We would like to thank Anonymous Referee #1 (AR1) for their constructive and positive comments. Below, we will respond to the comments made by AR1: the comments from AR1 in black, our response in blue.

The manuscript addresses frozen soil degradation and surface soil warming issues by introducing a realistic and computationally model which is more stable physically and efficient frozen soil module (FSM) into a land surface model—the third-generation Simplified Simple Biosphere model (SSiB3-FSM) in Tibetan Plateau and North China region. To this end, the performance of the used model, as well as the effects of frozen soil process on the soil temperature profile and soil thermal characteristics, were investigated over the using observation and models simulations. It an intriguing research topic whose rationale has been well established by the authors. The methods seem more likely to acceptable/reliable, the originality of the research is undoubted. The results interpretation and validation is appropriate and the manuscript is written well. In my opinion, the content of the manuscript fits well to getting published with HESS in its current form due to data availability and above-mentioned qualities.
However, I would like to mention some minor concerns which need to be addressed before acceptance.
R: Thank you very much for your helpful comments and suggestions for the improvements of the manuscript. We have responded to the following comments or questions and modified the manuscript accordingly.

The abstract could have been much improved by mentioning obtained observed and simulated results. There must be a take-home message at the end of the abstract, how the changing climate affected TP and NC concerning frozen soil properties and permafrost? The authors emphasized more on the model used rather than results. They even didn't mention the study period (1981-2005).
R: To better clarify the impact of frozen soil process on TP and NC and provide a take-home message for the readers, we modified the abstract by adding description of the study results at the end of the abstract. See line 30-31. And we also emphasized the study period is from 1981-2005. See line 20-21.

I would like to know why the decreasing trend of MFD stabilized (line 450-455) after 2000 while glacier mass balance results are in phase with global warming in TP. Most of the glaciers are losing mass and collapsing such as ARU glacier. Does it make sense? Please address this issue.
R: Thanks for your suggestions. Large number of studies have shown the annual soil temperature over TP has been increasing since 1980s and the rate is even more pronounced than the global warming (Liu and Chen, 2000). Therefore, the TP glaciers experience abrupt retreat under climate warming with westerly monsoon interaction (Yao et al. 2012). However, MFD was mainly controlled by the winter surface temperature. Spatio-temporal analysis of surface temperature over the TP during 1981-2015 shows that the winter surface temperature over the TP increased significantly in the 1980s, and the temperature changes were relatively stable in the 1990s and early 21st century (Bai et al., 2018). That is why the decreasing trend of MFD over TP after 2000 is stabilized. As for the variation of MFD after 2000, we add above discussion in the manuscript. See line 487-491.

References:

Liu X.D., Chen B. D., 2000, Climatic warming in the Tibetan Plateau during recent decades. International Journal of Climatology, 20 (14): 1729-1742.

Bai Lu, Yao Y. B., Lei X.X, Zhang L., 2018, Annual and seasonal variation characteristics of Surface temperature in the Tibetan Plateau in recent 40 years. Journal of Geomatics, 43(2): 15-18.

Yao T.D., and Coauthors, 2012: Different glacier status with atmospheric circulations in Tibetan Plateau and surroundings. Nat. Climate Change, 2, 663–667, https://doi.org/10.1038/nclimate1580.

In the caption of Figure 1, in order to distinguish "The heat and water flux between soil layers are represented by *H* and *Q*." with surface sensible heat flux "*H*" in the Figure 1, " heat flux *H*" could be changed to "H_k" and "water flux *Q*" could be changed to "Q_k".

R: Agreed. We have corrected this in Figure 1.

T in equation (5) should be T_s?

R: Yes. It should be T_s in equation (5) and we have corrected it.

In Figure 2, at the last step, the soil temperature, soil ice content and soil liquid water content at *k+1* time step should be calculated. So the soil liquid water content $\theta_{l,j}^{k}$ should be $\theta_{l,j}^{k+1}$.

R: Agreed. We have corrected it in Figure 2.

At line 207, why "nine soil layers over the TP region" were selected? Please clarify it.

R: Because the soil temperature are observed at nine soil layers. They are at 0, 5, 10, 15, 20, 40, 80, 160 and 320 cm. The information about observed nine soil layers can be found at line 213-214.

At line 271, line 306, line 318, please change "(2) Soil temperature profile in the TP", "(3) Soil temperature profile in NC" and "(4) Comparison with the force-restore method" to the corresponding subsection heading. For example, "**(2) Soil temperature profile in the TP**" should be "**4.1.2 Soil temperature profile in the TP**".

R: Agreed. We have revised them.

At line 412, it should be 15cm, not "1.5cm".

R: Yes. It should be 1.5cm. We have corrected it. See line 428.