

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-255

Anonymous Referee #1

Referee comment on "uDALES 1.0: a large-eddy simulation model for urban environments" by Ivo Suter et al., Geosci. Model Dev. Discuss.,
<https://doi.org/10.5194/gmd-2021-255-RC1>, 2021

General comments:

This manuscript provides a technical documentation for the open-source large-eddy simulation (LES) code uDALES which has been augmented with capabilities to handle arbitrary urban morphologies and to model the local evolution of surface energy budgets and their interaction with the flow. The documentation also includes the implementation of a simple chemistry model. Overall, I'm very pleased with the model development part, which has been documented, for the most part, with sufficient care and clarity. This paper will be an important reference for the uDALES community. My primary concerns relate to the validation practices which do not meet modern scientific standards. With the condition that these validation short-comings are corrected, along with few other minor comments below, I gladly recommend this manuscript for publication.

Specific comments:

P1, l17: "... since these structures channel high-momentum air downward to ground level". This keeps popping up in the context of urban boundary layer (UBL) flows, yet I still have not seen proper evidence for it, let alone an explanation what is the physical mechanisms for high-rise buildings creating *high-momentum* flow structures towards the ground. The downwash in front of the building or the wake turbulence behind it should not warrant such a simplistic characterization of wind conditions near the ground. I checked (Blocken et al. 2015) and it appears that the introduction, at least, provides only anecdotal evidence. If the evidence lies in some of the references within Blocken 2015, please point to it directly or rephrase the original statement so that the readers will not continue to spread this claim as a fact.

P5, I122: The pressure field is solved via FFT (which, by default, requires horizontally periodic boundary conditions), but some of the lateral boundary conditions described in Section 2.3.2 and Figure 1 are not horizontally periodic. Please specify how the pressure field is solved in those bc configurations.

P7, I173: Please clarify are the dimensions ($L_x \times L_y \times L_z$)? Is the order of grid resolutions now correct? It's best to document with clarity so you don't leave the reader guessing.

P7, I183: You claim to present quantitative agreement, but do not provide any quantity. Eye-balling the temperature contours from Figure 2 is not a satisfying validation strategy. Please provide a transparent validation metric for the comparison which other researchers in the field can compare their results to or reduce the comparison to a qualitative one.

P12, I295: Section 3.1 needs to be improved. The description of how surfaces within the discretized model are handled as facets is not clear. It is very difficult to understand how the LES grid relates to the facets used by the UEB model. Given the IBM implementation, the surfaces of all building blocks are made up of potentially a large number of cell faces, so are they grouped to form facets? It appears so but it's hard to get a clear picture of the method. What happens when the buildings are diagonal with respect to the LES grid? The Figure 4 provides some help but not much. Figure 11a is much better so you should make better use of it. Now it comes at the very end of the section, which is a struggle to reach with the current description.

P22, I537: Section 4.1 on Validation. Again, the standards for performing validation against measurements are not sufficient. Comparing vertical velocity and Reynolds stress profiles at one location visually does not constitute validation. And the scalar concentration along a line juxtaposed with measurements alone does not either. Validation metrics are derived for this purpose. What if the authors choose to further improve the numerics of uDALES and perform the same DAPPLE test case again? Will they judge the level of improvement by eye-balling the curves? Of course not. It is true that Xie and Castro (2009) do not carry out validation either, but their paper appears to focus more on establishing sufficient LES modelling criteria for urban flows. One of their conclusions is that the resolution requirement is ~ 1 m for this case. Here, validation is attempted and claimed, yet 2 m resolution is used without justification. Thus, please improve the validation section by providing appropriate validation metrics and justifications for the numerical setup. The wordings relating to the validation in Concluding remarks should also be made more scientific so that we do not have to engage in discussions trying to determine the degree of "soundness" in agreements. Verification is a different process and I have no objections with Section 4.2.

Technical corrections:

P17, I432: Only a suggestion: The lower case $\sigma_{L,i}$ does not go well with upper case L in the subscript. If this is not a universally accepted nomenclature, consider using

another greek symbol.

P28, l617: "... in this dissertation" This manuscript is likely part of a dissertation but perhaps the wording should be changed here.