<h1 style="text-align:center">Response to Reviewers' Comments</h1>

We would like to thank the reviewers for their comments and suggestions. We have revised the manuscript as possible. Comments from the referees are rearranged and responded one by one as follows, with the responses presented in blue.

Response for referee 2

General Comments:

It's my pleasure to review "Permafrost changes in the northwestern Da Xing'anling Mountains, Northeast China in the past decade" by Chang et al. Despite meeting the problems of the logger damage, lost in mailing, borehole damage and traffic control, the soil temperature including seven boreholes has been observed continuously for nearly 10 years, which is a valuable data set for understanding the hydrological process of regional permafrost. The manuscript is generally well organized and written. The manuscript can be accepted after addressing my following comments.

Response: First of all, thank you for your positive evaluation.

Specific comments:

Comment 1 Please strictly unify the font and serial number of the main title and sub-title in the manuscript according to the template of ESSD. In addition, keywords do not appear to be necessary.

Response: As requested, we have modified typesetting of the manuscript strictly according to the ESSD WORD template, including the font style and title system. We also removed the keywords in the revised manuscript.

Comment 2 Please check the acronyms in the full-text to ensure that each is defined when it first appears. For example, GH, MG, YTLH, etc. must be defined by Genhe, Mangui, Yituli'he, etc. in appropriate places; ALT must be defined at the first occurrence, not at Line 209; Is YT in Table 1 equivalent to YTLH? Please add one note after the Table 1.

Response: Thank you very much. In the revised manuscript, GH, MG, YTLH, etc. have been defined by Genhe, Mangui, Yituli'he at Line 22-23 and Line 72-73, and ALT by active layer thickness at Line 132 when they first appear in the full-text. Actually we have made a mistake to use two acronyms (i.e., YT and YTLH) for the same site (i.e., Yituli'he), and we have replaced YH with YTLH in Table 1 in the revised manuscript.

Comment 3 Please add a north arrow to the left sub panel of Figure 1. Full name of all boreholes shall be included in the description of Figure 1.

Response: According to you suggestion, we have added a north arrow for the left panel and give all the boreholes full names in the description.

Comment 4 Ground temperatures at the Borehole GH4 were automatically collected hourly by the Micrologger CR3000 (USA), whereas at other sites were manually measured with a multi-meter (Fluke 189®). Can the deviation of the two different recording methods be quantified? Please clarify their possible uncertainties.

Response: The ground temperatures at GH4 were automatically collected by a CR3000 Micrologger. Because the hourly data was recorded as the mean value of samplings in every ten minutes, the collected

data were steady and smooth. In contrast, the ground temperatures at other sites were manually measured with a Fluke 189® , and the data was collected once at an instantaneous time over a week or a month. Results show that the deviation of this two methods are obvious. With a more severe fluctuation, the manually collected data is not as steady as the automatically collected data. However, because there are no overlapping data collected between these two different methods at the same boreholes, we did not figure out how to quantify the deviation between the data collected by these two different methods for now, and the uncertainties are also hard to be assessed. We planned to install automatic data logger for the boreholes gradually in future.

Comment 5 Please add the factors (temperature, precipitation, etc.) of climate change from 1980 to 2020 in Figure 9 to better reveal the relationship between the maximum thaw depth and climate change.

