

## Response

First of all, we would appreciate the editor's comments and suggestions. We have checked the manuscript throughout carefully with the help of a native English speaker, including rearranging some text in section "Introduction" and rewriting some ill expressions in the manuscript. Here we upload both of the clean and tracked version. For the specific comments, we responded them one by one as following,

Responses for the specific issues and suggestions from the topical editor,

1) L18, "most areas" of global permafrost or the study area? Please clarify.

**Response:** Here, we mean globally, and we have clarified it in Line 18 in the revised version (clean version), as "Under a pronounced climate warming, permafrost has been degrading in most areas globally, ..."

2) L31, "Change, X, 2021" -> "Chang, 2021".

**Response:** Thank you very much. We have revised all the citations according to ESSD's style in the manuscript with Endnote.

3) L46, clarify what "It" refers to?

**Response:** We have rewritten the sentences. **The original sentence is** "Permafrost is sensitive to climate change (Farquharson et al., 2019; Sim et al., 2021; Zhang et al., 2019; Ran et al., 2018) and surface disturbances (Guo et al., 2018; Li et al., 2019; Li et al., 2021). It has experienced significant warming and widespread degradation during the last several decades (Jin et al., 2000; Jin et al., 2007; Zhang et al., 2019; Jin et al., 2021; Chen et al., 2020)".

In the revised manuscript, we revised it to "Due to climate warming (Farquharson et al., 2019; Sim et al., 2021; Zhang et al., 2019; Ran et al., 2018) and surface disturbances (Guo et al., 2018; Li et al., 2019; Li et al., 2021), permafrost has experienced widespread degradation during the last decades (Jin et al., 2000; Jin et al., 2007; Zhang et al., 2019; Jin et al., 2021; Chen et al., 2020)".

4) Section 2, it would be helpful to substantiate citations or clarify the sources of the values of climate variables.

**Response:** The statistic numbers of air temperature and precipitation are mainly cited from Yang 2007, and Jin et al., 2007, except that we have updated the MAAT in Gen'he to 2020 according to some newly collected air temperature data. In the revised manuscript, we have added these two citations in Line 91, as "During the same periods, the multi-year average of annual precipitation was 440 mm at Gen'he, 460 mm at Yituli'he, and 480 mm at Gangui (Yang, 2007; Jin et al., 2007)"

5) L137, please rephrase "freeze-thaw cycles took place".

**Response:** The original expression is "In Borehole GH5, despite of a small temperature range (0.5°C) at the depth of 6.0 m, freeze-thaw cycles took place."

We have revised it as "In GH5, there still exist obvious freeze-thaw cycles at the depth of 6.0 m, despite with a small varying range in ground temperature (0.5°C)" in Line 142 and 143 in the revised version.

6) L138, "negative temperature" is not a correct term, please change it to "below C".

**Response:** The original expression is “During the monitoring period, the sensor at 7.0 m in depth showed all negative temperatures, but in the left proximity of 0 °C, all year round, with a multi-year average of mean annual soil temperature at –0.08°C.”

We have revised the sentence as “However, the ground temperature at the depth of 7.0 m stayed constantly below 0 °C all year round during the monitoring period, approximating to 0 °C and with a multi-year average of mean annual ground temperature at -0.08°C” in Line 143 to 146. Also, we have rewritten all the expressions alike in the manuscript.

7) L157, L174, I would suggest avoiding using the expression “blow/above xx m in depth” to avoid confusion. Maybe consider rewriting them, for example, deeper than 8 m.

**Response:** L157 has been revised as “In MG1, the varying amplitudes of ground temperatures for depths deeper than 8 m were no more than 0.4 °C” in Line 164, and L174 has been changed to “According to Figure 5, ground temperatures at depths of 8-20 m fluctuated seasonally.” in Line 180. And we have changed all the expressions alike in the manuscript.

8) L174, rewrite “relatively cold”.

**Response:** The original expression is “permafrost at GH4 was relatively cold, with a multi-year average of MAGT at –2.84 °C at 20 m in depth.”

In the revised manuscript, we have revised it as “permafrost at GH4 was obviously colder, with a multi-year average of MAGT at –2.84 °C at 20 m in depth”.

9) L207, drop “the” before “permafrost table”.

**Response:** Thank you very much. We have revised the manuscript according to your suggestion, and we have checked all the usages of articles.

10) L213, avoid using “thanks”. It’s too subjective.

**Response:** Original sentence is “Permafrost here is well developed, partially thanks to the sufficient moisture provided by lowland swamp, ...”

We have rephrased the expression as “Permafrost here is well developed, partially attributed to the sufficient moisture provided by lowland swamp, ...” in Line 218.

11) L215-218, L251, the sentences are hard to understand, please rewrite.

**Response:** The original sentence is “Notably, there was a decreasing trend in ground temperatures at shallow depths no matter in summer or winter during 2010-2020 (Figure 2), otherwise suggesting a cooling permafrost at shallow depths in the last decade on the northwestern slope of the Da Xing’anling Mountains if no ground-surface conditions are taken into account”. Yes, it is really a little confusing.

In the manuscript version, we have changed it to “Notably, there was a decreasing trend in ground temperatures at shallow depths no matter in summer or winter during 2010-2020 (Figure 2), suggesting a cooling permafrost at shallow depths in the last decade on the northwestern slope of the Da Xing’anling Mountains” in Line 221 to 223, removing some misleading phrases.

12) L233, “Change trends ...” does not seem to be a proper term unless the authors

meant the changes of trends? Also, what does “larger depths” mean? Similar issues can also be found in other titles, such as 4.1.

**Response:** Thank you very much, we have checked all the title names of each section, and changed them one by one, for example, from “3.2 Change trends of permafrost temperature at depths” to “3.2 Changes of permafrost temperature at depth”, and from “4.1 Change trends of near-surface permafrost temperatures” to “4.1 Changes of near-surface permafrost temperatures”.

13) L274, avoid using “In a word”, and also rewrite the sentence.

**Response:** The original expression is “In a word, permafrost degradation in Gen’he is also evident at present in both forested landscape and anthropic zones, particularly in the latter one.”

Now, it has been revised as “Overall, the permafrost at depth in forested landscape in Gen’he is in an evident warming trend at present.”

14) L280, “the investigation”? Either change to “an investigation” or substantiate a reference.

**Response:** Thank you very much. Yes, the article “the” should be “an”, and we have changed it. We also checked all the usages of articles in the manuscript carefully.

15) Figure 1, the labels are hard to read in the middle map.

**Response:** We have revised the labels in figure 1, and we think they are much clearer now.

16) Figure 1 caption, please fix the double quote.

**Response:** We are very sorry for this mistake and thank you very much. We have revised it.

17)

**Response:** We have added two other citations in the manuscript, e.g., Wu et al., 2022, and Zhao et al., 2022.