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Comment on tc-2022-123

Anonymous Referee #1

Referee comment on "Simulating the current and future northern limit of permafrost on the Qinghai–Tibet Plateau" by Jianting Zhao et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-123-RC1, 2022

Review of "Simulation of the current and future dynamics of permafrost near the northern limit of permafrost on the Qinghai–Tibet Plateau" By Zhao et al.

This study simulates the thermal state and its dynamics of permafrost over a small region near the northern limit on the Qinghai-Tibet Plateau (QTP) where the permafrost is a fragile state. The simulation relies on a model developed from numerically solving the one-dimensional transient Fourier's law heat conduction equation. The model has taken several important biogeophysical processes, such as the phase change of soil water, into consideration for a better reproduction of the soil temperature field. The model is carefully validated and calibrated over the study area using meteorology and borehole data. As the result, the validated and calibrated model successfully improve the simulation of the spatial-temporal distribution/variation of permafrost thermal state over the study area, The model is then forced by CMIP5/CMIP6 projection data under the scenario of RCPs and SSPs. The warming rate of permafrost is slightly higher in the SSP scenario than in the RCP scenario. This study highlights the slow delaying process of the mountain permafrost in response to the warming climate. In general, this model-based study is well-shaped with model development, model evaluation/calibration, and model application/projection. The newly-developed model provides a new tool in estimating the response of mountain permafrost in the QTP to the warming climate, supporting new studies to the observational results. Overall, I recommend an acceptance after addressing some minor revisions.

Major issues:

The resolution of this modeling study is relatively high (1km), and the model configuration is totally one-dimensional. So, in my opinion, the model biases resulted from ignoring the

horizontal fluxes of heat and water should not be ignored any more under such a fine grid spacing. Considering the complex topography in the study area, authors should do more in estimating the model uncertainty because of the ignorance of horizontal heat and water fluxes.

Minor comments:

Section 2.3.1 What is the vertical resolution of your soil model?

Line 320: I suppose the warming rate for SSP245 should be 0.032 instead of 0.32.

Line 348: The single quotation mark in “model’s performance evaluation” is not correct.

Fig. 2-5. I have several questions concerns about the results shown by these figures on model evaluation.

- How do you explain the better performance of model in reproducing the soil temperature in the shallow layers than that in the deep layers (8m and 15 m) for some sites?
- Why in Fig. 3 and 5, there are discontinuity of time series for modeled temperature while no discontinuity in observed results, which is against common sense.
- I recommend to use dotted lines rather than dashed lines for modeled time series since the dashed lines cannot clearly show the annual peak temperature.

Fig. 6, 8, 9 and 10. For these spatial patterns, some of them has white lines for topography, while some do not. I recommend to add topography in all figures.