Review 3

General comments

Accurate estimation and partitioning of evapotranspiration (ET) are critical for understanding land–atmosphere interactions, yet current land surface models (LSMs) still exhibit notable deficiencies in representing transpiration and evaporation, particularly soil evaporation. In this study, the authors introduce a dry surface layer (DSL) resistance parameterization into the ISBA model and conduct simulations and evaluations at two contrasting semi-arid sites, leveraging comprehensive observational data from the LIAISE campaign. Their results demonstrate that the new DSL parameterization effectively reduces bare soil evaporation and helps address existing shortcomings in ET modeling, offering valuable insights for improving LSM performance in estimating evapotranspiration.

The manuscript is well-organized, with a robust methodological approach and substantial supporting data. The logical structure and discussion are also appropriate. However, the text is somewhat lengthy, and there is room for improvement in both language clarity and figure presentation. Revisions are necessary before the manuscript can be considered for publication.

We thank you for your positive review. We write this response in the past tense for clarity reasons. The modifications you suggest have been implemented as described in this response, the suggestions by the other reviewers have also been taken into account. The main text has been considerably reduced by moving the vegetation model description to an appendix, but other reviewer comments have asked for some additional text, although mostly minor. The main changes that the revised manuscript has following reviewer's comments are:

-Part of section 2.3.1 has been moved to the introduction by another review's suggestion

-Reduction on the number of equations, moving the larger part of the vegetation model description to an Appendix.

-Tables that can be omitted have been moved to the appendices.

-Addition of a glossary (symbols, units: as suggested by the review process)

-Vegetation parameter discussion is moved to an appendix and only parameter value decision is left on the main text.

-Small modifications to the figures as per the review process

-A section to prepare the reader for the sensitivity analysis has been added

-A table of sensors of the surface energy stations has been added and together with further citations of available related measurements

-The description of the measurements available has been clarified

The estimation of soil evaporation and DSL resistance is influenced by soil state variables such as soil moisture and soil temperature. However, the simulation results of these variables presented in this study (Figures 10 and 11) appear to be unsatisfactory, which raises concerns about the reliability of subsequent model evaluation outcomes.

For the VWC, the problems are present in both NON and DSL simulations. The problem was already acknowledged in the conclusions. This problem is not DSL dependent but rather pedo-transfer function dependent. A citation to emphasize it has been added since such results have been reported before (Aouade et al. , 2020) 'Laboratory based soil hydraulic properties were available but were found to be insufficient to reproduce the VWC*, a behaviour also reported in Aouade et al. (2020).* It is recommended that further studies include variables that define the soil water retention characteristics when calibrating the model.'

Regarding reliability, the issues of the VWC were reported and Sobaga et al. (2023) study was pointed as a future improvement compared to our current results. Additionally, as other reviewers still had some doubts on the VWC section, clarification between the NON and DSL simulations for the VWC has been added.

The temperature differences have been reported explicitly in the submitted article and the text points to a partial solution modifying the soil heat capacity. This is done in the original article of Swenson and Lawrence (2014) with the change of thickness of the first soil layer. Since the measurements of the soil properties did not include the thermal capacity we preferred to leave the default values so the reader can make the right assessment of the changes that the soil resistance induces. The increment in temperature of the S92 resistance while smaller by about half of that of the DSL, it is also present. The article showing the increase of temperature provides the full picture of the impact of resistance values which are higher than those published before. We had already declared in the conclusions that the resistance needs further testing in the model at a global scale, and this article gives the necessary perspective of key variables for a follow up study.

We made an effort to report on all variables in order to help identify the issues that can appear. In addition, we also provided suggestions in the text of how to approach them, such as testing the new pedo-tranfer equations or modifying the soil heat capacity for the soil temperature. The original article of Swenson and Lawrence (2014) does not include these variables, acknowledging these limitations for which improvements in these functions is a key for future use of this resistance.

It is recommended to reorganize the introduction and Sect. 2.3.1 for improved clarity. Currently, the Introduction does not provide sufficient explanation of specialized terms such as soil resistance, particularly dry surface layer (DSL) resistance. As these concepts may not be familiar to the broader readership of GMD, it would be beneficial to consider moving part of the description of soil resistance from Sect. 2.3.1 into the Introduction.

Section 2.3.1 has been reduced in the revised manuscript and part of the information moved to the introduction. The review of the literature has been moved to the introduction together with the importance of VWC for soil resistances and the data used to calibrate the DSL.

Sect. 5.4 presents the results of the sensitivity analysis. However, it would be helpful to briefly introduce the concept of sensitivity analysis and the specific method adopted in this study in the earlier methodological sections. This would provide clearer context and improve the continuity of the manuscript.

