

Interactive comment on “Empirical estimate of the signal content of Holocene temperature proxy records” by Maria Reschke et al.

Anonymous Referee #2

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Reschke and colleagues analyze transient climate model simulations in tandem with proxy-data syntheses with the purpose of advancing knowledge on the detectability of climate signals over the Holocene. Their analyses are sound, and the paper is nicely structured and well-written. In general, I am highly supportive of such work, and I certainly consider this manuscript to be worthy of publication in *Climate of the Past*. However, I have some substantial concerns before I can recommend publication, alongside a few minor comments/questions that might improve the readability and scope of their text.

Substantial Concerns:

1. The assumption of model simulation as reality:

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o Although the authors are upfront regarding their underlying assumptions and essentially state that they are taking the model output at face value, I strongly recommend exploring more ways in which the model simulations might be oversimplifying their results. For example, in their Discussion section, the authors discuss the role of the “spatial correlation structure of model simulations” and how these correlations might be overestimated. The authors should add a discussion here about how biases in the simulation of climate variability itself in these transient models can lead to biases in correlation distances.

o In other words, if a (hypothesized) transient simulation from 6 ka to present showed the same, coherent changes across the entire Northern Hemisphere, the calculated SNE, as the authors propose, would be exceedingly low - however, we know that such a transient simulation is an unlikely representation of reality. Thus, I feel that the manuscript would greatly benefit if the authors included text on how typical (and atypical) shortcomings of MPI6k and T21k are influencing their results.

2. Clarity on the separation of “multi-proxy syntheses” versus individual paleoclimate datasets and suggestions for improvement:

o In their abstract, the authors state that “The estimated low signal content of Holocene temperature records should caution against over-interpretation of these kinds of datasets until further studies are able to facilitate a better characterisation of the signal content in paleoclimate records.” Here (and later on in their manuscript) the authors need to be very clear about what “these kind of datasets” mean. If they are implying that a broad-brush collation of datasets such as R18 or M13 is over-interpreted, I might agree with them that their analysis tends to demonstrate this aspect. However, this is untrue for a myriad of individual paleoclimate datasets (many of which are subsamples of aforementioned synthesis data sets) that are carefully vetted with high sensitivity to temperature and/or other variables such as precipitation, vegetation, salinity, productivity, etc. and more so, to seasonality - both aspects put together which are not addressed in this paper at all. I strongly recommend rewriting the above statement

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in the abstract as well as the final statement in the introduction (“more reliable interpretations of proxy records”; amongst other places) as it unnecessarily detracts from what the authors are proposing. Such statements are also arguably misleading (e.g., modern monitoring and culturing will lead to far better interpretations of proxy datasets compared to estimates of SNR with a climate model) especially considering the point above that their analyses hinge on taking model output at face value.

o The authors’ work is a significant advance concerning model-data comparison. In its current version, suggestions on how model simulations or proxy development or the comparison of the two might be improved for better comparative metrics are lacking. I feel that some discussion on how their analyses might be developed further could be helpful.

Minor questions and comments:

- Perhaps I missed it, but why are there no counterpart plots to the T-cent in Fig. 1d-e shown in the main text for T-mill?
- Why does the correlation in T-mill with T21k (Fig. 3e) as well as with Uk’37 and Mg/Ca (Fig. 4b) show an uptick after ~15000 KM distance?
- What are spatially important regions for proxy record development? Considering that the authors’ work is specifically geared towards correlation distances, do their analyses pinpoint which regions are particularly data-deficient (e.g., Indian Ocean, South Atlantic, etc.) and would assist in their comparative metric?
- Is there any particular reason that the authors have not performed a similar analysis with the combined multiproxy datasets of R18, LH14, and M13?
- Again, I would suggest adding up front in the discussion that their analysis explicitly discounts the seasonality of proxies.
- Section 5.1: Is there a reference for anthropogenic forcing strongly increasing correlation decay length? Why necessarily, should this be the case? I feel there ought to be

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a statement explaining this here.

- Although the Reschke et al. in review citation is provided, is there any reason for the 1/400y cut-off for the centennial time scale as opposed to something else?

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