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Interactive comment on "A synthesis dataset of permafrost-affected soil thermal conditions for Alaska, USA" *by* Kang Wang et al.

Anonymous Referee #1

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Comments to the Authors

The manuscript describes a dataset of thermal conditions for permafrost-affected soils in Alaska. This complements an earlier published dataset providing deep ground temperature that was described by Clow (2013, ESSD). The compilation could be described as a value-added dataset which might be a more preferable term than synthesis dataset. The authors have gone beyond providing simply a compilation of raw data acquired from many sites and have calculated a number of key parameters and statistics. This value-added compilation will be useful to permafrost scientists, ecologists, hydrologists, engineers and practitioners as well as the modelling community. The manuscript provides a detailed description of the development of the dataset including the various processing steps and techniques used for quality control. It provides useful

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information that might serve as guidance for others that are compiling similar types of data for public dissemination. For these reasons, this manuscript should be published.

The manuscript however, requires a bit of work before it is acceptable for publication. There are a few places in the manuscript where more explanation would be helpful. For example, some of the parameters utilized such as effective snow depth and SHTM require further explanation (see specific comments). Other sections that require further explanation are outlined in the specific comments. For the most part the manuscript is well written but some editing is required to improve language and increase clarity. Some suggestions for editorial revisions have been provided but the authors should thoroughly proofread the revised manuscript before submission.

Although I have made several comments on the manuscript that I hope the authors will find helpful, dealing with them should not take much time. I expect that a revised manuscript that is acceptable for publication can be prepared within a reasonable time. I look forward to reading the published paper.

Specific Comments (keyed to page and line numbers)

P1,L1 – This is not a conclusion of this paper so it could be deleted. P1,L15 – It is better to use "increasing" rather than "warming" when referring to temperature. Suggested revision "Continuous increases in near-surface air temperatures. . ." or alternatively you could say "Continuous warming at the ground surface. . .." P2,L1 – Are you placing a dollar value on ecosystems? P2,L13-17 – Are these really permafrost datasets or is soil temperature (or shallow ground temperature) dataset a better description given that the measurements may not necessarily be in permafrost.

P2,L18-26 - There are other permafrost monitoring sites in Alaska and perhaps these should be mentioned. There are the measurements to about 20m that UAF collects and also the deeper temperatures collected by the USGS which have been published (see Clow 2013, ESSD). These could also be mentioned either here or in previous paragraph. P2, L27 – "near-surface ground temperatures" or "shallow ground temper-

atures" might be better terminology.

P2,L28 – revision suggested "....from the three most reliable monitoring networks over the past several decades:..." P2,L30 – indicate at what depth the ground temperatures are measured, i.e. "...ground temperatures to x depth)..." P2,L31 – revision suggested "....for 72 stations...." P2,L31-34 – Consider reducing the use of first person. Eg. "Detailed information and meta-data are provided for the dataset..." "Futhermore, two types of data ......were implemented: (i) testing for inconsistencies.....; and (ii)....use of the snow....."

P3,L6-9 – I don't think you need to give the description of the CALM network as these data are not compiled in the dataset that is the subject of this paper. I suggest that this section be deleted. You can mention in the Introduction that the dataset you have compiled complements other permafrost relevant datasets compiled for AK such as CALM and USGS (see above) datasets. The focus in this section should only be a description of the sources for your data compilation.

P3, L13 – In figure reference (here and elsewhere) you can remove the symbol as this information should be in the figure caption or legend.

P3, L14 – revision "....USGS installed stations to monitor permafrost..." P3, L16 – revision "....the USGS has maintained 17 automated..." P3, L17 – is "NPS has monitored ground temperatures since 2004" more appropriate?

P3, L26 – P4,L6 – There is some repetition in this section and it is a bit confusing. You could say that thermistors are utilized to measure temperatures to depths of 1.5m and that these are embedded in a rod, anchored in a single hole or inside a fluid-filled hole. You could then describe the calibration procedure and give the accuracy (should also give precision). The details of the systems used in the 3 networks including thermistor type and temperature range, measurement depths and installation method could then be summarized in a table along with any relevant publications for the particular network. The data acquisition system (datalogger) should also be mentioned as well as

frequency of site visits for downloads.

