

Interactive comment on “Impact of frozen soil processes on soil thermal characteristics at seasonal to decadal scales over the Tibetan Plateau and North China” by Qian Li et al.

Anonymous Referee #1

Received and published: 28 November 2020

General Review on manuscript “Impact of frozen soil processes on soil thermal characteristics at seasonal to decadal scales over the Tibetan Plateau and North China” 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

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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. 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). 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.

Detailed 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”. T in equation (5) should be T_s? 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 $\theta_{(l,j)}^{(k+1)}$. At line 207, why “nine soil layers over the TP region” were selected? Please clarify it. 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”. At line 412, it should be 15cm, not “1.5cm”.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2020-578>, 2020.

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