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Climate of the Past Discussions

Interactive comment on "Influence of radiative forcing factors on ground-air temperature coupling during the last millennium: implications for borehole climatology" *by* Camilo Melo-Aguilar et al.

Anonymous Referee #1

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The manuscript presents a rather detailed investigation of the coupling between air-surface temperature and ground temperature in a series of climate simulations over the past millennium with an Earth System model. The analysis is focused on two main aspects: their co-variability and inter-annual time scales and their relative trends over the period of anthropogenic warming. The main conclusions are that in general terms bot variables are strongly coupled, but with regional particularities. The main mechanism that modulate the coupling is snow cover. Considering the long-term trends over the past century, varying snow cover due to warming causes a change of the

coupling over time that should be taken into account when using ground temperature from boreholes to reconstruct past near surface-air temperature. Deforestation over the past century also affects the coupling between surface temperature and ground temperature.

In my view the manuscript is very well written,and I have just a few minor suggestions that the authors may want to consider.

- Sometimes, the text is a bit too wordy, with long paragraphs that pack a lot of information. This is admittedly a matter of style, but I guess that a typical reader would prefer some of the very long paragraphs broken up in smaller pieces, so that, after a first reading, the information can be located more rapidly if needed.

- The explanation of the negative correlation between air temperature and ground temperature in Tibet is intriguing, but I am not sure whether it is complete. The authors argue that the intermittent heat flux - modulated by seasonal snow cover - can cause a negative correlation between the *time derivative* of both temperatures, but does this translate in a negative correlation between the temperature anomalies themselves ? This may be true depending on the spectrum of the temperature variations. If the spectrum is white, i.e. little multidecadal variability, I can see that this explanation can be correct. However, if the temperature variations are mostly decadal, changes in the time derivative of temperature may not be enough to change the sign of the temperature anomalies. All in all, I found this mechanism interesting, but I am not completely sure that it is the sole explanation. Unfortunately, I cannot suggest new ideas.

Other minor points:

- 'Improving our knowledge of the LM climate variability' LM has been defined in the abstract, but I think not in the main text

- The second, postulate is that variations in SAT propagate downward to the subsurface through conduction (Pollack et al., 1998; Smerdon et al., 2003,

Delete comma after postulate

- 'In the present work the LM refers to the period from 850 to 2005 CE while the periods from 850 to 1850 and 1851 to 2005 CE refer to pre-industrial and industrial, respectively. 2 m air temperature is used for SAT and the first land model level..'

I my understanding, a sentence in English may not start with a number. Change to 'two-meter temperature..'

-CESM-LME supports the assumption that SAT is tightly coupled with GST at global scales and above multi-decadal scales. May be change 'above' to 'longer than multi-decadal temporal scales'

- 'the thermal difference between SAT and GST. In order to explore the influence of such processes on the global SAT-GST relationship this analysis is extended considering winter and summer seasons (DJF and JJA hereafter) independently (Fig. 1c,e).–

Specify boreal summer and boreal winter

- The correlation maps (Fig. 2b) provide a similar pattern with high and significant values in most the globe (>0.8 in regions located below 45âŮę north) and lower correlations over NH mid- and high-latitudes; especially over the east of Siberia.

'below' is here ambiguous (or even incorrect): does it mean between 45N and 90S ? or between 45N and the equator. Maybe simply say ' for northern latitudes smaller than 45 N

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