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Interactive comment on "Resolving the influence of temperature forcing through heat conduction on rockglacier dynamics: a numerical modelling approach" *by* Alessandro Cicoira et al.

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This manuscript models and discuss rockglacier flow and related seasonal and inter-annual variabilities by using a 1-D numerical flow model including thermal heat conduction. The model is forced by given temperature data below the active layer. Temperature data gaps were linearly interpolated. The main result shows that the overall flow velocities on an annual resolution is well simulated. However, seasonal and inter-annual variations are strongly underestimated. The authors conclude then that the heat conduction alone is not able to explain the variations and therefore non-conductive processes such as the presence of water must strongly influence the flow behavior.

General comments: This study is elaborated very carefully using a simple flow model and driving the model with available input data from the existing PERMOS network. I appreciated very much the very careful and critical discussion of their results. In general, the paper is written very concise and clear. I have only some minor points, where I suggest some small changes and additions in the paper. I would particularly enjoy when the authors would include some additional past literature and discuss them in relation to their obtained results being aware that the modelled time domain does not overlap with some past studies. However, for the discussion part this would may help to improve some interpretations.

Specific comments:

Page 1, Line 15: Please add here relevant reference: Barsch and Hell (1975). This paper is in my opinion more important than other papers mentioned here as it is directly related to one of the investigated sites of the authors.

Page 2, Line 18-19: Some earlier studies already investigated these effects, particularly on rockglacier Murtèl. (e.g. Hanson and Hoelzle 2004, Schneider et al. 2012, Scherler et al. 2014). Particularly, the paper of Schneider et al. shows clearly also that the thermal response within the active layer is very fast and is decoupled from pure heat conduction. This is especially true for the cooling process.

Page 3. Figure 1c: The borehole is according to my knowledge not at the correct place on this image. Please correct. see also paper by Hoelzle et al. 1998 describing the measurements in the boreholes at Schafberg.

Page 4, Table 1: Please explain in more detail what 'bottom temperature' mean. For example at Murtèl the total borehole thickness is about 58 m and you probably mean the temperature at 27 m depth exactly at the shear horizon. It would be nice, if the values in this table are referenced exactly with the corresponding literature.

Page 4: Line 10: Please add information also from the following reference: Herz et al.

(2003).

Page 4, line 14: here also the first model approaches by Wagner (1992) could be mentioned.

Page 5, line 1: Here many further and older relevant studies should be noted such as Kääb et al. (1998), Kääb (2002), Kääb et al. (2003).

Page 5, line 3: better to cite here the relevant papers in this context such as Arenson et al. (2010), Hilbich et al. (2009).

Page 5, line 8: The analysis of the mentioned time period was done by Arenson et al. 2002 and not in Haeberli et al. 1998.

Page 5: line 14: please have a look also at some older studies, which give some details about the old deformation measurements at the Schafberg site in relation to photogrammetric analysis (Hoelzle et al. 1998).

Page 5, line 23: Please add: Vonder Mühll and Schmid (1993).

Page 6, line 7: this is only partly true as in some papers is shown that also this rockglacier is highly inhomogeneous such as reported in Arenson et al. (2010) and ground water is influencing the thermal regime in a depth of about 58 m: Vonder Mühll (1992)

Page 6, line 27: here maybe some more sophisticated gap filling could be used such as proposed by Staub et al. 2017.

Page 7, Figure 2b: why are at the beginning of this time period no differences plotted. data seems to be available?

Page 8, line 17: how you know the slope of ice surface without using the existing geophysical measurements?

Page 8, line 23: this is maybe not true at all sites e.g. at the borehole at Schafberg. We were never sure if the borehole was really fixed in the lower part.

Page 8, line 23: use spatial instead of special

Page 9, Figure 3 and line 5: please give full references instead of just mentioning 'proposed by literature'

Page 16, line 2: text is missing? You mean results are discussed?

Page 16, line 3: Temperature modelling -> delete s

Page 16, line 5: you could use approaches of gap filling according to Staub et 2017

Page 16, line 18 and page 17 line 1: I am not convinced if this explanation is reasonable. When we know that rockglacier Murtèl is probably the coldest of all rockglaciers, I would first assume that water may play a less important role at Murtèl than at the other rockglacier which are warmer.

Page 20, line 36: However, at Schafberg all this information (deformation, geophysics) was already published. Please refer to this literature mentioned already above.

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