A new subsection has been added at the end of section 2 with the following text:

The DSL configuration for the main comparison is the one of Swenson and Lawrence (2014) but its parameters may not be the most suitable for ISBA. A sensitivity analysis, consisting in the variation of two parameters for the DSL resistance is later presented. This kind of analysis is necessary to characterize the changes of output variables and diagnose them. The response to the change can be identified, whether it is linear, nonlinear or negligible. As the number of parameters increases, the behaviours of outputs become intertwined and cannot be necessarily easily predicted. The sensitivity analysis identifies whether a parameter is relevant for a certain variable. We generate multiple simulations with two varying parameters and use the root mean square error (RMSE) of the simulations to suggest the more appropriate values for the estimation of the turbulent fluxes with ISBA for the DSL option.

Specific comments

Line 1: Latent heat flux (LE) and evapotranspiration are closely related but conceptually distinct terms, with different physical meanings and units. The manuscript should carefully review its use of both terms to avoid confusion. In particular, Figure 8 incorrectly labels the unit of LE as “mm,” which is not appropriate.

We have changed Figure 8 by E in the labels and caption and specify it is accumulated evaporated water in the text, modifying ET when not appropriate.

Line 61-64: It is recommended to number the four drying stages to make it easier for the reader to understand.

They have been numbered now in the revised manuscript

Line 83: The term “surface energy budget (SEB)” appears for the first time here, rather than at line 257.

The term appears now at its first appearance in the revised manuscript

Line 131: I don't quite understand what N and X represent in this context.

N and X represent the two possible strategies, tolerant and resistant. The text has been modified as follows to clarify:
"where D+max can be N for the drought-avoiding strategy applied for C3 crops (eq. A7), and X for the drought-tolerant strategy (eq. A9). *Given the same Dmax, evapotranspiration will decrease for C3 and increase for C4 plants under water stress conditions due to these different strategies.*"

Line 216: Please revise the citation "(Iden et al. 2021)" to "Iden et al., (2021)" to match the correct citation style. Similar formatting inconsistencies may exist elsewhere and should be reviewed.

It is revised for this citation and the other citations have been checked and revised for consistency.

Line 308: For La Cendrosa, irrigation was treated as rainfall by adding 30 mm of water between 00:00 and 02:00 UTC.
The text has been replaced with your proposed sentence in the revised manuscript

Line 323-324: While the alfalfa field is clearly identified as a C3 crop, the grass type used for Els Plans is not specified as either C3 or C4. Given that this distinction may affect model performance, the authors should clarify which type was used. Additionally, in Table 1, the crop is classified under the "C4 crop" category. Please check if this classification is correct.

Crops and grass can be either C4 or C3. The table now indicates crop/herbaceous and the text has been clarified indicating the grass at Els plans is simulated as C3.

Line 330-331: It would be helpful if the manuscript could briefly clarify what the "AST option" within SURFEX refers to.
It has been clarified in contrast to other options. The text now reads as:
"Additionally, the AST option within SURFEX is used for both simulations. With this option, the A-gs scheme is used to model photosynthesis *parameterizing its processes in contrast with other options that model transpiration directly without considering the biological processes."*

Line 347: "is" to "in".

It is changed now in the revised manuscript

Line 353: "one" to "1".

It is changed now in the revised manuscript

Table 1: It is recommended to unify the formatting of the table and add border lines to both the top and bottom.

It is changed now in the revised manuscript

Figure 9: It is necessary to provide a clear explanation of the meaning of the error bars and the orange horizontal lines shown in the figure.

A description has been added to the caption. It now reads as:
"Figure 9: Observed (blue) and simulated (red) albedo for the NON simulation for La Cendrosa (a) and Els Plans sites (b). Each boxplot measurement shows a central line with the median value. The size of the boxes correspond to the quartiles of albedo observations within the day and the error bars to the variability of the albedo within the day."

Bibliography

Aouade, G., Jarlan, L., Ezzahar, J., Er-Raki, S., Napoly, A., Benkaddour, A., Khabba, S., Boulet, G., Garrigues, S., Chehbouni, A., et al.: Evapotranspiration partition using the multiple energy balance version of the ISBA-Ag s land surface model over two irrigated crops in a semi-arid Mediterranean region (Marrakech, Morocco), Hydrology and Earth System Sciences, 24, 3789–3814, 2020.

Sobaga, A., Decharme, B., Habets, F., Delire, C., Enjelvin, N., Redon, P.-O., Faure-Catteloin, P., and Le Moigne, P.: Assessment of the interactions between soil–biosphere–atmosphere (ISBA) land surface model soil hydrology, using four closed-form soil water relationships and several lysimeters, Hydrology and Earth System Sciences, 27, 2437–2461, 2023.

Swenson, S. and Lawrence, D.: Assessing a dry surface layer-based soil resistance parameterization for the Community Land Model using GRACE and FLUXNET-MTE data, Journal of Geophysical Research: Atmospheres, 119, 10–299, 2014.