

Reviewer's report for gmd-2022-114

General comments

The authors briefly summarized the subgrid surface heat flux scheme initially proposed by Sun et al. (2021) and specifically introduced the modified version. These two stochastic sampling models actually introduce the uncertainties into the land-atmosphere coupling process other than, as the authors claimed, represent the realistic surface heat flux partitioning. How does the model deal with the surface energy balance closure in accompany with the imposed heat flux partitioning? On the assumption of normal distribution of the surface heat fluxes, how many land grid cells are subject to that normal distribution if the purpose of this study is to parameterize the realistic surface heat fluxes? And to what extent the other "abnormal" grid cells can play roles in impacting the simulated climate? I understand that it may be difficult to address these points at one time, but it will benefit the readers if the authors can provide some advantages and disadvantages of Sun's approach and the modified approach in the text.

As the manuscript reads now, it seems like the authors touched on a wide range of analysis of the atmospheric variables only briefly without really figuring out their scientific connections. Instead, the authors may consider restructuring the manuscript and dig deeper into aspects that are truly linked with the incorporation of the subgrid-scale treatment of surface heat fluxes. For example, the authors stated that the simulated large-scale circulation is significantly altered by the modified surface heat fluxes which further improves the simulated precipitation on the southern and eastern margins of TP. If so, is it possible to demonstrate the relationship between the changes in surface heat fluxes (Figs. 6&7) and the affected SLP field in Fig. 5? Also, it is very interesting to see the cloud feedbacks in EXP or EXP_COR, and that is supposed to be induced by the surface energy changes in this study. But in the context, the changes in cloud properties are considered the reason why surface heat fluxes are influenced.

Specific comments

L75: Suggest changing the title to "Materials and methods" or "Methodology"

L82: "all of the PFTs in the grid" -> "the corresponding grid"

L88: "selected as N pairs" -> "paired with each other"

L97: "normal distributions" see the general comment

L152: "Sun et al. improved ... (Fig. 2c)" Should it be Fig. 2d or Fig. 2c? Fig. 2c is comparing Sun et al. results with the control case.

L157: Given that the RMSE of EXP_COR is very close to EXP, is it sensitive to the average region the authors defined? Or, why do the authors choose 0-50°N, 0-180°E as the study area for the statistics?

L198-L200: If the authors can include the Fig.5b from Sun et al. (2021) into Fig. 5 in this manuscript, it may be easier for readers to understand the context on explaining model's overestimated precipitation in the southern TP.

Figure 5: Does it show the moisture transport vector or wind speed? The unit as depicted in Fig. 5 is m s^{-1} .

Figures 6-11: The inserted boxes do not zoom in much or indicate more useful information. They may be removed.

L221: Remove "resulting in better agreement with the observations"

L303-L305: This sentence is a little confusing. What is the difference between "subgrid variations in surface heat fluxes" and "their subgrid partitioning"? It might be good to provide an explanation.

Figure 12: Could the authors make this blurry plotting of a higher quality?