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Earth Surface Dynamics
Discussions
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Interactive comment on "A two-sided approach to estimate heat transfer processes within the active layer of rock glacier Murtèl-Corvatsch" *by* M. Scherler et al.

Anonymous Referee #3

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General comments:

A system for computing the volumetric energy balance of the rock glacier from measurements, including radiative and turbulent energy transfer within blocky debris, and change in heat storage is presented here. This is an interesting step forwards in developing modeling approaches suitable for permafrost bodies with coarse surface material. The energy balance results are compared to those from a permafrost model (COUP) that does not explicitly account for these processes, but introduces and heat sink/source term to encapsulate these excluded processes, and in contrast to the measured energy balance does account for freeze/thaw in the medium. Thus the results of the two approaches are not directly comparable, but both offer useful tools to develop

our understanding of the system.

A comprehensive, and well-written introduction to the topic is given, and the whole paper is well written and presented, and I recommend it for publication once the following points have been addressed:

(1) The aim is stated to compare two approaches that are not really directly comparable. I think this might be better stated by the following chain of arguments: (a) existing energy balance formulations do not account for the complex surface of block materials, (b) that is addressed here by developing a volumetric energy balance, (c) existing models do not account for all the energy exchange processes (d) a method to account for these by adding a sink/source component is examined here, (e) the results of both methods and relative strengths/weaknesses of the approaches with respect to different applications are discussed. The reason I suggest this is that your paper is focused on improving both measured energy balance and modeling approaches at the same time, and on the first reading I was a bit unclear about this duality.

(2) I would like to see some assessment of the errors associated with the parameters and correction factors included in the volumetric energy balance included (reduction factors, geometrical corrections etc.)

(3) I can see it is difficult to make direct comparison between the results and relative deviations, due to the different structures of the model to the measurements. So I understand you have presented the energy balance with seasonality of the model sink/source layer, but is there a different emergent seasonality in the energy balance measurements, or does that conform wel to the seasonality defined by the COUP results? I'd also like you to try and add a bit more explicit detail on what processes you think are causing deviations in the different seasons. This might have to be partly evidence based speculation, but would be a useful addition for non-expert readers in terms of determining the relative strengths and weaknesses of the two approaches in different seasons or environments.

Specific comments:

P142/L6: (sp) discontinuous

P145/L21: (sp) comparison

P147/L9: what is the timestep of this calculation? 30 minute? Daily?

P149/L13: (sp) Therefore

P150/L4: is there any field data upon which the assumed snow density is based?

P150/L17: is it possible to add a comment on how the exclusion of these processes could be expected to affect the results? E.g. relative over/under estimation in freeze or thaw times. Then you could return to that more explicitly in the discussion section of seasonal energy balance differences with the model data?

P150/L22: is the 3.55m temperature actually 0°C during this period in the measurements? Why use a fixed value instead of measured temperatures?

P152/L18: density assumed to be 40% in this case, but in section 2.3.4 ground heat flux was reduced by a factor of 1/3 to account for air filled voids – does that not imply that the ground heat flux reduction is assuming a porosity of 30%?

P153/L17: What is the timestep of the model versus the measurements?

P154/L1: detail here that the layer is 1m thick, and its location with respect to the surface. Also perhaps add some information on why this layer placement was chosen.

P154/L10: Which 2 depths was it optimized to? Can you explain the optimization procedure more explicitly – minimized RMSD on a daily basis, or it is something else?

P154/L19&20: 'Figure X shows. . .'

P155/L22: This is really interesting that you need the additional sink/source component to create permafrost conditions.

P158/L22: Was the additional 5° geometrical correction optimized through any procedure? What does it look like with no additional factor (i.e. 10° slope) or a larger additional factor? You mention that large errors could be associated with this unknown term so it might be nice to quantify the impact of these errors on the net radiation and total energy balance.

P157/L1: did you screen the met data for snowcover on the upper sensor? In data sets I have looked at it is usually possible to identify these cases when the lower sensor registers higher radiation than the upper sensor, and these can then be 'corrected' on the basis of an assumed fresh snow albedo.

P157/L5: I am not clear how the low wind speed would lead to discrepancies, as the measured low wind speed is an input to the model. Perhaps I have missed something here? Is it associated with the comment on P161/L7 which refers to a low wind speed sensible heat flux enhancement factor within the COUP model?

P158/L20: Is it possible to just briefly mention what this work was? P159/sect 3.1: Can you add a comment on the potential role of lateral transfers which are not included in either approach as far as I can understand?

P160/sect 3.2: Did you experiment with different sizes and placement of the sink/source layer – if so what was the impact of that and why did you chose this structure in the end?

P162/L10: (sp) from

Fig 1: very useful figure to understand the differences in approach.

Interactive comment on Earth Surf. Dynam. Discuss., 1, 141, 2013.