resolution?
2. Line 122-126: "Large, localized gradients of the horizontal velocity instigate large-scale turbulence early in the simulation, which then cascades into small-scale turbulence (Figure 3)" and "Localized shear instabilities instigate turbulence throughout the boundary layer within the first hour of the simulation. These structures break up rapidly into smaller eddies, reducing shear until a quasi-steady state is reached. Turbulence structures form rapidly close to the surface and propagate upwards (Figure 3)." It sounds to me as if you are saying the same twice. Is this intentional or should one of the two phrases be removed? Furthermore, it is not clear how turbulence is initialized. Do you apply random perturbations to the velocity field?
3. Line 144 "Vertical turbulence redistributes ... ." Should this be vertical turbulent mixing? Not sure what you mean by "vertical turbulence".
4. Figure 5: It is hard to appreciate the formation of a LLJ from the evolution of the wind speed components. Wouldn't it be more informative to show the wind speed magnitude and the wind direction with height?
5. Line 179-180 "Horizontal wind speed is on average 31 % slower ... ." Do you see a 31% difference in the wind speed or in the wind speed deficit? This is a big difference, so please clarify.
6. Line 196-198: Where are the order of magnitudes of the various forces coming from? Did you get these values from the results or are they a simple order of magnitude estimate? Please specify.
7. Line 221-222 "The streamwise velocity advects momentum back into the induction region of the turbine" and line 235-236 "The streamwise momentum advection replenishes momentum upstream of the first turbine row." I find the formulation of these sentences a bit weird and therefore confusing. Streamwise momentum advection simply acts as a source of energy because the flow is decelerating. Please reformulate to make it more clear what you mean.
8. Line 240 "Momentum advection by the v-velocity is 10.1 % as large as the ... ." This confusing, I guess you are saying that the momentum advection by the v-velocity is only 10.1 % of the vertical momentum advection?
9. Discussion of Figure B1 is a bit hard to follow. What does a negative value for the pressure gradient force mean? Does a negative value correspond to an upward or downward pressure force?