Climate warming has undoubtedly impacted the Cryospheric over the Tibetan Plateau. As the most widely distributed cryosphere element, thawed permafrost has caused damage to the natural and social economy; therefore, projections of the permafrost dynamics are the primary step to mitigating and adapting to climate change. Aiming to understand the permafrost dynamics on the regional scale, a model is a more powerful tool than fieldwork. Here, Zhao et al. apply a one-dimension heat conduction model to detect the permafrost change located on the permafrost's northern edge over the Tibetan Plateau. After evaluating the model's performance based on borehole records, the authors investigated the permafrost dynamics under historical and future climate conditions and claimed the terrain strongly affected the thermal regime of permafrost in the Xidatan area.

In general, this work should deserve attention or consideration by The Cryosphere if the authors could address review comments and add additional information.

General comments

1. It is hard for me to understand the approach that the authors applied to generate the forcing data for the future period (last paragraph of section 2.3.3). Firstly, why do authors regard the warming climate rate in the Xidatan Area as equal to the warming rate over the Tibetan Plateau in the future? In other words, why the mean warming rate of the larger area (e.g., Tibetan Plateau) can represent that of the smaller area (e.g., Xidatan area)? Secondly, if I understand the function (Eq 8 in Sun et al., 2019) which calculates the daily land surface temperature correctly, why do the authors consider the forcing data (land surface temperature) is linearly increasing in the future? Perhaps, the results of future projections in this manuscript may overestimate the permafrost degradation conditions in the future.

2. For the methods of spatially modeling (Section 2.3.4), how the authors obtain the soil stratigraphy in the area without any borehole, e.g., 35°40' N - 35°42', because the authors pointed out that "the well-adjusted thermos-physical parameters of multilayered soil columns during the model calibration were specified and assigned for each grid cell of the same soil classes in the surrounding areas of the calibrating borehole".
3. I suggested the authors should be better replot Fig 2-5, because it is hard for me to see the model's performance.
4. For the third paragraph of section 4.2, the authors cited some projection studies that used statistical methods to detect the permafrost state in the future. But, as far as I know, there are existed some studies using the land surface model to simulate the permafrost change over the Tibetan Plateau, e.g., Guo et al., (2012), Qin et al., (2017), and Zhang et al., (2022). Therefore, what is the advantage of the model used in this manuscript compared to other numerical transient models?

Reference:

Guo, D., Wang, H., Li, D. 2012. A projection of permafrost degradation on the Tibetan Plateau during the 21st century. 117, D05106. Journal of Geophysical Research: Atmospheres. https://doi.org/10.1029/2011JD016545.

Qin, Y., Wu, T., Zhao, L., et al. 2017. Numerical modeling of the active layer thickness and permafrost thermal state across Qinghai-Tibetan Plateau. 122, 11604-11620. Journal of Geophysical Research: Atmospheres. https://doi.org/10.1002/2017JD026858.

Zhang, G., Nan, Z., Hu, N., et al. 2022. Qinghai-Tibet Plateau permafrost at risk in the late 21st Century. Earth's Future. 10, e2022EF002652. https://doi.org/10.1029/2022EF002652.

Specific comments

1. I do not see any citations for Table 2 and Table 3 in the manuscript.
2. L322-323: 0.032℃ a^{-1} (SSP2-4.5, moderate mitigation)?
3. L326: RCP8.5?
4. Please keep the abbreviation of 'SSPx-y' consistently, e.g., some sentences use SSP1-2.6 (L322), and some sentences use SSP1-26 (L502).