Frozen soil undergoing freeze-thaw cycles has significant impacts on local hydrology, ecosystems, and engineering infrastructure within the context of global warming. However, it is challenging to depict a dynamic thermal equilibrium system of ice, liquid water, water vapor and dry air in soil pores, when soil experiences the freeze/thaw process. Through careful design and analyses of numerical simulation experiments, this study may help us understand the contribution of airflow-induced water and heat transport in the frozen ground. I just have a few comments/suggestions that may improve this manuscript, before it can be accepted for publication in HESS.

Major comments:

1. The authors should clearly state/add the innovative points by this study in the title, abstract, and body text (e.g., objectives, results and discussions, as well as conclusions), by comparing to the listed publications in the references by the same authors. It is obvious that this group has quite a few nice publications on the physics of frozen ground, by describing the contributions/roles of vapor, liquid water and solid ice in the water and heat transports. After my reading of this manuscript, it is more like a sensitive study or a review paper. Please add text to clarify the major difference of this manuscript from previous studies, and demonstrate the new processes/knowledge to the permafrost hydrology community.
2. In Figure (1-3 & 5), the red and blue lines are always overlapped. Is there a better way to show them?
3. The difference between CLPD-air and CLP is that air flow was taken into account. What are the key processes that the air flow affects frozen ground? The difference should be briefly introduced in Section 2.2, for better understanding in this

manuscript.

4. There are many results in this paper, and I think you can add more details in Section 5 (conclusions).
5. Literature review about the frozen ground/permafrost hydrology by this manuscript is incomplete. I would like to suggest the authors also referring to the following ones but not limited to them. E.g.,
   - *Qi et al. (2019). Coupled Snow and Frozen Ground Physics Improves Cold Region Hydrological Simulations: An Evaluation at the Upper Yangtze River Basin (Tibetan Plateau). Journal of Geophysical Research: Atmospheres, 124(33): 12985-13004.*
   - *Biskaborn et al. (2019).Permafrost is warming at a global scale. Nature communications, 10(1), 264.*
   - *Wang et al. (2017). Development of a land surface model with coupled snow and frozen soil physics. Water Resources Research, 53, 5085–5103.*
   - *Bao et al. (2016). Development of an enthalpy‐based frozen soil model and its validation in a cold region in China. Journal of Geophysical Research: Atmospheres, 121(10), 5259-5280.*
   - *Iijima, Y., Ohta, T., Kotani, A., Fedorov, A.N., Kodama, Y., & Maximov, T.C. (2014). Sap flow changes in relation to permafrost degradation under increasing precipitation in an eastern Siberian larch forest. Ecohydrology, 7(2), 177-187.*