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Interactive comment on "Effects of short-term variability of meteorological variables on soil temperature in permafrost regions" *by* Christian Beer et al.

Anonymous Referee #2

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The manuscript by Beer et al discusses the role of changes to variability in weather rather than mean climate in governing soil temperature change in the northern high latitudes. The result is that reduced variability is likely to lead to (a) increased snowpack via less frequent melting events, and (b) changed bryophyte thermal conductivity. The authors then take the inverse of this argument to argue that the response under warming is likely to be an increase in the variability, and thus a decrease in snow packs, and thus a reduction in the rate of soil to air warming. The implication of this is that anomaly forcing methods may therefore lead to some biases in the response, although I am not totally clear after reading the paper how important this bias actually is. Nonetheless it is an important point to make and consider.

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The article is interesting, well-written, and worth publishing. The basic outline of the argument makes sense, although it would seem simpler if the argument were streamlined to take as a reference case one where variability were held constant and mean values changed in the future transient, and this were compared to the case where both transient means and variabilities were taken from a GCM, as this would not require the change in signs that the current argument requires. I also don't understand why the transient cases were not run globally. This would allow us to more quantitatively estimate the magnitude of the bias as well, rather than having to use the qualitative comparison in the paragraph lines 409-423. So I'd suggest that the authors try to explain why they didn't follow such an approach here.

Minor/specific points:

What are the units in figure 4a ? if unitless, what scale are they relative to – i.e. (T_redvar - T_control) / T_control would be different if in K or C...

The colorbars are really confusing. The same yellow-green-blue colorbar is used throughout, even though each instance of it is being used for a different purpose. I.e. in figure 4, the colorbar is being used for a divergent quantity, but the zero point is in a different point of the colorbar in the two panels. Then in figure 5, the same colorbar is being used for a non-divergent scale, but with two very different gains. Then in figure 6, the same colorbar is used again, but now the zero is at the bottom of the colorscale rather than the top, etc. This sort of thing is really confusing for a reader who must recalibrate their expected color with each new figure. Please try to stick to a convention where you only use one colorbar for one purpose, different types of colorbars for divergent and nondivergent scales, and if you show something with different units, then please use a new and different colorbar. At an absolute minimum, please just keep zero in the same place for each figure.

In figure 6, why isn't the land/ice mask consistent over greenland between the panels?

For figure 10, it looks like the range of variability is reducing quite a bit in the control

case. this is clearly the case with temperature, and most likely the case with precip if expressed relative to the mean value (which, it should be pointed out given the motivation on line 160, is how anomaly forcing for precipitation is applied). and the same appears to be true in figure 11. if this is generally the case, doesn't this undercut the whole argument of the discussion section, which starts out by positing that variability will increase rather than decrease?

For figure 10, how do you compute the 1st and 99th percentiles of annual mean data when you only have a single timeseries that spans a 100-year transient run?

One thing that is missing here that would help the reader assess the importance of the problem is how large is the change in permafrost area, or active layer thickness within permafrost area? Such figures would have required a transient, global reduced variability run. Why couldn't such a run have been produced?

I don't follow the argument on line 436 at all.

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