

# ***Interactive comment on “Parametrisation of the variety of human behaviour related to building energy consumption in TEB (SURFEX v. 8.2)” by Robert Schoetter et al.***

## **Anonymous Referee #1**

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Paper Title: Parametrisation of the variety of human behaviour related to building energy consumption in TEB (SURFEX v. 8.2)

## **General Comments**

This paper describes a method to improve the simulation of energy consumption within buildings by accounting for an ensemble of human behaviours and building uses within a single model grid point of an urban land surface model. The paper is novel, well organised, thorough and convincing. It will be useful for the urban modelling community and fits within the scope of Geoscientific Model Development. If the issues noted below are addressed, I recommend the paper be accepted for publication.

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## Specific Comments

Overall this is an impressive contribution, both in the technical implementation and in the reported improvement of model performance. However, some minor amendments and corrections will improve the manuscript.

The paper is long, so I do wonder if readability can be improved by moving the whole of Section 2.3 into Appendix B. This section details how different human behaviours are represented in TEB. The basic methodology of this section is dealt with in Sections 2.1 and 2.2. Section 2.3 is an important contribution, but may be better placed in an Appendix to streamline the paper, and because it continuously references tables there.

Also, there is no discussion of the effect that compartmentalisation has on the computation time of the various simulations. I would appreciate knowing the computational cost of the additional calculations.

## Technical Corrections

pg1 ln17: “consist of the net solar and infrared”. Much of solar radiation is in the infrared, so “short and longwave” or “net all-wave radiation” is more appropriate.

pg1 eq 1: “ $R_{net} = Q_{sen} + Q_{lat} + Q_{sto} + Q_{ant}$ ” This is a non-standard representation of the surface energy balance that causes confusion regarding the sign of terms, and differs from the cited source. For example, the current form of the equation is not consistent with your line 20: “The storage of heat in the construction materials leads to lower negative values of  $Q_{sto}$  during the day.” As currently formulated, if  $Q_{sen}$  is positive in the day (as stated),  $Q_{sto}$  should also be positive in the day. Also, in this form the anthropogenic term will always be negative which is inconsistent with later parts of the paper. Suggest a more common form, for example as in Oke 1982 already cited in the paper (with all daytime terms positive), or conform to the cited source (Christen and Vogt, 2004).

pg1 ln 20: “. . .which leads to higher (lower) values of  $Q_{sen}$  ( $Q_{lat}$ ).” True in the daytime

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only, and sign doesn't conform to cited source.

pg1 ln20: "The storage of heat in the construction materials. . ." Other than issues noted above, I find this sentence difficult to understand with the use of lower (higher) negative (positive) etc. Suggest simplifying to say urban  $Q_{sto}$  exhibits greater diurnal amplitudes than vegetated areas.

pg2 ln18: ". . .greenhouse gas emissions, its is important. . ." replace "its" with "it". Consider revising to remove multiple "it" references.

pg2 ln24: ". . .lack of detailed information on the diurnal, weekly and annual cycles". Inventory approach might also lack information on spatial variability at appropriate scales.

pg2 ln28: "This approach therefore requires eddy flux measurements. . ." change to ". . .requires turbulent, radiant and storage flux measurements."

pg2 ln29: ". . .knowlegde" misspelt

pg2 ln33: "However, they rely. . ." replace with "However, they may rely. . ."

pg3 ln10: (and other instances) ". . .in an UCP. . ." replace with ". . .in a UCP" (as "in a you-see-pee").

pg3: ln15: "The UCP-BEM require. . ." replace with "A UCP-BEM requires. . ." or "The UCP-BEM approach requires. . ."

pg4 ln7: "UCPs represent the. . ." replace with "These UCPs represent the. . ." because not all UCPs are based on street canyon unit.

pg4 ln26: Add "In reality" before "The behaviour-related parameters. . ." to differentiate from model parameters.

pg5 ln16: "A general overview of our approach to consider for a variety. . ." replace with "A general overview of our approach for considering a variety. . ."

