

## ***Interactive comment on “Spatio-temporal variability of Arctic summer temperatures over the past two millennia: an overview of the last major climate anomalies” by Johannes P. Werner et al.***

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We are grateful for the very detailed review and the extremely thorough commenting in the uploaded pdf! In the following we will try to first answer the most important (as we understood them) comments and take the rest in shorter form later.

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## 1 Warming trend

1. The trend map from 1–1850 CE. The gridded reconstruction itself is (repeatedly mentioned!) only going back to 750 CE.
2. The warming trend over Greenland is not supported by the raw proxy data

Reply:

1. True, although the assessment this is based on relies on the spread of the annual reconstruction of the past. The trend should in principle be more robust against this. We propose the following solution: Only plot trends back to 1 CE in regions where the reconstruction is estimated to retain skill. Additionally plot a trend analysis going back only to 750 CE, though of course this could be influenced by the onset of the MCA.
2. We will also add the trends of the individual proxy series on the map. The one presented by the reviewer did contain a few that we discarded, but it is a step in the right direction.
3. Even more important is it to show a map with an estimated SNR (or the plain  $\beta_1$ , the scaling of the individual proxies) – as also commented by the reviewer. See the attached figure for the current estimates (bound to be revised in the updated reconstruction). The numbers will be added either in the proxy data tables in the appendix or in an own table, depending on the typographical limitations. (see attached figure)

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## 2 Arctic Amplification

The comparability of reconstructions is noted as questionable (or at least difficult) in the text, and thus the exercise is criticised (rightly so). There also seemed to be a misunderstanding regarding the analysis, in the sense that we limit ourselves to the European sector of the arctic – the circum-polar behaviour being indeed quite different timing and amplitude wise. We have decided to remove this chapter entirely, and wait for comprehensive reconstructions based on the North American and the Asian data.

## 3 Lake data

We made indeed a linear response assumption for the lake data, which might be defended by noting that the interpretation of some of the used records is based on the cross correlation to instrumental data, i.e. the linear assumption. However, we have now decided to transform the data using the inverse quantile transformation. It will be interesting to see if the data is then weighted more in the actual reconstruction (preliminary results suggest so, though not overly much).

## 4 Other comments

The reviewer caught several typos and a few strange (i.e. wrong) grammatical constructs, these will (of course) be fixed.

- Fig 7, flip axes? add data coverage

R: We will add the data coverage. We will also try to toy with the axes orientation, however we feel that the current orientation with the longitude in the “natural”

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orientation is superior to a time axis going left to right. We also updated the estimate of what constitutes a “significant” warm or cold event.

- C1: how is this screenign used?

R: This is a misunderstanding, we mostly did this to see how the reconstruction changes the LRM properties. It has been commented by others (also at meetings and conferences) that basing the reconstruciton on an explicit spatial and temporal model is bound to change the correlation (in space and time) behaviour of the resulting reconstruction (see e.g. Raible et al. Clim.Chage 2006 for the effect on the spatial correlations in EOF based reconstructions). In principle, all spatio-temporal reconstruction mehtods impose an explicit model. In the classical world (PCA, CCA, . . .), the spatial patterns are truncated and the temporal process is assumed to be i.i.d. In other methods (Ed Cook’s PPR), the data is pre-whitened to remove auto-correlations first, and then do a regression, while basing the spatial correlations on the instrumental period and imposing a convex spatial structure through the search radius. This will be clarified in the final version of the manuscript

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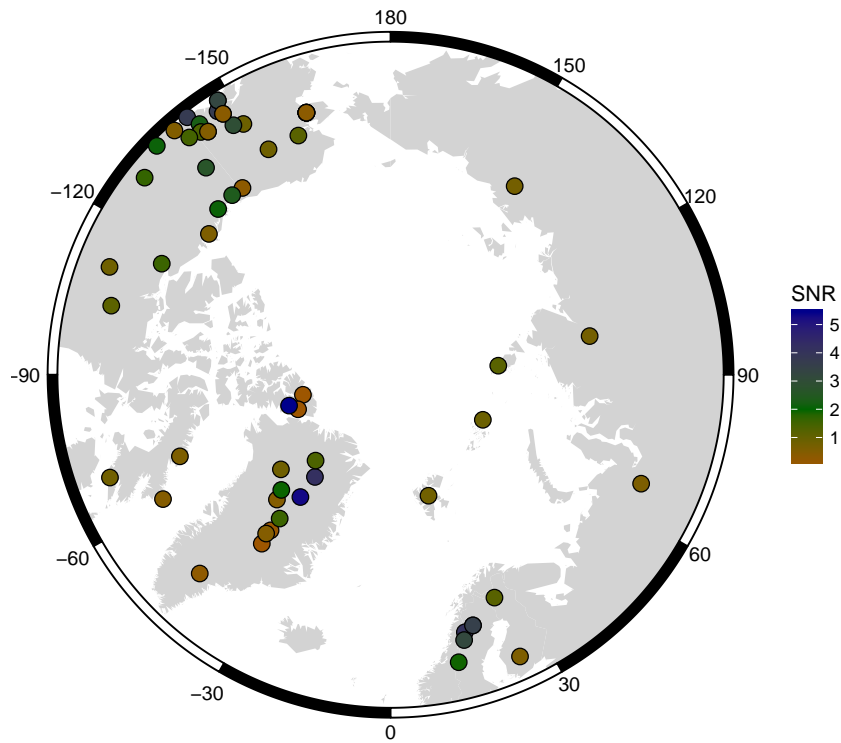


Fig. 1.