

Response to the Referee

We thank the Referee for the insightful and constructive comments on our manuscript. The format is as follows:

Referee's comment

Our reply (revised text)

Referee #2

This manuscript evaluates the performance of the WRF-urban modeling system over Paris during a three-month (JJA) warm summertime period. Three WRF-experiments are conducted over the metropolitan area, one simulation using the BULK scheme to represent the urban surfaces, and two simulations (i.e., CTRL and PAR) using the multilayer BEP-BEM urban canopy model. In the CTRL run, urban pixels were classified using the LCZ classification system, but the urban canopy parameters (UCP) for each LCZ were not modified (default values). On the other hand, in the PAR simulation, the UCP were tailored for each LCZ using morphological observations across the metropolitan area. WRF-simulations were compared against urban and rural weather stations for near-surface air temperature across the diurnal cycle. Numerical results demonstrate that the CTRL and PAR runs perform better than the BULK simulation, but it was not clear which BEP-BEM simulation was the best. It seems to be PAR run performs better than CTRL run in rural areas, but not in urban areas. This topic is interesting and worthy of being investigated, but some clarifications are needed before this manuscript can be accepted for publication.

We thank the Referee for the feedback. The manuscript has been revised in terms of its structure, following Referee's recommendations. New figures have been also added to the supplementary material. Further sections and figures have been added regarding the evaluation of the PAR experiment, to examine thoroughly its divergent behavior in non-urban areas compared to the other two simulations.

Because of the substantial revisions made to the original manuscript, we recommend that the reviewers assess the revised manuscript using the version in which all tracked changes are accepted. Nonetheless, a version displaying the tracked changes will be also provided.

Accordingly, all responses to the reviewers' comments refer to the clean revised manuscript version, in which the track changes have been accepted.

Following are my comments:

- 1. Abstract, lines 22-23. Why do you think the best performance is obtained with the PAR configuration over non-urban grid cells? The urban schemes, including BULK, are only activated over urban grid cells, so the results in rural areas should be similar for the three numerical experiments.*

Thank you for addressing this issue. In fact, we investigated the divergent behavior of PAR in non-urban areas by addressing a new section (3.3) in the revised manuscript, where – apart from examining two variables that affect 2 m air temperature (cloud fraction and surface downwelling shortwave radiation) – we also concluded a possible internal model variability (IMV) to PAR. Consequently, we modified the sentence at lines 22-23 from the older version of the manuscript with this statement:

“Over non-urban grid cells, the best performance is exhibited for the PAR simulation with a summer daytime bias of -0.26 °C and a summer nighttime bias of 1.62 °C, results that are greatly influenced by internal model variability (IMV).”

2. *Line 109, page 4. Change “defined by the road widths” by “defined by the road and building widths”.*

This has been assessed.

3. *Section 2.4. Were Anthropogenic Heat emissions from AC systems considered in the BEP-BEM simulations?*

Yes, anthropogenic heat emission from AC systems were considered and were the same for the two BEP-BEM simulations.

4. *Section 3.1, Fig. 5b. Why do the CTRL and PAR simulations produce significant different results in the non-urban areas? Differences in heat advection from the urban core to the rural areas cannot explain these variations, in fact, BULK and CTRL produce similar results in the non-urban areas. Please, clarify this assumption.*

As stated earlier, we have examined this issue in the new added section 3.3.

5. *Section 3.1, Table 3. Could you add the results from BULK simulation?*

Because of the addition of a table related to the EO-data, Table 3 from the older version of the manuscript is now Table 4. Nonetheless, results from BULK have been added.

6. *Section 3.2, Table 5. Could you add the results from BULK simulation?*

The results from BULK have been added in now Table 6 in the new version of the manuscript.

7. *Section 3.2, Fig. 9b. Fig. 5a shows that BULK simulation is warmer at night than PAR simulation in urban areas, however, Fig. 9b shows the opposite. How can you explain this result*

Former Fig. 5a (now Fig. 7a) depicts the daily profiles for the summer, while former Fig. 9b (now Fig. 10c) depicts the spatial differences between PAR and

BULK during the heatwave event. These two figures do not examine the same periods.

8. *Section 3.2, Fig. 9. Can you explain the significant daytime differences among PAR vs CTRL and PAR vs BULK for the non-urban areas? What is the physical reason of these substantial disparities across the rural areas?*

As stated earlier, we examined this issue in the new added section 3.3.

9. *Summary section, lines 375-380. Why does the PAR simulation produce better results than the other two simulations in the non-urban areas?*

We modified this part of the summer section by adding the following sentence:

“Hence, while PAR exhibited lower errors at non-urban areas, this improvement is unlikely to be attributed to the implementation of the EO-derived UCPs. On the contrary, it may arise from internal model variability, alongside a model sensitivity to the modifications made in UCPs, which may have contributed to increased cloudiness.”

10. *Summary section, lines 425-430. Was the AH from AC systems taken-into-account in the BEP-BEM simulations?*

Correct, they were taken into account and were assumed constant through the whole day. In this sentence, we try to emphasize the importance of adding more detailed information about the use AC systems in a given area of interest.

We again thank the Referee for their thorough comments and evaluation. We believe that the revisions have enhanced the consistency of the manuscript and the further examination of the divergent behavior of PAR experiment in non-urban areas compared to the other two simulations.