pg 8 eq5: "linearised Stefan-Boltzmann law." I don't understand why emissivity is

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squared in this linearised form of SB law. I can see this comes from Bueno et al. 2012, but it is not referenced or derived there, and it differs from other published forms (e.g. Eq. (7) of “Linear relationships in heat transfer” (Marin 2009)). Please explain or redefine.

pg11 In10: “Mean Absolute Bias” is this the same as mean absolute error (MAE)? Perhaps use MAE, which is more common name. Otherwise define MAB.

pg11 In12: “We find...” I appreciate the comparison to test non-linear behaviour of fractional-approach, although Section 2.2 would benefit from subheadings, as this is a mini result.

pg11 In17: “However, such situations are rare...” are they rare in all regions? In all building types? I can imagine certain situations that would be thermally isolated, for example in non-residential buildings. If the fractional approach satisfies your accuracy criteria for all but the heated/unheated cases, can you separate these instances and use the tiled approach there? Otherwise state, “In this study such situations are rare...” and justify.

pg11 In23: “opening window,” change to “opening windows,”

pg11 In24: “humans or their...” change to “humans and their...”

pg12 In5: “We consider the design temperature...” In this section generally I was not immediately clear whether equations were calculated separately for each compartment or aggregated across compartments. It appears from the code they are separately calculated, which is appropriate. Perhaps reiterate at the beginning of Section 2.3 that each equation is undertaken on each compartment separately.

pg12 In25: “Since we cannot take...” change to “Since we do not take...”

pg13 In20: remove second instance of “with and without shading...”

pg15 In3: “it is possible to use the fractional approach...” isn’t the fractional approach

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already being used here? Or do you mean to make an added distinction from building use and human behaviour compartments?

pg19 ln28: “we only consider for the...” change to “we only account for the...” or “we only consider the...”

pg19 ln29: “In households with high RT [regulation tendency], the design temperature for heating is on average lower...” I was confused here because I would think a household with high tendency to regulate temperature would have a higher heating design temperature (i.e. smaller comfort range – more regular). I see you follow Bourgeois et al. high/low definition, but with a name change to include “regulation”. I suggest an alternative like Efficiency Tendency [ET], clarifying that those in the high category would be more efficient in their energy use, thus allowing a lower heating comfort temperature.

pg20 ln9: “Bourgeois et al. (2017) also define indicators related to equipment of buildings with electrical appliances (EQ)...” The cited source is clearer as to what EQ is actually measuring, that is “Ownership of large household appliances”. Suggest the sentence is reworded to define EQ clearly.

pg21 ln32: “The radiative part of the internal heat release is assumed to be 0.1 for all building uses. This might be an oversimplification, but the overall contribution of lighting to the total internal heat release is only 5

pg29 ln13: “In this area, the simulated building energy consumption is larger than the inventory.” You say post-war buildings are large consumers for heating, and that construction period is not taken into account in TEB, so shouldn't the inventory show larger building energy consumption in this area than TEB? In any case, one could say a current shortcoming of TEB is that building construction period is not accounted for.

pg29 ln16: “The values for the RMSE are quite close to the absolute bias, which is consistent with the well simulated time series” Close values for RMSE and absolute bias

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don't necessarily mean a well simulated time series, just that the variance of the error is low (e.g. see Willmott and Matsuura: Advantages of the mean absolute error (MAE) over the root mean square error (RMSE) in assessing average model performance, *Clim Res*, 30(1), 79–82, doi:10.3354/cr030079, 2005.)

pg31-32 Figure 7 and 8: State in the caption that these results are for the MAP experiments.

pg36 In5: “For each day of week” add “. . .the week”

pg38 Table A3: Define RT so the table stands alone.

pg39 Table A4:  $QIN_{nom}$  units should be [ $Wm^{-2}$ ]. Define EIU.

pg40 Table A6: Define ‘low, medium and high design temperatures’ or refer reader to appropriate section.

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