Title: Urban Weather Modeling using WRF: Linking Physical Assumptions, Code Implementation, and Observational Needs

Author(s): Parag Joshi et al.

For consideration to *Geoscientific Model Development*

Recommendation: **Minor Revision**

This manuscript describes and compares three different urban land-surface schemes in WRF, down to the specific code implementations and precise differences. This document is a rare comparison of the actual implementations instead of just comparing simulation outputs. The authors also go beyond a mere tech note and add significant, informed discussion of the schemes, suggesting observations that could help improve inconsistencies and shortcomings. This could be a good template for future scheme comparisons; in particular the use of *exact* symbol names from the code is an excellent idea. For these reasons, this paper should be published. I have some concerns about the manuscript I would like to see addressed before acceptance.

Minor comments:

- Eqn. 8: Is this supposed to just be applied to wall (B) and (G) but not either roof category? If so, how is the heat flux computed for the two kinds of roofs? Also, do we expect more than very minimal wall-surface to be represented at resolutions that mesoscale models are run at?
- Section 3.2: Is everything on lines 237–272 about SLUCM, after which BEP in MLUCM is discussed?
- Also Section 3.2, lines 268–272: that the minimum moisture availability (`BET`) has such a large effect on urban energy balance is an interesting finding, although it is disturbing that the default value during rain events leads to instabilities. Is this because the default simply allows for too much latent heat flux, causing a runaway feedback, or is there a numerical cause for this instability?
- Section 3.2, lines 295–300: it is a bit shocking to know that the poor state of canopy resistance measurements has been known for 20 years now. I am hopeful that this paper may spur some action.
- Eqn. 33: Are `dg` and `dgr` prognostic variables?
- Eqns. 37 and 38: Why two separate values of `SG`? One shaded and one sunlit?
- The figures 1–4 showing the differences in the very complex radiative transfer between SLUCM and BEP in MLUCM is quite useful. Is such a complex scheme really worth the additional computational cost?
- Section 5, lines 498–502: It is suggested that MOST is insufficient. What may be used to go beyond MOST?
- Section A1, line 545: “even minor implementation issues can meaningfully influence model output” is an excellent point describing one of the biggest challenges of model development, and of engineering in general.

Formatting and language:

- Line 144: “denote” should be “denotes”.
- Lines 240–242: Some symbols did not get correctly formatted as LaTeX Math Mode.
- Line 272: Missing bibliography reference
- Line 275: “IN” → “In”.
- Line 327: Is this supposed to be 2.5 or $2^5 = 32$?
- Line 379: Missing equation reference.