General Comments

This paper presents an in-situ observational dataset on permafrost thermal regimes along the China-Russia Crude Oil Pipeline (CRCOP) route in northeast China, consisting of meteorological observations, soil temperature and soil moisture content data, and electrical resistivity tomography (ERT) data. The analysis of this dataset shows that the operation of CRCOP has had profound effects on the thermal state of the ground. The results are useful for better understanding the responses of permafrost to climate change and engineering activities. This dataset is valuable for evaluating the integrity of pipelines and the effectiveness of measures to mitigate the permafrost thaw, as well as for validating numerical models. The manuscript is overall well organized and written, but there are still some shortcomings that need to be addressed.

Specific comments

1, Please enhance the description of data processing (e.g. how do you deal with missing data and how these missing data affect the results?) in the revised manuscript. This will be important for full understanding of this dataset.

Response:
Thank you for your suggestion. We have added the description of quality control of data in the revised manuscript. Obvious erroneous recordings are manually removed and all the missing or abnormal data are replaced with null values before daily average values are calculated.

2, Warm-oil pipeline dissipates heat into the surrounding permafrost, resulting in thermal and physical disturbances to the pipeline right-of-way. These disturbances can compromise pipeline integrity and pose the potential risk of oil leakage. Therefore, in-situ permafrost monitoring has been made along several important pipeline routes (e.g. the Norman Wells pipeline and Trans-Alaska oil pipeline), where reliable first-hand data has been collected. I suggest the authors mention those important studies as background to this study.

Response:
What you mentioned above is right. Pipelines constructed in permafrost are inevitably faced to major challenges related to thaw settlement, frost heave, slope failure, icing, and frost mounds. Therefore, the monitoring systems were established along several pipeline routes, such as the Norman Wells pipeline and the Trans-Alaska oil pipeline, to obtain field data for understanding how the permafrost foundation performed when a pipeline went through or above it. Such datasets and associated analyses are valuable because they can provide references and implications for CRCOP. According to your suggestion, these important studies have been added to the introduction section in red in the revised manuscript as follows:
"As a result, a permafrost monitoring network along the CRCOPs route was gradually established by referring to the experiences and lessons from other oil/gas pipelines (e.g. Norman Wells to Zama oil pipeline in Canada, Alyeska oil pipeline in the U.S., and Nadym–Pur–Taz natural gas pipeline in Russia) in permafrost regions (Burgess and Smith, 2003; Johnson and Hegdal, 2008; Smith and Riseborough, 2010; Oswell, 2011). Boreholes were instrumented to measure GTs in the

active layer and near-surface permafrost on and off the right-of-way (ROW) of the CRCOPs and electrical resistivity tomography (ERT) surveys were used to delineate frozen and unfrozen ground in the vicinity of the CRCOPs (Kneisel et al., 2008; Farzamian et al., 2020) ".

Newly added references as follows:

Burgess M M, Smith S L. 17 years of thaw penetration and surface settlement observations in permafrost terrain along the Norman Wells pipeline, Northwest Territories, Canada. Proceedings of the Eighth International Conference on Permafrost, 2003: 107-112.

Johnson E R, Hegdal L A. Permafrost-related performance of the Trans-Alaska oil pipeline[C]. Proceedings of 9th International Conference on Permafrost, Fairbanks, AK, USA. 2008: 857-864.

Smith S L, Riseborough D W. Modelling the thermal response of permafrost terrain to right-of-way disturbance and climate warming[J]. Cold Regions Science and Technology, 2010, 60(1): 92-103.

Oswell J M. Pipelines in permafrost: geotechnical issues and lessons[J]. Canadian Geotechnical Journal, 2011, 48(9): 1412-1431.

3, Section 2. I found the locations of the sites are not accurate enough, rounded to two decimal places. The locations of boreholes and ERT profiles are not given in the manuscript, nor in the associated dataset. I suggest the author can provide accurate locations (at least four decimal places in unit degrees) for these mentioned locations.

Response:

Thank you for your suggestions. We have provided accurate locations for the five monitoring sites in Table 1 with four decimal places in unit degrees. The boreholes and ERT profiles have been given ID according to where they exist. For example, for JB-B-1 the -B- indicates that is a 'borehole', and the prefix JB is an abbreviation for the site name. So, the locations of boreholes can be determined by their name prefixes.

4, Ground temperature was automatically collected by the dataloggers of RTB37a36V3 and CR3000 or measured manually with. Please provide a description of the errors occurring in these measurements.

Response:

Results show that the accuracy of the manual readings is estimated to be ±0.1 °C, which is lower than the RTB37a36V3 and CR3000 data loggers because the data measured with Fluke 87/89 was collected once at an instantaneous time (Juliussen et al., 2010). However, there are no overlapping data collected via these three methods at the same borehole, we can not quantify the deviation of the three different recording methods.

Reference:

Juliussen H, Christiansen H H, Strand G S, et al. NORPERM, the Norwegian permafrost database–a TSP NORWAY IPY legacy[J]. Earth System Science Data, 2010, 2(2): 235-246.

5, The ROW widths are equal at each monitoring site? Please give a clear description.

Response:

Generally, the ROW is approximately 20 m wide along the pipeline route except for some special sites, such as poor geological conditions. In the revised manuscript, we added the description.

6, Figure 3, seems problematic in the caption. According to the caption, column (a) indicates the active layer, but ground temperatures in XT in (a2-4) were measured below zero degrees for several consecutive years, which actually implies permafrost at this depth.

Response:
We are sorry for this mistake. The caption was revised as "Variability of ground temperatures at depths of 0–3 m (a) and 8–20 m (b) at the undisturbed sites along the route of CRCOPs in Northeast China, 2018–2021.".

7, In Lines 110-111, please give exact timing for the borehole drilling.

Response:
The exact timing has been added in the manuscript, as described as "Besides, a new borehole (JB-B-I) was drilled in March 2017 down to 60.6 m near the above-mentioned AWS.".

8, Line 232 to 240, ERT results show that a talik formed around CRCOP I is much larger than that around CRCOP II. What is the reason?

Response:
The CRCOP I was constructed during 2009-2010 and began to operate in 2011. To reach the requirement of 30-million-ton throughput per year signed by the governments of China and Russia, an equal-size new pipeline, i.e. CRCOP-II, in parallel with CRCOP-I was built in 2017 and began operation in 2018. Due to a longer operation time and heating from the CRCOP I, the talik formed around CRCOP I is much larger than that around CRCOP II.

9, Line 255-257, it's difficult to directly observe the 1.5 m cooling range of two-phase closed thermosyphons and the 4 m lateral extent of thermal disturbance in Fig.9c and d, please clarify this point.

Response:
Thank you for your suggestion. Difficulties in understanding and even misunderstandings may arise if the distances of boreholes and thermosyphons from the pipe centerline were not provided. In the revised manuscript, this detailed information has been added in Table 3.

10, In Figure 8 and Appendix D, please use blue for higher resistivity and red for lower resistivity in ER images, like the color scheme in Figure 9. This is more intuitive for readers.

Response:
We re-draw Figure 8 and Appendix D according to your suggestion.

11, In Figure 10, please add the unit for soil volumetric liquid water content.

Response:

Yes, we added the unit in Figure 9 in the revised version.