

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-191

Anonymous Referee #2

Referee comment on "Convective heat transfer of spring meltwater accelerates active layer phase change in Tibet permafrost areas" by Yi Zhao et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-191-RC2>, 2021

This manuscript applied the SHAW model to investigate the impacts of CHT on active layer thermal dynamics on the Tanggula station, a typical continuous permafrost site located at the eastern Qinghai-Tibetan Plateau with abundant meteorological and soil temperature/moisture observation data. The 2008-2009 observed hourly data were used to calibrate the model parameters and those of 2010 for validation. The control experiment was carried out to quantify the changes in active layer thermal regime affected by vertical advection of liquid water, consisting of three setups: using (1) the original SHAW model with full consideration of CHT; (2) a modified SHAW model ignoring the CHT due to infiltration from the surface, and (3) a modified SHAW model ignoring complete CHT processes in the system. The results show that the CHT events mainly happened during thawing periods when the active layer melted at shallow (0-0.2m) and middle (0.4-1.3 m) soil depths, and its impact on soil thermal regime at shallow depths was significantly greater in spring melting periods than in summer. The impact was minimal in freezing periods and in deep soil layers. The overall annual effect of CHT by liquid flux is to increase soil temperature in the active layer and accelerate the thawing of permafrost at the study site. The topic is interesting and suitable for the journal The Cryosphere. I do have some major concerns such as: The introduction should be consistent with the topic. The discussion should be stated as different format with the results. The concepts such as the difference between unfrozen water and liquid water content need to be defined in the context. I listed my major concerns as follows:

- The abstract is too long and needs to be shorten.
- My main concern is that the data in 2008-2010 was used in this study, which was too old. I recommended to update the time series of the data.
- "Tibetan" or "Tibet"? It should be maintained consistent throughout the text.
- The logic of the introduction is a little bit unclear, and some of its details are not adequately rigorous. As I know, there were many works that has been done on this work based on different models, such as Yu et al., 2018, Liquid-Vapor-Air Flow in the Frozen Soil, JGR, and He et al., 2018, A coupled model for liquid water-vapor-heat

migration in freezing soils, Cold Regions Science and Technology. I suggest that the authors to provide a thorough review on this aspect and state the previous pros and cons on the previous work, then clearly state that why this need be done to make a real progress and what is the different between them?

- How representative is the Tanggula site for such a large area of the Qinghai-Tibet Plateau? It is suggested to add more points in different regional to illustrate the problem. Why did the authors select this site?
- Why to use SHAW model, the introduction is not clear.
- In model settings: Table 1 should remove to this section, and what I want to know is how this parameter is obtained, which has important effects on the simulation results.
- The simulation error is large, especially for soil moisture (Fig. 1), which will bring large uncertainty to the simulation results of sensitivity experiments in this paper, and the results are doubtful.
- Why is the analysis divided into shallow, middle and deep layers, and what is the basis for the layers?
- What is the spring meltwater referred to in this article? If it is snow melt, how much snow is there on the Tibetan? How much melt water is there and how much of it is infiltrated into the soil, all these questions are not answered in the article.