

Interactive comment on “A decade of detailed observations (2008–2018) in steep bedrock permafrost at Matterhorn Hörnligrat (Zermatt, CH)” by Samuel Weber et al.

GENERAL COMMENT

This manuscript presents an impressive dataset recorded over ten years on the north east ridge of Matterhorn, in steep bedrock permafrost conditions. The dataset includes multi-spot measures of rock temperature and resistivity at different depths, fracture kinematics, displacement and tilting of rock buttresses, time-lapse images and in situ meteorological data.

Data collection methods and sensors setup are exhaustively discussed. The dataset, that includes raw data and post-processed products, is openly accessible and available from a long-term data repository (Pangaea).

The dataset is new and extremely relevant for researchers studying the instability processes related to permafrost degradation in high-mountain environment. The variety of measures represents a great added value that allows the use of these data for developing, calibrating or validating process-oriented models as well as designing and testing of remote early-warning systems. Moreover a number of specific fields of research like e.g. geomatics, hydrology, datascience and more could potentially benefit of this dataset.

I have few **major comments**:

1. The manuscript provides all the informations needed to other researchers for an effective use of the dataset but sometimes these informations are lost in the complexity of the paper. This happens because the article is not exclusively focused on the dataset published in Pangaea but also on the Permasense web portal. Although the two objects are intimately linked, I believe it is important to keep them separate to promote the use of published data (that can be cited by others) rather than the use of real-time ones (that cannot). I strongly suggest moving all content related to access and use of the Permasense web portal, included the processing code published on zenodo, to appendix A or publishing it in a separate article.

2. The Chapter 3 – Technology is out of the purpose of this paper because of tailored on the hardware and software architecture of the GSN and the related storage infrastructure. These aspects are very important and impressive but, in fact, irrelevant for the effective use of the dataset. Also for this, I strongly suggest moving this chapter in appendix A or use it as core for a separate publication in another journal and keep in this publication just the essential (like e.g. figures 2 and 3).

3. In the context of environmental science and notably in permafrost studies, the site description (chapter 2) is important and should provide the reader (who does not know the area) with all the basic information, to frame the area in terms of climate, topography, morphology and geology. In my opinion these general informations are totally missing in the manuscript and this gap must be filled. I strongly suggest to provide the following general informations:

- climate: temperature, precipitation, seasonal extremes, etc... on average
- topography/morphology: mean orientation of the ridge, mean aspect and slopes of the ridge flanks, elevation interval, etc...
- geology: main lithologies and rough structural setting (e.g. orientation of the main faults and fractures families...)

I guess that in Hasler's papers and PhD thesis all these infos are more or less ready to go. See also the technical corrections for further comments.

4. Downloading the dataset from Pangaea repository I noticed that all the .csv files contains a lot of decimal places. In my opinion the dimension of the archives could be significantly reduced by rounding all the double values to the 2nd decimal place. Please consider this.

To conclude, I believe the article is excellent for publication in ESSD after a careful reorganization of the contents to make it much leaner and exclusively focused on the Pangea dataset.

Technical corrections & typing errors

P2/R19-21: remake this sentence the sense is understandable but not easy readable. Maybe the brackets are not well positioned?

P2/R24: put a comma after “setting”

P2/R25: “data: The longest” uppercase after the colon. This is systematic in your paper but Mr. Google told me that is not usual: *‘Capitalization: First Word After a Colon. In British English, the first letter after a colon is capitalized only if it's a proper noun or an acronym; in American English, the first word after a colon is sometimes capitalized if it begins a complete sentence’*.

P2/R25: remove the acronym w.r.t. whole over the paper (lot of occurrences), use the full words instead

P2/R31-32: this sentence is a kind of repetition, can be removed

P3/R9: what do you mean with ‘sensor (type) extension’?

P3/R21-32: move&merge this block of text in the “research interest”-paragraph 2.1.
See also major comments n.3

P4/R4: please provide a most statistically significant MAAT, at least over the period 2008-2018. If possible provide also the mean annual precipitation (mm), seasonal extremes and other useful climatic informations. See also major comments n.3

P5/R22-25: ‘All the ... context’, already said at the end of the Chapter 1-Introduction... remove or merge there.

P6-P11: See major comments n.1&2

P12/R16-18: a description of section 5 is not pertinent here. Move it to the end of the chapter 1 or delete.

P12/R19: It would be very useful to have the figure 16 in this chapter, between table 2 and figure 6. This is important especially for the comprehension of caption in table 2 and remarks in rows 19-26.

P12/R20: ‘reliability’ in place of ‘availability’

P12/R23-24: ‘Therefore... paper’ is not necessary. This remark already rise up from previous sentences.

P12/R28-32: . Remove the first sentence that is well-known and move this block at the end of paragraph. That is, start the paragraph with ‘Since 2010...’

P13/R1: in Table 1 WXT520/536 is cited, while in text just WXT520. In fact WXT536 appears just in tab.1. Please fix this inconsistency or explain it.

P15/R7: define 'near surface' in terms of depth... 10cm?

P15/R8: explain the acronym NTC

P15/R12: please, add a reference to Tab.1 after 'used'

P15/R12: remove the last sentence, it is a repetition of row P15/R8-9

P16/Fig.7: this figure is not cited in text (notably paragraph 4.1). Anyway I guess it is not very relevant, I let you decide whether to keep it or take it off.

P16/R4: explain acronym ADC. Please add the drift values also for this sensor (if possible)

P16/R10: table 2 shows the depths of temperature measures in rock face and fractures but the indication of which of the 4 thermistor systems is used is missing.

To address this task you can label (as e.g. A,B,C,D) the ground temperature in Tab.1 (first column) and text in this paragraph (P16/R1-9), then call the same labels in the caption of Tab.2 like e.g.:
^aIntervention: Change of thermistor system from A to D. ^bIntervention: Change of thermistor system from B to C. etc... Tab.2 might become little more complex but more exhaustive and meaningful.

P17/Fig.8 and 9: due to the length of the time series, evaluate of enlarging the plots exploiting the entire width of the page while keeping fix the present height.

P19/Fig.10: same as above

P19/R2: bis → is. This sentence could be replicated in the table's caption.

P19/R4: remove 'here'

P19/R6: add a comma after 'rockfall'

P19/R13: remove the last 'remotely'

P19/R14: comma after 'active'

P20/R2-4: please, indicate clearly in the first sentence that what you call the 'primary' antenna, works as a master station with respect to the others and that it is located at point MH42/HOGR. At first glance, it was not easy to be sure of that. I know this will be discussed further in section 5.2, but it is better to have it here too.

P22/R17-18: check the English, the sentence sounds strange

P22/R22-23: this sentence can be omitted.

P30/R24: use acoustic emission / microseismic instead of AE/MS

P31/R1: See major comments n.1&2.

P32/TableA1: the reference to this table is missing in the text.