The Cryosphere Discuss., 5, C1698–C1700, 2012
www.the-cryosphere-discuss.net/5/C1698/2012/

The Cryosphere Discussions

Interactive comment on "Modelling the temperature evolution of permafrost and seasonal frost in southern Norway during the 20th and 21st century" *by* T. Hipp et al.

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Received and published: 11 January 2012

This manuscript has been rejected with the encouragement to resubmit an improved version as outlined below. The new version is available as manuscript "Modelling borehole temperatures in Southern Norway - insights into permafrost dynamics during the 20th and 21st century".

In the interactive comments and the revised submission, the authors have resolved many of the issues raised. Several important open questions concerning the reliability of the analysis, the clarity of its design and its description remain. The present quality of this manuscript is not sufficient for it to be published in The Cryosphere. There is,

however, great merit in this investigation and I encourage the authors to resubmit an improved version at a later stage.

The open issues can be summarized as:

(1) Uncertainty due to n-factors: In the rebuttal the authors write "However, these two years are extremely different in relation to the last 10 years we have measurements at the site. So, the variations are likely to be lower than shown here,..." and in the revised manuscript "The mean nF- and nT-factors from 2008 – 2010 (Table 1), are well within the variation of the period 1999-2009.". Based on the text, neither statement is supported as far as I can retrace it. Juv-PACE has only values in period S1. Juv-BH5 is in S1 and S2 for nf and nt OUTSIDE the variability given for the ten years. This is strange, since the analysis of Isaksen et al. 2011 and of the manuscript overlap by one year. The difference between S1 and S2 (nf: 0.09, nt: 0.03) for Juv-BH5 is only 12% (nt) and 15% (nf) of the total range between the highest (nf: 1.04, nt: 1.30) and lowest (nf: 0.29, nt: 1.10) values reported. The subsequent analysis reported in Table 5 is thus at the very least to be treated with great care but should likely be repeated with more strongly altered n-factors.

(2) Temporal granularity: The temporal granularity of the driving data is variable. The n-factors are derived from daily data and the scaling of FDD and TDD to monthly granularity must be discussed at least.

(3) Comparison of measured and simulated temperatures: P20L31: "Nevertheless, even with the stated simplifications, modelled GTs agree well with observations and the present borehole temperature distributions are reproduced when simulating the evolution since 1870. We suggest therefore, that the simple modelling approach is capable of capturing the dominating processes within the time scale considered." Currently (P10L6), this cannot be judged because initial conditions for validation are prescribed from the boreholes. It should be demonstrated by comparing a profile simulated since 1870 with a measured one. This would also reveal better the errors introduced by

two-year n-factors or material properties.

(4) Spin-up and Fourier fit: (a) It is still unclear to me, what was done during spin-up. What parameters did you fit? What cycles were reproduced? Daily? Seasonal? (b) Step 1 is unnecessary if you spin step 2 until steady-state as indicated P10L19. (c) "visible GT changes" are not a reproducible criterion. This is a simulation and you can use a threshold.

(5) Borehole-to-area scaling: In your introduction where you declare the aim of the study and in other sentences (P15L13, P18L14, P20L11), you extrapolate from the borehole locations you simulate to an entire mountain landscape without consideration of the scaling involved.

(6) Validation: "... as close as possible correspondence...". This still does not allow to judge, what quality is needed or to decide between valid and not valid.

Interactive comment on The Cryosphere Discuss., 5, 811, 2011.