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Geoscientific Model Development Discussions

Interactive comment on "Dynamic Anthropogenic activitieS impacting Heat emissions (DASHv1.0): Development and evaluation" *by* Isabella Capel-Timms et al.

Anonymous Referee #2

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GENERAL COMMENTS: Overall, this manuscript presents an intriguing and thoroughly reasoned agent-based framework for evaluating the dynamically and spatially varying anthropogenic heat emissions across cities. Such a framework is superior in theory to prior approaches to estimate Qf and should be published. Nevertheless, this reviewer has several high-level concerns about the practical implementation and evaluation of such a complex model. It is likely that the authors can suitably address these issues through additions to the manuscript text, including appropriate caveats (or further explanation) regarding model accuracy.

1. At a fundamental level, this model is extremely complex with so many degrees of

freedom, and input variables/assumptions that are highly uncertain, that in practice, the model may not be any more accurate than much simpler inventory-based estimates. The authors need to make a stronger case that the added complexity increases accuracy and makes a meaningful and important difference in the anthropogenic heat profiles, and in secondary results related to the use of these profiles (e.g., estimates of the local diurnal warming signal when Qf is incorporated into atmospheric models).

2. Related to the above point, validation is foundational to determining the usefulness of a framework such as this. However, as recognized by the authors, validation is not really possible given the significant limitations of other methods of estimating Qf. Nevertheless, when the authors do compare estimates of energy consumption to actual observations (from utility data) their model does not appear to perform very well. So, any estimates of anthropogenic heating derived from the energy use estimates may be suspect.

SPECIFIC COMMENTS: 1. Lines 40-44 – This may seem like a minor point, but while eqn 1 is a commonly used representation of the energy balance for cities, it is not clearly articulated whether this is truly a surface energy balance or a volumetric energy balance. If the former, then storage is zero and Qf is minimal as most Qf is emitted directly into the air volume. If the latter, then advection would seem to be of significance in a heterogeneous urban setting. 2. Section 2.4.3 – Does STEBBS allow for a dynamic setpoint temperature? Most commercial and many residential buildings have setpoints that vary based on management (either BMS or by individual occupants). 3. Section 3 – are light manufacturing and industrial buildings taken into account in either DASH or GQF? These can be significant energy users in certain areas of larger cities, and might be ignored, potentially explaining part of the underestimation of energy use in the CBD. For that matter, can the authors provide more clarity on how many archetype buildings they use in their modeling? Some prior studies doing similar tasks have suggested 20-30 archetypes are needed to adequately capture citywide variations in residential + commercial energy consumption. 4. In section 4 (and elsewhere) can authors clarify

whether “occupancy” differentiates indoor and outdoor location of individuals? If AC is present, the rejected heat from indoor metabolism includes metabolism + AC energy used to reject it. 5. Lines 631-637 – the errors in estimates of domestic energy consumption seem rather large in general. It would seem that if the building sector archetypes are reasonable, the errors in estimating energy consumption should be much smaller. 6. What are the units in Figure 11 e and f? 7. Appendix B – STEBBS: the description of STEBBS suggests that walls and roofs are modeled as single layers with bulk properties. Can the authors clarify whether the conduction equation is solved within these single-layer constructions? If not, they would essentially be assuming steady state conduction through the wall and roof at all times–which would introduce significant errors. Other assumptions in STEBBS may be questionable, as well. I am not familiar with STEBBS. Some more details on this model would be helpful. Additionally, there are standard test cases (from ASHRAE) against which building science models are evaluated and validated. Can the authors present some quantitative data to confirm that the STEBBS model produces accurate estimates of building energy consumption for any specific building (e.g., compare model results with those of a trusted and ASHRAE-validated model such as TRNSYS or EnergyPlus for each of your archetypes). If only $\sim$20 archetypes are simulated for a single year, this task is actually rather quick in existing software such as EnergyPlus (or DoE-2) which has already undergone extensive validation and improvement over the past 40+ years. If STEBBS is new (and less validated), can the authors make the case for why they didn’t simply go with an existing model?

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