Interactive comment on "Implementation of street trees in solar radiative exchange parameterization of TEB in SURFEX v8.0" *by* Emilie Redon et al.

Anonymous Referee #1

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The paper presents a new parameterization for street trees within the solar radiative exchange scheme in the existing Town Energy Balance (TEB) scheme. The authors provide a clear motivation as to why trees warrant inclusion in urban land surface schemes and critique the latest modelling techniques for representing them. A brief overview of the TEB model and how it treats solar radiation is presented before the new street tree parameterization is described and how its formulation is implemented within the existing scheme (good use of appendices to present the full equations). Comparison and evaluation is made against a complex microscale radiative transfer scheme (SOLENE) for a range of tree configurations (13) and three different canyon aspect ratios, as well as an existing version of TEB with low vegetation. The evaluation focused on the seasonal differences between models in solar receipt for canyon facets for nonvegetated and vegetated canyons, sensitivity to the vegetation layout and comparison

of canyon albedo. Results are presented in a number of tables and graphs which on the whole are intuitive, clearly presented and discussed in sufficient detail in the results section. However the section on sensitivity to vegetation layout characteristics requires further work. The discussion and conclusion clearly highlight the differences between the models, while exhuming the benefits and limitations of the scheme.

Overall the paper is very well written and adheres to the requirements for publication within Geoscientific Model Development. There are a few points within the paper that require clarification from the authors coupled with a few minor grammatical and presentation errors that require correction (please see below). With these points satisfactorily answered and errors amended I recommend this paper be accepted for publication in the journal.

Points for Correction and Clarification

1) At a number of points you refer to keeping computing times acceptable (e.g. Page 1, Line 7; Page 6, Line 21). It is unclear what is an acceptable computing time is in this context. Do you mean relative to a complex model? How is the representation of this process going to significantly add to computing time? Surely representing the process correctly is more important in the first instance, and computing time shouldn't determine a limit on how we approach a problem from a modelling perspective as computational optimisation and simplification can be applied later.

2) Page3 Lines 27-31. Since the conference paper of Young et al. (2015) there have been a number of developments relating to the Trees in Urban Areas model (TUrban). The tree representation is not currently implemented within MORUSES (Met Office – Reading Urban Surface Exchange Scheme). Instead the scheme has been developed and is currently been tested within the Single Column Reading Urban Model (SCRUM) as described in Harman and Belcher (2006) and Porson et al. (2009). The view factors for both fully visible and partially occluded facets are calculated analytically based on Hottel's crossed string construction (Hottel 1954). A paper is about to be submitted on

this method to Boundary-Layer Meteorology but unfortunately to have gone through the review process in time for this papers publication (Young et al, 2016). These sentences need amending in light of this new information.

3) Section 3.2. You talk about improvements of the radiation budget but only mention the longwave radiation budget on Page 6 Line 3. How is this to be modelled for the high vegetation? Although the paper is focused on shortwave radiation it would add to the paper if you described briefly how longwave radiation is treated.

4) Page 6, Lines 24 – 30. The hypothesis about street trees and why they are confined within the canyon is not particularly compelling without explicit examples of such rules on tree management and location. Is this specific to France? Surely the justification is more to do with the model assumptions of the canyon and roof being treated separately in the modelling of the surface energy balance in that the canyon and roof are assumed to be independent of each other? Either that or are you just considering the effects of trees that are not taller than the buildings, as to consider these is not possible within the current TEB configuration?

5) Page 16, Lines 9-10. The use of the words 'good' and 'only' are very subjective. You need to state what is it good relative to?

6) Section 6.4. This section on sensitivity to vegetation layout characteristics and associated figures is not particularly clear. Statements are made without the use of statistical values nor clear comparison using examples from the relevant figures (Figs 8 – 10). Page 16 Line 19 states 'The comparison of statistical scores', these statistics need to be presented within the text or in a table.

7) Section 6.4. Figures 8, 9 and 10 do not show any particular clear patterns (there is a lot of scatter and points on top of each other) that allow the reader to determine the full impact of differences in vegetation or whether it was significant, an alternative method for showing this data is required. It is unclear of the utility of comparing two types of error (RMSE and %Err). Could you clarify why you have done this and how this shows

how sensitive the model is to these changes? An explanation of this is required in the text.

