

Interactive comment on “Warming permafrost and active layer variability at Cime Bianche, Western Alps” by P. Pogliotti et al.

Anonymous Referee #2

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General comments This study is based on 7 years of observations from two boreholes and seven surface points on an alpine permafrost monitoring site at Cime Bianche (3100 m a.s.l.) in Italy. The aim of the study is to provide a first synthesis on the state and recent evolution of permafrost at Cime Bianche, focusing on: 1) to quantify the spatial and temporal variability of ground surface temperatures in relation to snow cover; 2) the small scale spatial variability of the active layer thickness; and 3) recent temperature trends in deep permafrost at the site.

The authors present an extensive list of existing and relevant literature in their introduction and try to put their work in a theoretical context. However, the Introduction in its present form is too long and unfocused. It is not obvious from the first paragraphs what their main research question(s) is. Why is it interesting? The introduction should

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summarize the relevant literature so that the reader will understand why you were interested in the question(s) you asked. In my point of view two to four paragraphs should be enough.

Both Data and Methods and Results are presented in an understandable way. The measured data are interesting and highly relevant for the research community - and relevant for the readers of The Cryosphere. However, and here is my main objections; several points from the interpretations and conclusions presented are well known from the existing literature. The presented analysis are quite simple and do not reach the level of most recent knowledge/understanding. The potential for new insight is large but not fully utilized.

The site in general appears to be reasonably homogeneous, but it should be both interesting and possible to do more in-depth analyses on how the timing and the duration of the snow cover influence your ground surface temperature data. In addition the influences of other variables than snow cover on ground surface and ground temperature variability should be analysed. I suggest that the authors make more sophisticated analyses to get new insights into e.g. how the spatial and temporal variability of ground surface temperatures are in relation to several of the climatic parameters they have measured at the site - such as air temperature, solar radiation and precipitation (influencing e.g. soil humidity) when the ground is not snow covered. And how does the inter-annual variability of both air temperature and snow cover influencing your observed warming trends?

In addition, I cannot see that your results supports that permafrost is “degrading” (see specific comments below).

A major revision is therefore necessary.

The English need some smoothing and corrections.

I have some more specific comments below.

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Specific comments

Title The (sub)region/term “Western Alps” may not be clear for all readers from e.g. America. I suggest writing “western European Alps”.

Abstract L2, P4034, L2: Suggest to include “Italian” or “the Italian side of the Western Alps”, e.g. write: “. . .permafrost at the Italian monitoring site Cime Bianche (3100 m a.s.l.), Western Alps.”

P4034, L3: ground temperature observations

P4034, L5-8: You write: “The analysis aims to quantify. . .(iii) the warming trend of deep permafrost temperatures”. Since this paper is the first synthesis on the state and recent evolution of permafrost at Cime Bianche, “warming” or “cooling” of the permafrost is a result itself. In L16-17 you conclude that: “The analysis of deep temperature time series reveals that permafrost is warming”. . . Thus suggest that you in L8-9 replace “(iii) the warming trend of deep permafrost temperatures” with “(iii) recent (or present?) temperature trends in deep permafrost”.

P4034, L11-13: Is the accuracy in your measurements so high that the use of one centimetre can be justified here? As far as I can see the spacing of the thermistors around the ALT in DP is two meters! The use of a simple interpolation between two thermistors having two meter spacing for the determination of ALT based on the 0-isotherm. introduce a quite large uncertainty.

Data and Methods P4039, L5-6: Did you do any calibration of the thermistor chains before installation? As far as I know such thermistors have +/- 0.1 degC accuracy without calibration. Some additional information about this would be useful here. You also mention sensor noise at P4041, L12-13. The whole setup with datalogger and possible external noise sources etc. should be included when talking about absolute accuracy.

P4040, L20-26: Please give some additional information about accuracy of the ALT

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determination used here (cf. my point above (P4034, L11-13)), in the light of especially the spacing of your thermistors and their accuracy.

Results P4046, L18-21: Did you compare this tendency with climatic data, e.g. air temperature and snow cover? Variable snow cover may be responsible for some of the interannual variability observed in the upper permafrost layers, but also for the observed warming trend at greater depths.

P4046, L27-28: During some warmer years or under/after a longer warm period the warming rate will always be higher near the upper permafrost layers than in the deeper part. Thus, please rewrite this sentence.

P4047, L5-6: I cannot see that your results supports that permafrost is “degrading”. The term “Permafrost degradation” is normally expressed as a thickening of the active layer, a lowering of the permafrost table, a rising of the permafrost base, or a reduction in the areal extent or the complete disappearance of permafrost”. Thus I suggest to better write: “. . .that permafrost at Cime Bianche is warming and that significant positive warming rates are reported at all depths”.

P4054, L26 to P4055 L8: This is also reported from several other studies, which are included by the authors in their reference list (see my general comments).

P4055 L11-12: I cannot see that your results supports that permafrost is “degrading” (see my previous point. And “observed warming rate exponentially decreasing with depth” is the normal case, and should not be a surprise.

Table 2, P4066: ZAA with two decimals – can it be justified? Here the spacing of the thermistors is one meter (see my previous points).

Figure 5, P4071: Especially the minimum profiles are not very smooth. How do you explain this, in the light of the apparently high accuracy of your measurements? Is it real and may be due to lithological contrasts, or variable ice-and water content and/or latent heat effects? Or is it due to non-calibrated thermistors (cf. my point at P4039)?

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