Response to Referee $\#6$:

General Comments

In the present study, the authors have taken advantage of the existing knowledge to produce a new version (v2.0) of the uDALES code, demonstrating in addition the positive impact of the changes on prediction capabilities.

The effort here is to present the improvements on uDALES 1.0 to become uDALES 2.0. Therefore common descriptions are better to be limited and give more emphasis in the differences.

It is assumed that each application selected serves a specific objective. It is good this specific objective to be described and at the end of the specific exercise, conclusions need to be drawn in relation to this objective. A generic objective is to compare results of uDALES v2.0 and uDALES v1.0 and commenting on the differences and their causes. Please make sure that those principles are kept to a large degree, for all applications presented.

It is most probable that some limitations still persist in the v2.0 version. It would be helpful, in a separate chapter, such limitations are discussed including the way forward.

Response: We thank the reviewer for these comments. In the revised manuscript, we have emphasised and expanded on differences between uDALES v1 and v2 in Sect. 3. We have also provided a more thorough conclusion of each of the validation cases. Finally, we have included a discussion of model limitations, though we thought it was more appropriate as the the penultimate paragraph in the Conclusion rather than a separate chapter.

Specific Comments

Comment 1: Lines 41- 43 “RANS only resolves the mean flow, and entirely relies on turbulence modelling to incorporate the effect of fluctuating components. As a result, RANS often fails to accurately reproduce transient flow features and quantities such as turbulent kinetic energy (van Hooff et al., 2017).” . It is not evident that the RANS characteristics prevent them to reproduce transient flow features. Do you mean unsteady flow features ? . Concerning turbulent kinetic energy predictions with RANS Models probab;y there are models that claim they can do this. See for example : Bartzis, J,G , Boundary-Layer Meteorology (2005) 116: 445–459 ,DOI 10.1007/s10546-004-7404-y

Response 1: By the phrase ‘transient flow features’ in lines 41-43, we indeed meant the ‘unsteady flow features’ i.e. the time dependent evolution of the flow. While simulating the cross-ventilation for a isolated building, van Hooff et al. (2017) showed that all RANS models, namely shear stress transport (SST), renormalization group (RNG) or Reynolds stress model (RSM), failed in reproducing the turbulent kinetic energy because steady RANS could not capture the vertical oscillation of the jet entering through the windward window of the building. We agree with the reviewer that the original statement was too broad. We have rephrased the sentence in the revised manuscript as “... these models often fail to reproduce unsteady flow features, leading to inaccurate prediction of quantities like turbulent kinetic energy for the flows that involve time dependent modulation (Moonen et al., 2012; van Hooff et al., 2017; Blocken, 2018; Vita et al., 2020)”.

Comment 2: Lines 45 -46 : “… LES is inherently more accurate than RANS…” . It would be better to say “… LES is expected to be more accurate than RANS”. We should not forget that we have to apply LES correctly and this not always easy for open flows such as the atmospheric boundary layer.

Response 2: We agree, and revised the sentence as ".. LES is expected to be more accurate than RANS ... provided that the boundary conditions, including the surface, are modelled accurately, which is challenging for urban boundary layer flows."

Comment 3: Lines 105-107 : Concerning horizontal grid, it seems that there is a different treatment for x- and y -directions. In real problems this might impose limited degree of freedom in selecting x- and y- directions. In other words is this selection application dependent ?

Response 3: In practice, it is true that the x- and y- directions almost always conceptually correspond to the spanwise and streamwise directions respectively. However, this does not have to be the case when running periodic simulations, and when using inflow-outflow boundaries with fixed values. When using a time-varying inflow condition though, this can only be specified on the x inlet plane. We have included this discussion in the conclusion.

Comment 4: Lines 110 -113 ; The inlet flow conditions are briefly discussed. The key problem here is how the upwind large eddies are introduced into the computation domain, keeping in mind that any introduced error persists downwind. Please expand.

Response 4: We have added (on Line 111 onwards): “The resolution in the y- and z-directions of the main simulation necessarily equals that of the precursor, meaning there no interpolation is required in these directions, and the flow variables on the output plane of the precursor can be copied directly to the inlet of the main simulation. Technically, the Dirichlet inflow boundary condition for the main simulation is enforced at $x = 0$, so u can be set directly as it defined on cell edges. The other variables are (linearly) interpolated in the x-direction as they are defined on cell centres.”

Alternatively, the reviewer may be referencing the need for a ‘run-up’ region before the flow reaches the geometry. We have also added to the end of Line 113: “ It is good practice to have a reasonable distance between the boundaries and the object of interest, in order to allow the flow to adjust (Tominaga et al., 2008).”

References

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Moonen, P., Dorer, V., and Carmeliet, J.: Effect of flow unsteadiness on the mean wind flow pattern in an idealized urban environment, Journal of wind engineering and industrial aerodynamics, 104, 389–396, 2012.

Tominaga, Y., Mochida, A., Yoshie, R., Kataoka, H., Nozu, T., Yoshikawa, M., and Shirasawa, T.: AIJ guidelines for practical applications of CFD to pedestrian wind environment around buildings, Journal of wind engineering and industrial aerodynamics, 96, 1749–1761, 2008.

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