8) Section 6.5, Figure 11. There are four aspect ratios presented in figure 11 what is the difference between h/w = 2 and h/w = 2b? The second is not referred to in the text nor the figure caption.

9) Appendix A. Why is the view factor between the road and the tree = 0? Surely this would have an implication when calculating the canyon longwave radiation balance as the road will see the underside of the tree layer.

Grammatical and Format Errors

1) TITLE. The authors may wish to amend the title to read more clearly as 'Implementation of street trees within the solar radiative exchange parameterization of TEB in SURFEX v8.0'.

2) ABSTRACT, Line 1. With the first use of an abbreviation the term/phrase/name it is used to abbreviate should be stated e.g. Town Energy Balance (TEB) or TEB (Town Energy Balance). The same applies to SOLENE.

3) ABSTRACT, Line 3. The word 'obviously' is not required here as it is not obvious without reading the paper that there is increased complexity. It would be more appropriate to state this as a fact by removing the words 'has obviously'.

4) Page 2, Line 34. 'Surimpose' should read 'superimpose'.

5) Page 5, Line 13. The work 'especially' is not required in this sentence.

6) Page 6, Line 32. Should the word 'refined' be 'defined'?

7) Page 7, Lines 7 -10. This paragraph is not clear. Should it read as follows? 'In order to calculate these terms in TEB, the following section describes how direct solar radiation reaches canyon surfaces. Then, absorption is obtained by separately resolving the first absorption of total solar radiation on each surface and the sum of absorbed

shortwave radiation after infinite reflections within the canyon'.

8) Page 11, Line 21. Should the first word be TEB on this line?

9) Page 12, Line 15. This first sentence doesn't read well. Consider splitting into two sentences, one explaining that TEB was run with equivalent configurations and another stating the differences between models.

10) Page 13, Line 15. Use of the word 'The' is redundant in this sentence. Start with 'Table 3 presents'.

11) Page 13, Line 20. 'Let's remind' is not the correct style nor grammatically correct (Let's = Let is. If using this use 'Lets'). You may consider the following change to the sentence. 'Considering that the temperate climate is characterized by four distinct seasons with contrasting sunshine, air temperature and humidity conditions, seasonal analysis was undertaken'.

12) Page 14, Line 27. Incorrect style and grammar using 'let's remind'. The word 'considering' would be more suitable.

13) Page 14, Lines 27-28. This sentence doesn't make sense.

14) Page 16, Line 5. I am not sure what you mean by 'inversely slightly underestimated'?

15) Page 16, Line 20. Misspelt 'exchanges'

16) Page 17, Line 9. A missing paper reference at the end of this line.

17) Page 17, Lines 9-10. Acronyms for models without full model names (as in point 2).

18) Page 20, Line 2. Missing equation reference.

19) Page 22, Line 1. Misspelt 'example'.

20) Figures 4 and 6. The shades of blue used to represent 'wall A', 'wall B' and 'walls'

are not clear and will not reproduce well if printed in black and white. Consider changing colours or using different line thickness. The subplots are also too small, consider reducing white space between subplots. This coul be achieved by limiting the number of axis labels especially as you are using the same scale and variable on each row.

References

Harman, I. N. and Belcher S. E. 2006. The surface energy balance and boundary layer over urban street canyons. Quarterly Journal of the Royal Meteorological Society, 132, 2749 – 2768.

Hottel, H. 1954. Radiant-Heat Transmission. In: Heat Transmission. Ed. McAdams W., McGraw-Hill, New York, pp 55 – 125.

Porson, A., Harman, I. N., Bohnenstengel, S. I., and Belcher, S. E. 2009. How many facets are needed to represent the surface energy balance of an urban area? Boundary-Layer Meteorology, 132, 107 – 128.

Young, D. T., Clark, P. A., Barlow, J.F. and Hendry, M. 2016. An analytical method for radiative exchange within a vegetated urban canyon. To be submitted to: Boundary-Layer Meteorology