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Interactive comment on "The Microscale Obstacle Resolving Meteorological Model MITRAS: Model Theory" *by* Mohamed H. Salim et al.

Anonymous Referee #2

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This paper discusses the MITRAS model, which is an obstacle resolving meteorological model capable of simulating complex urban landscapes including thermodynamic effects. This seems to be an established code and a this detailed description on how MITRAS functions is a welcome contribution to the literature.

With regards to the model description, I would like to request further clarification regarding the coupling between the thermodynamics and the aerodynamics, i.e. the buoyancy forcing. The paper discusses in detail sensible and latent heat fluxes, but there is no mention of concepts like virtual potential temperature and eq. (5) does not show any buoyancy forcing. Does this mean that MITRAS treats temperature and moisture as passive scalars and can it only consider neutral conditions?

The incorporation of large scale forcings is a crucial element of these simulations and

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Discussion paper

will be of interest to readers, but I found the discussion on page 3-4 to be somewhat confusing. Would it be possible to provide one equation in which p, $\tilde{p}$, p_0 and p_1, p_2 and P_2 are shown together so it is clear how these are related?

I found the discussion regarding the turbulence modelling to be confusing. The authors use the term "filtering", suggesting that MITRAS uses an LES type formulation. However, both presented turbulence models, namely the Prandtl mixing length model and the Kato-Phillips model, are both RANS-type models. Sharpening of the language seems in place. MITRAS seems to fit most comfortably in the transient-RANS (T-RANS) or the VLES category of turbulence models.

The chosen applications are interesting and impressive but no validation is presented. The authors state that this will be done in a separate paper but this implies it is impossible to assess how well MITRAS is able to reproduce the physics of the built environment.

Details:

1. Abstract: "...zero kinetic energy ..." Too much detail?
2. P2 l15: The LES code PALM should also be mentioned in the literature review.
3. P2 l19: . . . MITRAS is specific ... to what?
4. P4 eqs (3)-(6): also present the continuity equation. Suggest to use subscript notation for the coordinate transformation terms, e.g. $\partial \dot{x}^1/\partial x = \dot{x}^1_x$ to distinguish the geometrical coefficients from the other derivatives. Also the Jacobian (?) α^* is not defined.
5. P8 L21-22: it is unclear what the authors mean/do. The text suggests they are using limiters but they do not specify which.

6. P9 L10: wall-functions seem in place as it is unlikely that the boundary layers near obstacles can be resolved. However, in section 4.1 it turns out that wall-functions ARE used. Clarify text.
7. P9-10. The surface energy balance (20) does not consider the storage term ΔQ_S, but equation (22) does suggest there is storage in the ground. This seems inconsistent.
8. P10 L19: Lateral BOUNDARY
9. P13 eq 33: the maximum value 442413 of the roughness length seems pretty random. Does this number have any significance?
10. P14 eq (40): this is not a backward Euler step; this strategy results in carrying out an Euler explicit scheme for the heat fluxes and an Euler backward scheme for temperature.
11. P15 eq (43). This equation is dimensionally inconsistent unless the coefficient c_{wt} has dimensions s^{-1}.
12. P18 eq (51): can be omitted
13. P19 section 5.5: how is atmospheric stability dealt with?
14. The paper contains some typos here and there and could do with a final proof-read.

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