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The Cryosphere Discussions

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5, C181–C184, 2011

Interactive Comment

Interactive comment on "Scale-dependent measurement and analysis of ground surface temperature variability in alpine terrain" *by* S. Gubler et al.

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This contribution is a good example of how the current availability of cheap miniloggers can be used to address pressing scientific questions. The problem of scale is one of the current larger questions in geomorphology, and it is has lately also received some attention within periglacial geomorphology - especially within the GIS/environmental modeling part of that community.

I find the approach used here a very valuable contribution. It shows convincingly (but not surprisingly) that both small-scale and larger-scale variability of mean ground surface temperature is substantial; which calls for caution when model outputs are compared with measurements (or when measurements are used to calibrate models.

I have made a few specific comments in the text - uploaded as a separate file. My more general comments regarding potential improvements follow here.

The general aim of the paper is somewhat vague, stated as "to obtain and analyse a spatially-distributed and dense GST dataset in an alpine environment". This is achieved, but the problem is how this information is intended to be used for larger scientific questions. It is not quite clear whether the paper focuses on technology/methodology/the theoretical issue of scale, or science. The discussion doesn't help much in this respect, providing more of a summary of results than real assessments and conversations with other studies elsewhere, especially outside of the Alps. As I see it, the obtained information should be stretched into either a more theoretical discussion of scaling issues, or towards consequences and recommandations for permafrost mapping and modelling.

With respect to experiment design, two spatial scales are investigated - intrafootprint (10x10m) and interfootprint (some km2). This choice is clearly relevant to address typical spatial scales and sources for variability encountered in pemafrost mapping, but maybe less so in a general discussion of scaling relationships. A choice has for instance been made NOT to investigate the range of spatial autocorrelation, maybe based on knowledge of these effects from earlier BTS measurements, but this could have been commented more. A more regular nested sampling design may also have provided interesting data.

The sources of variability is another issue that could be discussed more. As I see it, the GST is a complex function, probably exhibiting deterministic chaotic behaviour due to the interactions between snowcover, vegetation, water availability, soil type and terrain, and their effects on the energy fluxes. Thus, any picture (of GST variability)that emerges at the footprint scale for typical ground conditions is very helpful to aid the researcher where to be cautious and to address this small-scale variability in GST in

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future model calibration or validation. Further, the parameterization of GCT is very briefly presented. I get the point with using a dummy variable, however the different GCTs that go into the model - what are they?

The multiple regression models are a nice outcome of the study. However, we do not know anything about how general these relationship are. All data go into the model construction, and the power of extrapolation to new data therefore remains unknown. Especially the model for footprint variability may be promising, as this gives important hints regarding sources of error when calibrating or validating permafrost models. However, as with all regression models, the physical relationships between the predictor variables and the model outcome should be discussed.

An important point is the outcome of the study in terms of how these results may improve permafrost modelling. As ground temperatures are effectively filtered both in the temporal and spatial domain, I am not certain that the consequences are large. Of course, large scale permafrost models are driven more by large scale forcings, such as MAAT, while smaller scale or more detailed grid-based models can incorporate the effects of terrain parameters other than altitude etc. Even with detailed information, incorporating effects of sub-grid variability, there will always be extrapolations involved in the models - with additional and unknown problems involved. Permafrost models should serve two purposes: screening and experimenting. In the first case, the initial screening must be followed up with more detailed field measurments anyway. In the second case, running a permafrost model involves an experiment - first directly relating to investigating energy flux - ground coupling (testing our knowledge of physical or empirical relationships involved in permafrost distribution and its transient behaviour) and then (providing such proper knowledge exists) for instance for coupling GCMs and long-term fate of SOC in permafrost areas. In doing experiments, clear knowledge of errors are vital, but the scale of the experiments are also important, and your type of data may be most relevant in high resolution studies. Thus, a clearer discussion of relevance, coupling to permafrost models (or other relevant environmental models, e.g.

ecological models) etc. would benefit the paper and serve the interesting approach more justice.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/5/C181/2011/tcd-5-C181-2011-supplement.pdf

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Interactive comment on The Cryosphere Discuss., 5, 307, 2011.

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