The Cryosphere Discuss., 6, C173–C178, 2012
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The Cryosphere Discussions

Interactive comment on "Modelling borehole temperatures in Southern Norway – insights into permafrost dynamics during the 20th and 21st century" *by* T. Hipp et al.

Anonymous Referee #2

Received and published: 24 March 2012

GENERAL COMMENTS

The manuscript presents the results of the application of a 1-D heat conduction model for investigating permafrost evolution in 3 mountainous areas in southern Norway from the Little Ice Age to 2100. The model is calibrated and validated using ground temperature data from several boreholes located along an altitudinal transects. The paper provides interesting insights on future permafrost conditions (ground temperature and active layer thickness changes) in Southern Norway. The manuscript is generally well written. Aims and motivations of the paper are very interesting.

An additional effort should be done to improve the structure and organization of the

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paper and to clarify some sections (especially site description and methods) and to increase the overall readability of the paper. Moreover figure order is difficult to follow and confusing: figure references in the text continuously jump back and forward.

I suggest manuscript publication after the above mentioned and following more specific major issues are addressed:

SPECIFIC COMMENTS:

P342L7: you mention 13 boreholes and in the paper (tab 1 and tab 3) you show data from 9 boreholes.

P344L3-L8: move this paragraph before P343L19. You are generally describing your approach/method which should be presented before the major aims of the manuscript.

P344L5 / P344L13: 13 boreholes or the 9 presented in tab1 and tab3? Why Juv-BH5 which is presented at P360 is not in the tables? If you add Juv-BH5 to the boreholes in tab1 or tab3 you get 10 boreholes. Which are the other 3?

P345L1: you cite six boreholes + PACE (which are shown in Fig 1) but in the following lines you present only BH1, BH3, BH4, BH6 (the same listed in tab1 and tab3). P345L5: you cite 3 boreholes (which are shown in Fig 1) but in tab 1 and tab 3 you only have BH1 and BH3.

P345L10: you cite two boreholes (being consistent with table 1 Tron BH1 and BH3) but Fig 1 shows 3 boreholes.

P345L10: you are presenting the sites in the order Juv/Jetta/Tron. It's rather easy to get lost in boreholes acronym throughout the paper so, in order to help the reader, try to respect this order in all section, figures and tables (or chose the order you prefer but then respect it).

P345L22: The "entire period". Which period? There are many time interval considered in the manuscript, so be more precise. Maybe you should say "the period used for

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model calibration was divided ..."

P346L20: lower boreholes (Tro-BH2). Indicate also the acronym in order to help the reader to become familiar with your boreholes.

P346L27: Jet-BH2 is not in tab 1!!

P346L27: the uppermost borehole . . . add also the acronym (?Jet-BH1?) in order to help the reader to become familiar with your boreholes.

P347L8. Figure order. In the previous section you present information that are in figure 3. Here you present data that are plotted in figure 2. Consider the idea to change the order of figure 3 and figure 2. Figures order should follow the order with which they are introduced in the manuscript.

P347L11. Why 1640 m asl ?

P348L21: you should start this section with a sentence that explains your objectives: which data do you want to reconstruct for the past and which mains steps you follow. Then go into the details of each methods.

P348L21-P349L6: this part is unclear.

P349L7: MDAT ? I guess it's mean daily air temperature but you should define this acronym P349L15: does the RMSE has a seasonality?

P350L1: lapse rate do not change in time? As you are using lapse rates observed in the period 2008-2011 to reconstruct data back to 1870, try to find some references that address this topic and authorise you to assume that lapse rate over more than a century does not change.

P350L17: the reference to fig8 a) is not necessary and not so clear.

P351L3: you used reconstructed and future air temperature data together with n-factors to derive GST values. Explain how you computed daily/monthly GST data from

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n-factors. Inverting eq5 and eq6 you only get FFDs or TDDs. How you get daily/monthly GST values form annual sums of thawing/freezing degree days?

P353L25 This section should be shifted in the results.

P353 GT modelling and figure 7. You present ME values as means at all depths. Which is ME variability with depth?

P353 Does ME have a seasonality?

P355L25: what happen at Jetta?

P356L11: you present Juv-BH6 results which are not in figure 9.

P356L13: define what "permafrost degradation" is and how you define it's relation to ALT increase as you are showing and discussing ALT increase data.

P356L26: until 1990. why 1990? you said that your analysis periods were 1860-1999 and 2000-2010.

P357L7 you should explain why Fig 3c indicates the possible beginning of a talik development and how this concept is related to the definition of permafrost degradation.

P357L13 Why are you only presenting results for Juv-BH1 and Juv-BH4? Consider the idea to select 2 boreholes for each area and add a plot that show GT data presented in section 4.2.2 and in section 4.3.1

P359L21. Discuss the effect of this interesting sensitivity analysis also on ME.

P360L18. BH5 results are never mentioned or shown before in the manuscript (at least after a quick search – BH5 is only cited in P360 and in the Acknowledgements). You just introduce this Juv-BH5 in the discussion. As you are generally discussing the effect of constant SWC and 3-D effect, I do not think that it's necessary to cite Juv-BH5 whose data and results are not presented in the manuscript.

P361L19 do you show somewhere the results of this important test? If not insert here

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in the text summary statistics (ME, RMSE).

P362L16 inter-annual change of ALT is computed as the mean of the yearly anomalies respect period (1860-2010) mean?. Do you get similar results if you compute inter-annual change of ALT over the two periods you used in section 4.2.3?

P364L21 which 13 boreholes? See my previous comments P344L5

P365L6 move this paragraph after P366L2

P365L19 move this paragraph after P366L2 (this should be the last one)

P373 table 1: change line position below Juvasshoe

P377 figure 2: panel a and b should have the same x-axis

P381 figure 6: show also a Tron plot

P381 figure 6: shaded areas are not enough shaded

TECHNICAL CORRECTIONS

P342L19: consider the idea the insert a "," after particular

P343L21: consider the idea the insert a "," after sediment cover

P343L24: "in the high-mountain environment of Southern Norway." You already said this at L21

P345L13: consider the idea the insert a "," after boreholes

P345L13: insert GST measurement depth

P346L1 MAAT range: I guess this is a spatial range (between boreholes). If yes specify it.

P347L13 consider the idea the insert a "," after period

P347L15 . . . on average by 1.4°c . . . is "by" correct?

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P347L16 . . . the winter 2008-2009 . . . this a part where the reader could easily get lost; help him being consistent: use S1

P348L22 change (Hanssen-Bauer and Nordli, 1998) with Hanssen-Bauer and Nordli, (1998)

P349L14: regressions between measured temperatures . . . add the period (2008-2011)

P350L16: specify the regression period (2008-2011)

P356L11: insert a reference to Fig 9 at the beginning of this paragraph

P356L13 remove other boreholes an cite directly Juv-BH1 and PACE: . . . increase in ALT at Juv-BH1 and PACE was only +0.2 m (24 %, +0.1 cm yr−1) and +0.7 m−1 (54 %, +0.5 cm yr) respectively (Fig. 9a)

P377 figure 2 caption: (b) Monthly air temperature . . .. add “air”

Interactive comment on The Cryosphere Discuss., 6, 341, 2012.