

## ***Interactive comment on “Temperature variability and thermal offset in steep alpine rock and ice faces” by A. Hasler et al.***

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Like the paper by Gubler et al (in this issue) the study by Hasler et al. is a very valuable contribution, highlighting ground temperatures (GT) variations over short distances in steep alpine rock walls and ice faces. An impressive field set up is presented, with 17 sites and ground temperatures down to more than 1 m in rock and clefts, and 5 m depth in ice patches. The data set show high variability of ground temperatures depending on elevation, snow cover, cleft density and exposition. Some major findings are described, e.g. the role of cleft ventilation and shallow snow cover in cooling the mountain sides compared to vertical rock walls. This makes this study to a major and valuable contribution for the community, and highlights especially the high spatial variability in mountain environments in relation to spatial permafrost models, which

normally operates with much coarser space discretisation schemes.

However, there are some minor to major issues that should be addressed before publishing, which I think would increase the value of the paper. In the following, I will give some from my view important points for potentially addressing during the revision, while minor issues I have marked directly in the pdf and uploaded as supplementary information.

1. Abstract: Give main results there, no “for instance”.
2. Give a key map, with site location in Switzerland, and the location of all the names you use in the paper.
3. Introduction: It is rather long, and much of the last paragraph might be better within the “Discussion”.
4. Consider to join chapters 2 and 3, and call it “Methods and data pre-processing”, and try to reduce it in size a bit.
5. Error propagation (eq. 1): Very nice to address the uncertainties through the error propagation law. However, you should mention that  $U_{mat}$  and  $U_{to}$  increases if some of the parts included in eq. 1 are correlated with each other, following the general error propagation laws.
6. About filling data gaps: Why not using some sort of simple or multiple regression to data series with no gaps, to produce a series there, with a measurable level of confidence?
7. TO: I think this approach of data analysis is nice and very valuable. In relation to former publications, the TO of course is an equilibrium term, averaged over e.g. a normal period, and TO has inter-annual variations. However, the value is a significant measure to address ground thermal processes. In Fig. 8 you give TO as absolute differences, but the depth over which the differences are calculated varies as far as I can see (e.g. for the firn deeper than for the holes). Either calculate the TO over the

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same range of depth, or give normalised values, e.g. °C/m. You can evt. Make to figures, one for the 1 m depth and one for the 5 m depths.

Further: You are aware that the TO is related to TTOP (Temperature of top of permafrost) in literature. As far as I can see, your deepest loggers are not on top of the permafrost. Maybe the expression TO is then a bit misleading (as you discuss in the introduction), and should be re-considered to e.g. “thermal gradient” or  $\Delta$ MGT or so. The message would be the same. You discuss this matter in the introduction, however, as literature clearly discusses extensively the TTOP-approach, the terms should be used according to that. If you re-consider, the title should be changed by substituting “thermal offset” with e.g. “thermal gradient” or “temperature differences”.

8. Discussion: The discussion is relevant, however, partly difficult to follow. I would suggest to re-structure or sub-divide the discussion in a technical discussion (accuracy, representativeness etc) and a scientific discussion (T-gradients, causes for the variability, implication for numerical modelling etc.). AND: You use some space to address the uncertainties etc. Why are they not further discussed?

9. Conclusions: Relevant conclusions, very nice. However, the last paragraph on p. 738 is a discussion and should be treated as that.

10. Finally, the use of the temperature abbreviations, MAT, MAAT, MAGT, MAGST, TO,. I was a bit confuses how you define all this terms, and what is what. You should systematically go through your text and address this matter, and, when used the first time, give the full name and explanation.

Please also note the supplement to this comment:

<http://www.the-cryosphere-discuss.net/5/C256/2011/tcd-5-C256-2011-supplement.pdf>

Interactive comment on The Cryosphere Discuss., 5, 721, 2011.

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