

## ***Interactive comment on “Simulated high-latitude soil thermal dynamics during the past four decades” by S. Peng et al.***

**Anonymous Referee #1**

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General comments:

Peng et al. compares simulated change in soil temperature from 1960 to 2000 with nine process-based land surface models which are forced with historical data. Through a set of additional factorial simulations the effect of different forcing variables on soil temperature is explored as well as the uncertainty contribution from forcing versus model structure (and parameters). Finally, they study present estimates of how much the near surface permafrost area has decreased in this period and its sensitivity to soil temperature.

Altogether it is my understanding that this study presents new results which fits with the scope of The Cryosphere. The aim is clearly stated and the manuscript is with few exceptions well written and logically structured. However, the discussion should in my

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opinion be deeper on some points before the conclusions can be drawn. Also, it seems that the spread in model results is not always reflected in the text and not shown on certain figures. I therefore recommend the paper to be published in The Cryosphere after major revisions.

Specific comments:

I would have liked to see a deeper discussion about the differences between the models and to what extent this can be assumed to represent the uncertainties in our understanding of the actual system. This issue is briefly touched upon in the last part of the conclusion, but should in my opinion be expanded, and be discussed before conclusions are drawn.

The discussion of the different drivers of trend in soil temperature (section 3.3) does not reflect the importance of the different variables. In particular the importance of  $T_a$  and the spread in sensitivity to this variable should be discussed more. For LWDR it should be more clearly stated that this is based on only two models, which does not have a representative sensitivity to for instance  $T_a$ . This should also be reflected in the conclusions about which variables are most important in driving  $T_s$ .

The statement that in UW-VIC “nearly 100 %” of the trend in soil temperature can be explained with  $T_a$  (P2310 line 17-19) does not reflect the results presented in table 3.

Figure 4 and 6 seems to show a too narrow range of values, excluding the extremes. This is clearly also the case in figure 5, but here I think it is sufficient to include a note about this in the figure caption.

P2306 line 25: The term “some of their non-linear interactions” should be explained better.

Technical comments:

P2306 line 6: Either “hereafter” or “in the following” should be sufficient.

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P2306: The sentence starting with “To separate . . .” is not very fluent. Dropping the “:” and writing the variables in a parenthesis would make it clearer.

P2307: I found the sentence starting with “if the maximum soil depth. . .” hard to understand. Please clarify.

P2307 line 7: differenced => differences

P2307 line 27: Wei et al. 2013 not found in reference list. Is it Wei et al. 2014?

P2308 line 3: which “seven models”?

P2308 line 22: Unclear sentence.

P2309 line 8-9/Figure 5: why is CLM only showed down to 35 m?

P2309 line 12-13: Please elaborate on the negative trend seen in UW-VIC below 2.5m.

P2311 line 12: Please rephrase. Does not all show trend since 1960?

P2311 line 14: is => are

P2311: Please rephrase last sentence.

P2315: Please rephrase first sentence.

P2315 line 7: Lawrence and Slanter et al. 2013 => Slanter and Lawrence 2013 ?

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Interactive comment on The Cryosphere Discuss., 9, 2301, 2015.