Egusphere-2026-981

Response to Reviewer 1's comments.

General comments

This model evaluation paper compares two different green roof models for their ability to calculate the green roof surface energy balance in terms of the latent heat flux QE, the ground heat flux QG, the surface temperature (Tsurf), and substrate volumetric water content. The two models are the EnergyPLus EcoRoof formulation (ER_o), a modified version of EcoRoof (ER_m)and the green roof submodule of WRF (WRF-MLGR).

The analysis reveals that both models show certain biases for different reasons which are mainly related to differences in model structure and assumption. Generally, ER overestimates QE and Tsurf modestly, whereas WRF-MLGR more strongly underestimates QE but overestimates QG and Tsurf. The study clearly quantifies the deviations between model output and green roof observations from a test site in Ontario, Canada.

The paper is well written, well-structured and easy-to-follow. It presents and discusses all the mentioned terms of the surface energy balance in detail and quantifies deviations between measurements and model outputs. Hence, the paper is an important contribution to assess model performance for green roof studies in context of surface-atmosphere exchange studies, process analysis, climate change adaption studies, or urban climate research.

Response:

We thank the reviewer for their positive and constructive summary of the manuscript and for recognizing its relevance to the topic of green roof modelling and surface energy balance representation.

Specific comments

1. Introduction, l.58: the state-of-the-art on earlier model evaluation is fairly short. You might briefly specify which general performance those evaluations found, e.g. whether energy fluxes were over- or underestimated and to what extent.

Response:

The state-of-the-art on earlier model evaluations has been revised (l. 58-81) to include the reported evaluation results from previous studies, focusing on typically assessed variables (e.g. soil temperature and atmospheric variables). This addition also helps clarify that most existing evaluations do not assess surface energy fluxes directly, which is consistent with the motivation of this study.

Note: All line numbers refer to the clean version of the manuscript.

2. l. 73: I suppose QH was not evaluated in your study because it could not be measured directly, right?

Response:

Yes, Q_h was not directly measured at the test site and is therefore not evaluated in this study, as it can only be estimated as a residual of the surface energy balance. This clarification has been added (l. 109).

3. Methods, l.139. Due to the small dimensions of the green roof advective effects might play a role. As this was analysed in a Master Thesis (Kurukulaarachchi, 2017) which is not available to the public, could you briefly specify how advective effects were analysed in that study?

Response:

The paragraph (l. 158-163) was revised to describe in more detail the advection analysis used in Kurukulaarachchi (2017), which was based on diagnostic criteria. Moreover, the Master's thesis is publicly accessible and a link has been added to the reference list (l. 760).

4. Results, l.232: Here you state that 50% of the energy are partitioned into QH. However, the sensible heat flux was not directly measured – what is calculated as a residual of the surface energy balance?

Response:

Yes, for this statement Q_h was derived as the residual of the surface energy balance. This has been clarified in the revised manuscript (l. 260-262).

5. Discussion, l.437: I suggest to move the paragraph on the test of the elevated green roof module (and Fig. 12) to the results section.

Response:

The paragraph has been moved to the results section, under the subsection 3.2 Observed energy balance. (l. 272-282)

6. Results, section 4.2.1.: I am wondering whether incorporation of specific CAM parameterisations/formulations in green roof models could (significantly) enhance model performance in term of QE and the surface energy balance representation? Could you briefly discuss that issue?

Response:

We add a paragraph to the discussion (l. 511-521) to address the potential role of CAM-specific parameterisations in green roof models and add a one-at-a-time sensitivity analysis in the supplement materials (S6). Although no studies were found explicitly applying CAM formulations

in energy balance models, sensitivity analysis results from this study indicate strong model sensitivity to vegetation parameters in ER, supporting the need for improved physiological representation for Sedum vegetation.

7. Results, l. 507. I would suggest to, in the context of green roofs, we referred to "substrates" rather than "soil," since no actual soil is used on green roofs (they typically consist of small rock fragments, at least in most European green roofs)

Response:

The correction has been made replacing the word 'soil' with 'substrate' where applicable.

Technical corrections

Fig 3: labels on x and y-axis are quite small

Fig. 4: The figure legend is hardly to read

Response:

We thank the reviewer for highlighting these issues. Both figures have been revised to improve readability. Axis label font sizes have been increased, and the legends have been repositioned outside the plot area to avoid overlap and enhance clarity.

Response to Reviewer 2's comments.

General comments

This study provides a high-quality assessment of existing green roof models, addressing a gap in the literature. Overall, I find the evaluation scientifically sound and the discussion insightful.

Response:

We sincerely thank the reviewer for this encouraging comment and for recognizing the value of our work in addressing this gap in the literature.

Specific comments

I have two minor suggestions:

1. Move the green roof variable setup from the supplement into the main manuscript (currently Table S3).

Response:

The green roof variable setup previously presented in Table S3 has been moved to the main manuscript and is now included as Table 2 in the "Model setup" subsection (l. 199).

Note: All line numbers refer to the clean version of the manuscript.

2. Present time-series plot or scatter plots in addition to time-averaged results to show deviations during dry and rainy periods for different fluxes.

Response:

Figure S6 has been added to the supplementary materials to illustrate model behavior at the hourly scale under dry and rainy conditions, complementing the time-averaged results in the main text. The scatter plots provide the full distribution of hourly model–observation pairs and show the same dry-versus-rainy contrasts in bias and spread observed in the time-averaged results. References to figure S6 are made on l. 312-314; 350-352; 392-394.

We thank the reviewer for these suggestions and hope the revisions are satisfactory.

Sincerely,

Maria Martinez Mendoza