

## ***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 #3**

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

The paper examines the relationship between surface air temperature and ground surface temperature within a set of model simulations. The idea is to use the SAT-GST correlation as a metric to examine – or as a proxy, for the ground surface energy balance. This is done with the CESM-LME model ensemble that includes a set of experiments with all forcing as well as simulations with individual forcing. It is expected

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that comparison of the resulting simulations would yield information regarding the importance of each of these forcing on the SAT-GST relation over spatial scales and its temporal evolution. The paper briefly mentions that this may be important for borehole climatology based climate reconstructions.

This is a generally well-written papers, but it would benefit from a full language revision.

I have several minor clarifications that I believe need to be implemented for completeness before the paper is published.

- What do “regional” and “local scale” mean in the context of this model resolution?
- How is the SAT defined within the CESM? Is it always the surface air temperature at a height of 2 m above the bare ground? Is it defined differently over a (say) forested area? If so, what could be the potential problems for the SAT-GST correlation?
- Could the author comment on the role played by evapotranspiration on the SAT-GST metric?
- What is the justification for using the two-phase regression model?
- Why do authors use the “change points” obtained from the SAT-GST regression for the analogous analysis for snow cover? Shouldn't these snow cover “change points” be determined independently in order to see whether a relationship exists?
- DJF and JJA refer to northern Hemisphere seasons, but are used in the global context. There is some discussion later in the text to acknowledge these restrictions, but they should be given up front or simply restrict the analysis to the northern hemisphere; likely there would be no difference in the results.
- Regarding the discussion about the Tibetan Plateau (Fig 4) , could the authors discuss whether the CESM resolution can account for the topographic variations and whether such high elevation variability could introduce unforeseen effects on SAT-GST?
- In Figure 9, are all trends for the “post-change” interval? If so, why are the values given

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in K/decade? Most change points are post 1850; there should be at least a century post change. i.e. could you give the changes in K/century?

- I am not convinced that the results from this work necessarily imply that borehole climatology reconstructions would have to be revised to account for SAT-GST uncoupling. The effects are small and given the uncertainties inherent to the estimates of the quasi-steady state of the thermal regime of the ground, these additional errors are likely very small. Perhaps a simple theoretical experiment with +/- the LUC uncertainty imposed on a typical borehole temperature profile and its resulting inversion may illustrate the effect well, if any.

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Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2018-72>, 2018.