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## Comment on acp-2021-914

Alberto Martilli (Referee)

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Referee comment on "Revising the definition of anthropogenic heat flux from buildings: role of human activities and building storage heat flux" by Yiqing Liu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-914-RC2>, 2021

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In this manuscript authors analyze the difference between Building Energy consumption and heat flux ejected to the atmosphere by buildings due to human activities. They base their analysis on the comparison between a no occupied building and one occupied. They first show, using conservation equations, why these two quantities are different, and then they use a series of EnergyPlus simulations to quantify the differences.

I like this manuscript. I think it highlights a very important point for urban atmospheric modelling. My few comments below are oriented to improve the clarity and strength the message.

Comments:

- I strongly suggest authors to include a list of symbols. This will improve the clarity and help the readers to follow the equations.
- Authors define  $Q_{F,B}$  as "...the heat released from buildings into the atmosphere as a result of human activities inside the building (including human metabolism)" (lines 53-54). Then in  $Q_{F,B}$  they include  $Q_{waste,o}$ , the heat emitted to the atmosphere by HVAC. Indeed, running the HVAC is a result of a human activity, so it is understandable to include  $Q_{waste,o}$  in  $Q_{F,B}$ , but I think it would be worth reminding here that not all the  $Q_{waste,o}$  is coming from heat generated inside the building by human activities (e. g. lighting, powered appliances and metabolism). A significant part of this heat is energy that has entered in the building from outside in form of radiation through the windows, or heat diffusion through the walls. In other words, an empty building with HVAC functioning, would still have  $Q_{waste,o}$  different than zero. This energy, that is not from anthropogenic origin, would have been stored in the building without HVAC. This message (to me one of the most important of the study), is already implicit in the manuscript, but I believe it should be made explicit in the text.
- Lines 57-58 "This energy modifies the internal building volume...". Energy cannot

modify the internal building volume, Please clarify.

- Lines 65-66 "Some of this additional energy is transported out of buildings through indoor-outdoor ventilation exchange and immediately contributes to  $Q_{F,B}$ ". HVAC also would immediately eject the additional heat.
- Line 79. Just to improve clarity, and avoid misunderstanding, I would remind here that  $Q_H$  is not the sensible heat flux that could be measured on a mast in the inertial sublayer. This should include also  $Q_{Waste}$  and  $Q_{BAE}$ .
- Figure 1. If  $\Delta H$  is the difference in sensible heat flux from building surfaces between an occupied and an unoccupied building, I am a bit surprised to see such small variability between night and day. I would expect that the change in storage would affect more the heat flux, in particular during night.
- Based on this study – Can authors derive some recommendations to users and developers of urban canopy parametrizations that include simplified building energy models?
- *As suggestion for future studies:* it would be interesting to investigate how the use of HVAC systems modulate the temporal behavior of the storage term also for other types of buildings (e. g. commercial), that have a different human behavior (occupancy, schedule of operation, etc.). Given that storage is key in the development of the nocturnal UHI – how does HVAC affect the strength of the nocturnal UHI?