Dear Professor and Editor Ylva Sjöberg,

Thank you very much for your comments. In response to your comments, we have made further improvements to the manuscript. Below please find the point-by-point responses to your comments. Please refer to the change-tracked doc for all we have modified.

Thank you for submitting a revised version of your manuscript. I find your manuscript very close to publication in TC, but have a few minor and technical comments that I would like to see addressed before publication (line numbers refer to your tracked-changes ms version):

First of all, I'm missing a clear description of how the temperature of infiltrating water is determined, and in general how the top boundary is defined and potentially differ between the three models. (e.i. how is the temperature of snowmelt water and rain water determined?) This is also needed to understand the effects of the melt events in January 2010 in the three models. I'm asking for a brief description of these definitions.

As per your comment, we clarified the definitions of the temperature of water fluxes in Section 2.1:

"The SHAW model assumes that the migrating liquid and vapor water fluxes have the same temperature as the layers in which they are generated. Since the model does not provide a specific estimate of rain temperature and ignores the CHT processes within the canopy layer, rainwater entering the residue layer through the canopy is simply assumed to be at the same temperature as the residue layer when no snow cover is present on the surface. When snow is present, rainwater flowing through the canopy will participate in snow processes before it reaches the residue layer, and the temperature of snowmelt is assumed to be the same as the temperature of the snow layer at the time of melting."

We also have highlighted the differences in the model configurations between the three scenarios in Section 2.2:

"The resulting differences between the NoSurf/NoConv and Control simulations, each configured by the same model settings including the same meteorological forcing data, lower boundary conditions, and calibrated parametric values, thus reflect the effects of liquid CHT on the active layer dynamics."

The top boundaries of the simulations were defined using the same set of the meteorological forcing data. All model simulations were performed with the same model configuration. The only difference between the three scenarios are the models (one is the original SHAW model and the other two are modified SHAW models with partial of complete CHT processes removed).

L240 add space before parenthesis "m(Xiao, Zhao, and Dai et al., 2013)"

L251 (Fig. 1) move parenthesis in "is from (Zou et al., 2017)" to "is from Zou et al. (2017)".

L288 add space before parenthesis "TGL site(Liu et al., 2013)"
Corrected.

Section 2.4: Either use sub-headings (e.g. "2.4.1 Driving data") or completely remove the words in bold (e.g. "Driving data") from the beginning of each paragraph in this section.
We chose to remove these words.

L397-403: Clarify how CHT is responsible for warming in this case (January 2010). It reads like it is heat conduction from snowmelt water that lead to temperature increase - but was that process not included in all simulations? Did any of the cases not include snowmelt water at all?

It's a little bit complicated here. In our contrasting experiments, no water migration processes are changed, so the snowmelt flow in all scenarios is simulated the same. A same amount of liquid water will be generated and percolate through the snow layer to the topmost soil layer (the specific soil layer at 0.00 m). The difference lies in that in the Control scenario, sensible convective heat due to snowmelt percolation was considered, while in the other two scenarios, convective heat flux due to the snowmelt water movement was not considered because the CHT process at the ground surface was removed from the model. In January 2010, although the soil was frozen and impermeable, the abnormal snowmelt caused liquid water to flow to the 0 m soil layer. As a consequence, in the Control scenario, sensible convective heat flux due to snowmelt percolation altered the temperature of the 0 m soil layer and then the temperature gradient there. Although snowmelt water could not further penetrate the frozen soil layer, these temperature perturbations in the 0 m layer were then transmitted to the shallow soil layers by heat conduction. However, in the NoSurf and NoConv scenarios, despite the same amount of snowmelt water was accumulated in the 0 m layer like in the Control, no convective heat transfer occurred and no subsequent heat conduction would occur. Although heat conduction is involved here, it is a result of convective heat transfer due to snowmelt. We recognize the resulting differences in the shallow soil layers as the indirect effects of CHT on the ground surface. The resulting differences are specially distinct during January 2010. As this is an interesting finding, we provided detailed discussion on this in Section 4.2.

Accordingly, we have revised the relevant texts to clarity this indirect effect and the difference between the Control and the other two scenarios in January 2010 in Section 3.2. Hopefully, it is now clearer:
"The differences in soil temperature were noticeable even at shallow depths in January 2010 (Figure 4b and c), when soils at those depths were frozen and impermeable. This phenomenon coincided with the occurrence of extra snowmelt events during this period, as shown in Figure 3. Although snowmelt did not infiltrate into the underlying impermeable soil layers, it moved downward into the uppermost soil layer (0.00 m) during these periods. In the Control scenario, the sensible convective heat flux due to percolation of snowmelt water altered the temperature of the uppermost soil layer and consequently the temperature gradient there. These temperature perturbations were then transmitted to the near-surface

soil layers by conduction. In the other two scenarios, where the CHT process at the ground surface were excluded from the model, the same amount of snowmelt water was transported to the top soil layer, but no convective heat was transferred and thus no thermal disturbance occurred in the shallow soil layers as in the Control, as manifested in the temperature deviations in the shallow layers when contrasting the scenarios. It suggests that CHT could also have indirect thermal impacts during freeze periods, providing that snowmelt occurs during these periods in response to changes in air temperature."

L482: What do you mean by "pikes"? (peaks?)
We replaced "pikes" with "peaks".

L491: This sentence needs some revision "Liquid water migration agrees the occurrence of CHT very well (Figure 6a and Figure 7a)". ("Liquid water migration correlates with the occurrence of CHT very well (Figure 6a and Figure 7a)"?)
We used "correlates" instead in this revision.

L677: add space "Zweigel et al.(2021)have"
Done

L757: Missing a word in this sentence? "During the spring thaw period in, the differences..."
We deleted the word "in".

I look forward to receiving a new version after these minor revisions.

Thank you very much!