

Interactive comment on “Change in Frozen Soils and Its Effect on Regional Hydrology in the Upper Heihe Basin, on the Northeastern Qinghai-Tibetan Plateau” by Bing Gao et al.

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First we want to thank Anonymous Referee #1 for his constructive comment and his good suggestions. We are answering his comments in the following, for clarity we repeat the original comment (C) and answer (A) afterwards:

Specific comments

C: The paper is improved. I have only minor specific comments other than the general comment below. In general, in this paper I would like the authors to address if there is a horizontal talik above the permafrost or not. Surely there would be somewhere in

C1

the catchment especially where the permafrost is discontinuous. Horizontal taliks exist where the maximum frost depth does not extend as deep as the maximum seasonal thaw depth. So there is a perennially unfrozen zone above the permafrost but below the active layer. Could this be significant like the conversion from permafrost to seasonally frozen ground? Would the model account for this?

A: Thanks for this comment. We have checked the results of soil temperature of each layer for all grids. We have found some taliks in permafrost region. But the horizontal taliks are not significant as shown in fig. 1.

Minor comments

C: L51, delete ‘the’.

A: We have revised as suggested.

C: L56, delete ‘the’

A: We have revised as suggested.

C: L57,58, the authors should be careful with the phrase ‘field experiments’ here. If they are talking about looking at field data, some of the studies (e.g., Jacques and Sauchyn 2009) have been done on large spatial scales. If they are talking about intensively monitoring a catchment, that is different and likely only accomplished on fine scales.

A: We have modified “field experiments” as “intensive field observations”

C: L62, delete ‘the’.

A: We have revised as suggested.

C: L31 and many other places in the manuscript. If I were the authors I would define runoff up front. They use it in the normal hydrological way, but many hydrogeologists or civil engineers could be interested in this paper, and runoff often means different things to different people. Given that The Cryosphere is a bit of a general cold regions

C2

journal, I'd suggest a clear precise definition early on in the paper for runoff.

A: Thank you for this suggestion, we added the runoff definition when it first appeared in this paper. The related sentence has been revised as "A few studies reported that permafrost thawing might reduce river runoff (This paper defines the runoff as all liquid water flowing out of the study area.)".

C: L70, delete 'the' before 'vertical'.

A: We have revised as suggested.

C: L72, 'overly simple ways' is vague. Explain or remove?

A: We modified "in overly simple ways" as "by simplified ways".

C: L83, delete 'the' before 'downstream'

A: We have revised as suggested.

C: L88, 'thickness' can be removed (besides it makes no sense to say that the thickness is thin and the thickness is warm).

A: We have revised as suggested.

C: L91, delete 'the' after 'air'.

A: We have revised as suggested.

C: L103-107 and 172-175. This seems to be almost branding for the research grant and, in my mind, is only suitable for the acknowledgements not the main body of a research paper.

A: we have delete the sentences about the Heihe Research plan in the main body.

C: L122, 'mean' should be before 'annual'.

A: We have revised.

C3

C: I'm surprised by the high RMSE in the soil temperature results, especially after calibration'

A: We calibrated the soil reflectance according to vegetation type, and we do not calibrate the soil heat capacity and soil thermal conductivity. The soil heat capacity and soil thermal conductivity are estimated using the method developed by Farouki (1981). This may lead uncertainties in simulation of the soil temperature.

C: Section 5.3, the uncertainty 'analysis' is highly qualitative.

A: Yes, we discussed the uncertainty qualitatively in this paper. Due to the complexity of the distributed model and large number of model parameters, it is challenge to quantify simulation uncertainty. This work will be done in the future study.

C: Figure 1, The authors could show the plateau on the map of China. OR be clearer what the grey zone refers to in the inset.?

A: We have modified Figure 1 to show the plateau on the map of China.

C: Figure 7, the caption should be clearer why there are groups of 2 figure panels for each location.

A: We have changed the caption of Figure 7 as "Comparison of the simulated and the observed daily river discharge at: (a) the Yingluoxia Gauge, (b) the Qilian Gauge, and (c) the Zhamashike Gauge (The upper panel is the calibration period, and the bottom panel is the validation period for each gauge)"

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C4

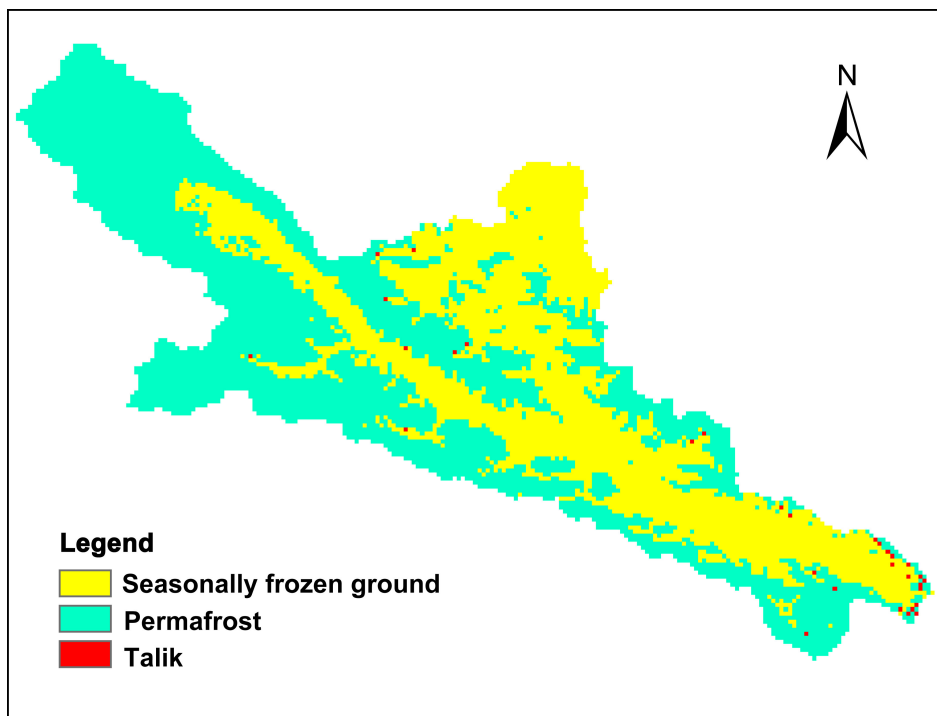


Fig. 1.