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Interactive comment on "A One-Dimensional Model of Turbulent Flow Through 'Urban' Canopies: Updates Based on Large-Eddy Simulation" *by* Negin Nazarian et al.

Anonymous Referee #2

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General comments

This paper presents the improvements of a 1D column model, previously developed on the basis of 3D RANS simulations, which is updated with new LES results. These LES results are obtained for several aligned and staggered arrays of cubes in a periodic domain, with varying plan area density, and with the LES model PALM.

The paper is already quite interesting and useful as it is but should benefit from some clarifications and improvements as described below. There is also a noteworthy sensitivity discussion of the results.

My first remark is on the use of "RANS" throughout the paper. RANS is an equation

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system and need to be used with a turbulence closure. In the paper it appears that RANS is synonymous with RANS+ “k-l” turbulence closure. This is not trivial because a lot of the shortcomings mentioned are for the k-l closure and not RANS with more general closure. This should be clarified in the paper.

My second remark concerns the sentence in the introduction: “RANS simulations as the basis for 1-D parameterization. Given the simplified assumption of the turbulent flow in the RANS models, it is likely that the turbulent length scales derived from the RANS-CFD model are a culprit”. This sentence is very paradoxical because the 1D model is also RANS-k-l. It would be nice to explain why we expect RANS to perform better in 1D than in 3D ? Another point might be that other levels of closure might not have these shortcomings. It is well known that the k-l closure is not good for obstacles and the k-eps approach is much better for that. Why not choose such a closure or even a second order closure (it is cheap in 1D) ?

My third remark is regarding the analysis of the length scale (lk). It is presented p14 as a “measure of the efficiency of vertical transport” while we see in Fig 9 that is has a minimum at roof level. However it is well known that there is a large transport at roof level (Fig.12 right), caused by large instationary structures induced by the roofs. This is very paradoxical and can work only in conjunction with a very sharp velocity gradient (equation 2 and 3). Here it seems to me that the model is trying to compensate for a too large velocity gradient with a small lk. Another turbulence closure might be able to overcome this.

Another new aspect of this paper is to include the dispersive stress in the 1D parameterization. While a good case is made in Fig 9.2 that the length scale variation as a function of plan area density is more realistic with LES results, it would be interesting to add the RANS results also with the dispersive stress included to see if this is still the case.

Finally there are some problems with the results with trying to cast the LES results

into a simple k-l closure and also maybe with the averaging used that need further discussion / explanation: - Fig 6 left : there seems to be negative values for the average canopy velocity profile - Fig. 9 left : the length scale becomes negative - Fig. 10 right : for the Cmu constant first we have to swallow its variation with height and then it becomes negative !

Detailed comments :

P7L11 : “neutral simulation for idealized configuration” : how much of these results can we expect to hold with stratifications and irregular neighborhood?

P7L24 : “The flow is driven by a pressure gradient of .... The corresponding u_T is 0.2ms−1” How is this total wall friction velocity obtained ? What about the pressure drag on the obstacles : it is not mentioned in the paper (and could be computed)?

P8L8 : RANS k-l closure ?

P8L18 : for the choice of domain size : the laboratory studies are not periodic and therefore they must indicate a number of row necessary to reach nearly constant values independent of position. (maybe 4-6 rows ?). Can you compare your results to these laboratory studies ?

P9L9 : spin up time of 3h seems enormous for such a small area. The rest of the paper is adimensional so it is difficult to judge (grid/domain size, velocity ?) but the time step of 2s seems also large. Why is there a need of a sampling every 50 time step ? Averages could be computed along the calculation if it is a storage problem.

P11L8 : in the discussion of the dispersive stress (Fig 7) what is the significance of the change of sign. How can it be interpreted?

P15L4 different zones is : are

P17L31 : the same diffusion coefficient is due to the k-l chosen but is different in the k-eps

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