P4,L4-6 – It would seem that you know that the probes are not well anchored in permafrost and the change in the "stickup" is due to heave rather than settlement of the ground in response to permafrost thaw (which might be the case if your probes extended to greater depths in the permafrost). Heave of the probe would take place over the winter as the freezing occurs and I assume you make the correction in the summer (although details are not provided). One might question how reliable your winter temperatures are in terms of the depth of measurement. More detail should probably be provided with respect to the amount of heave that occurs annually as well as how the temperatures are corrected.

P5, L11-12 – Do you correct for the vegetation effect? Trim the vegetation?

P5,L21 – revision suggested "...compile the dataset." P5,L23 – Does this mean that you might lose the 1m depth at sites where there has been significant heave of the probe? Minor revision suggested "...beyond the maximum observed depth..."

P5,L25-26 – revision suggested "...models are monthly, the monthly means were calculated for all variables, including air and....." P5, L26-27 – "Annual means were also calculated to allow...." Do you mean relationship between air and ground temperatures? P5, L31 – Is the frost number determined for only the ground surface temperature or at each depth? Also, do you include the freezing and thawing degree day indices in the dataset as these are useful for models etc.

P6, Eq 1-3 – For DDF are you using a complete winter/freezing season (e.g. Oct – May). You should probably provide a bit more explanation.

P6, L6 – revision suggested "Data records from many sites have gaps..." Also, equipment malfunction is another problem that may result in data gaps. One thing that is not mentioned is the frequency of site visits.

P6, L7-15 – For the missing data allowance, was there any consideration given to vary-

ing this according to the particular variable and its short-term variability. The deeper ground temperature would exhibit less variable so perhaps there could be allowance for more missing data than air temperature for example.

P6,L17 – P7,L7 – This section could probably be simplified and shortened. Maybe you could say that a unique name is assigned to each site. You could briefly mention how you deal with replacement sites.

P7,L11 – Effects of snow on ground thermal state – is this validation or analysis? P7,L21-22 – revision suggested "...keep the ground warm by reducing cooling (or heat loss) during the winter" P7,L23 – revision " ...snow depth and soil thermal properties." P7,L24 – There is no snow cover outside of Oct-Mar for even more northerly locations?

P7,L24-30 – This section is a bit confusing and more information/explanation should probably be provided especially since the parameters mentioned are specific to Slater et al. (2017) and may not be familiar to many readers (i.e. use parameters like n-factors, offsets to describe effect of snow etc.). How is SNDeff determined. Is it represented by one of the terms in Eq 4? Is SHTM equivalent to deltaAmpnorm? Is Amp-grnd referring to ground surface temperature, since snowcover will influence surface temperature, whereas the damping effect at depth will be more dependent on ground thermal properties.

P8, L11 – "spatially variable" better than "spatially complex" P8,L12 – delete last part of sentence "according to the synthesis dataset" – not necessary as it is shown in the figure that is derived from your dataset. P8,L13 – You could just say "located near the glacier" P8,L16 – revise "The other two sites,....." P8,L17-18 – Did you mean to include this last part of the sentence? You could make a comment that the thin snowcover is due to wind exposure. P8,L19 – This is the Frost Number calculated by Eq (1)? I don't see this value in table 3 only the freezing and thawing degree day indices.

P9,L1-14 – Wouldn't the comparison of trends for ground temperature at various depths be the most important thing to check for sensor drift etc. (i.e. ignore any snow effects

and focus on propagation of temperature wave with depth).

P10,L13-15 – See earlier comment regarding more explanation required for these parameters (SHTM, effective snow depth).

P11 Figure 6 – Labels on Y axis overlap between graphs. The trend requires correct units, degC/year, m/year. Are you showing standard error of the estimate also on the graph (should mention in caption)

P12, Figure 7 – Error bars represent standard error from the regression analysis?

P13,L1-4 – While snow is an important factor and influences the winter ground temperature (and therefore the amplitude), vegetation and ground cover can also effect the amplitude through their influence on summer temperature. Is this part of the reason for the considerable scatter in your graph?

P13,L5-6 – Delete this – repetitive.

P13,L8 – It is more correct to say "Changes in near-surface ground temperatures over time are important indicators of a changing climate" The direction of the change in ground temperature will indicate whether there is warming or cooling.

P13, L8-18 – Will the database be periodically updated as new data are collected? You mention it is worth maintaining but you could say more regarding plans for updates.

Table 1 – In section 2.2, interpolation to determine ground temperature for 4 target depths is mentioned. In the table, reference is made only to 1m. Are they any statistics calculated for the other depths? It isn't clear from the table or section 2.2.

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