Author's Response:

Certainly, the MS has been improved based on reviewers' comments. Two more points need further attention:

We thank the editor and reviewers for their constructive comments. Please find our additions below.

1). Spin-up time: what you described in the revised text is reasonable, can you use one or two sentences to describe the equilibrium conditions? For example, it is a common practice that the minimum soil temperature difference between two consecutive time steps is < 0.001 deg C over the entire soil temperature profile. In this way, it will avoid the different spin-up time issue.

We agree on the editor's suggestion to clarify the equilibrium conditions and added the following sentence to the section 2.3:

"However, the common practice in all model spin-up procedures was to keep the mean annual soil temperature change less than 0.01°C in all soil layers."

2). Evaluating the different model outputs from each model may need at least in the discussion section. The authors can at least say that which model shows better results comparing with in-situ data. This will serve as a reference for model improvement in the future.

According to your request, we have added the following paragraph to the end of Section 4.2:

"Adding to all these outcomes, some models match the site observations better than others at specific sites. For example, the mean annual soil thermal profiles are better captured by JSBACH at Nuuk, by JULES and COUP at Schilthorn, by ORCHIDEE at Samoylov, and by COUP at Bayelva (Fig 11). Comparing just the topsoil conditions at the non-permafrost Nuuk site, JSBACH is better matching the observations due to its moss layer. On the other hand, by having better snow depth dynamics (Fig. 4), JULES and COUP models are better suited for sites with deeper snow depths like Schilthorn and Bayelva. Contrarily, the wet Samoylov site is better represented by ORCHIDEE in snow season (Fig. 2a) due to lower snow depths in this model (Fig. 4) and thus colder soil temperatures. However, the snow free season is better captured by the JSBACH model (Fig. 2c) due to its effective moss insulation and LPJ-GUESS model due to its insulating litter layer."