Response: The following figure presents the maximal thaw depth of permafrost at YTLH. However, we did not have meteorological data at YTLH. Therefore, the mean annual air temperature (MAAT) at Gehe (about 18 km away from YTLH) and Tulihe (about 30 km away from YTLH) was compared with the maximal thaw depth at YTLH here (Figure r1). The MAAT from 1980 to 2020 at Tulihe is calculated based on the daily observation of a national weather station. At Genhe, we only collected the MAAT from 1996 to 2020. We did not have the data on precipitation at Genhe before 2010. The MAAT at Genhe and Tulihe shows an obvious warming trend. In contrast, the maximal thaw depth of permafrost takes a decreasing trend from 2004 to 2020 at YTLH. It seems inconsistent at first glance. However, the thaw depth of permafrost is mainly subject to the positive air temperature, and MAAT is the mean of all negative and positive air temperatures. The annual mean of positive air temperature at Genhe from 2010 to 2020 shows a slight decreasing trend, at least not warming, although MAAT from 2010 to 2020 warmed up, which was mainly caused by the warming negative air temperature. In addition, the maximal thaw depth was also subject to other conditions, such as soil moisture and vegetation cover, both of which are related to precipitation. Visual inspection can tell that the increased thaw depth (2012~2014) is coincidentally connected to the low level of precipitation (Figure r2). Of course, the influencing paths of precipitation on thaw depth through the soil moisture and vegetation are complex and indirect, even with significant non-linear relationship. We cannot simply clarify them completely here. However, we will give them more insight investigation in future.
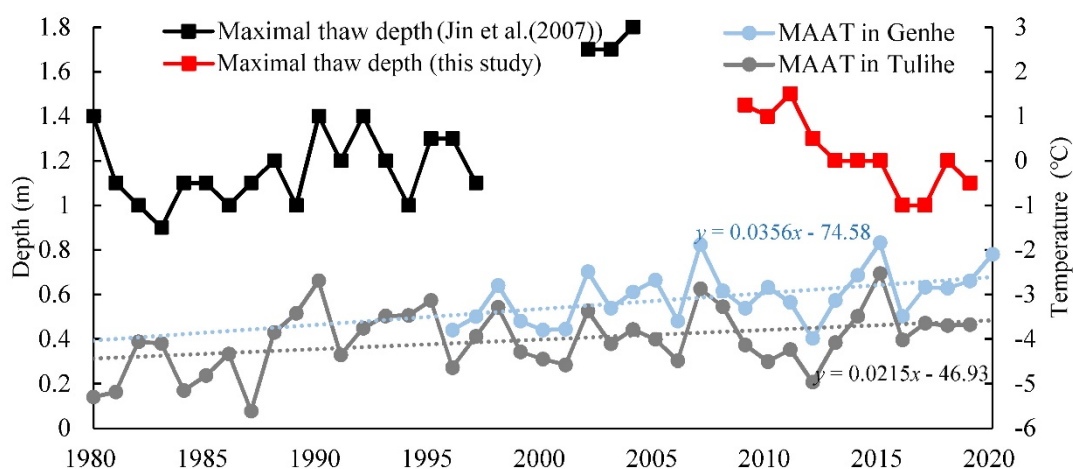

Figure r1 The maximal thaw depth (1980-2019) in Yituli'he and MAAT in Genhe and Tulihe on the
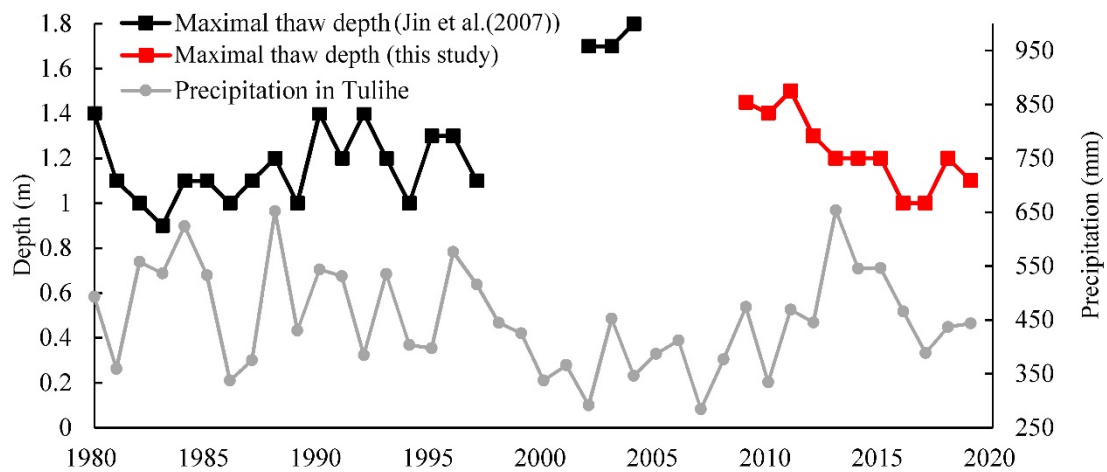
Figure r2 The maximal thaw depth (1980-2019) in Yituli'he and Precipitation in Tulihe on the northwestern flank of the northern Da Xing'anling Mountains in Northeast China

Comment 6 In discussion, please consider the possibility of hiatuses recovery and the possibility of increasing the frequency of observation (MG1, MG2, and MG3) from month to week. Because it is probably to enhance the comparability between these borehole data or with borehole data in other regions on monitoring frequency.

Response: On data hiatuses recovery at MG1, MG2, and MG3, data users could use a linear interpolation method to generate weekly series from monthly series for the observed ground temperatures at depths, because the fluctuation is not much severe except some outliers. We planned to install automatic data loggers for some boreholes as soon as possible to guarantee the data logging accuracy and time resolution.

The dataset (https://doi.org/10.11888/Geocry.tpdc.271752):

Comment 7 What represents the difference between two and nine decimal places in the observed value? What determines it? Why do they alternate in all sites except for the MG3 (two decimal places)?

Response: We are sincerely sorry that we did not pay attentions to the format (i.e., decimal places) of the released data. Actually, the ground temperatures are calculated from the resistance observed by thermistor cables, and the decimal places of output are not set uniformly. Data users can take the first two decimal digits.