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Climate of the Past Discussions

Interactive comment on "The extra-tropical NH temperature in the last two millennia: reconstructions of low-frequency variability" *by* B. Christiansen and F. C. Ljungqvist

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With this manuscript, Christiansen and Ljungqvist add reconstructions of extra-tropical Northern Hemisphere mean temperatures for the common era and for the last 500 years to their prior work (Christiansen, 2011; Christiansen and Ljungqvist, 2011; Ljungqvist, 2010) using the LOC method described by Christiansen (2011) and Christiansen and Ljungqvist (2011). Both reconstructions but even more so the 500 year series are welcome additions to our understanding of past and future climate changes.

The following comments are not meant to be a full review but rather intend to highlight some questions that arose while reading the present manuscript and thus hopes to

help to improve the manuscript. Comments focus on the two millenia reconstruction.

Comments:

1. While the reconstructions (millennial and 500 year) are of interest in themselves it would help, if results over a validation period were discussed. Although measures of merit over calibration and validation periods (like reduction of error coefficients, coefficients of efficiency, Pearson's R2 and mean offset from the target) are only in parts informative, they give a qualitative impression of the reconstruction merit.

2. A more interesting question is: Are the presented two millennial reconstructions to some extent regionally biased? More specifically, this question has two parts.

2a. Firstly, the (main) reconstruction in Figure 5 heavily relies on high latitudes. Simulation studies (Fischer and Jungclaus, 2011, Servonnat et al., 2010) indicate a notable influence of orbital changes in high latitudes even on the "short" time scale of the last millennium. Thus, would the reconstruction be altered if the percentage of high latitude proxies were reduced? Indeed, the triad of reconstructions in Figure 6 and the discussion of robustness and geographical distribution address this question to some extent. However, the percentage of high-latitude proxies remains larger than 40 percent in all three reconstructions and the geographical distribution in Figure 9 shows the warm anomalies with largest amplitude in higher latitudes (and the Chinese location of Dulan) for the medieval period.

2b. Secondly, the (main) reconstruction in Figure 5 further relies on four proxies from east Asia; that is, most of lower latitude information stems from this region. Of the four proxies, two are regionally representative and they represent the only two regional – that is probably noise reduced – proxies in the network. The other two east Asian proxies are both representative for the high altitude of the Tibetan Plateau and its vicinity. It is not obvious how this may bias the reconstruction, but clarifying the question would certainly help future reconstruction efforts.

3. Another question concerns the mixing of temporal resolutions, which also relates to the four east Asian proxies mentioned above. These contribute most to the decadally resolved data utilized in the reconstruction in Figure 5 and they also, although less so, feature prominently in Figure 6. Put more clearly, Figures 3,5 and 6 appear to indicate, that the attempt to resolve the low frequency variability over the last two millennia unintentionally overly emphasizes the low frequent variations present in only a few of the used proxies. For Figures 5 and 6, the reconstructions appears to near perfectly represent a small number of the considered proxy series.

4. While the authors discuss the similarities between their present and earlier works (Christiansen and Ljungqvist, 2011; Ljungqvist, 2010), the most notable features are probably the deviations in reconstructions for the period 1000 to 1400. While Christiansen and Ljungqvist (2011) find similar temperatures in the early 11th and early 14th centuries, the latter period is notably cooler in the present work. Furthermore, the difference in temperature appears to be strongly amplified in the present study between the turn of the first to the second millennium CE and the coldest period in the first half of the second millennium CE. This may also reflect a more prominent influence of some low frequent proxies on the reconstruction. Similarly differences are prominent between the earlier 500 year local reconstruction by Christiansen (2011) and the present 500 year data; a discussion could improve our understanding of this period and help in reconciling climate simulations and reconstructions over this period.

5. The second to last (minor) comment concerns Figure 7, where the numbers of considered proxies do not match those in Figures 5 and 6 for the millenial (blue) curve.

6. Lastly, while it may make the Figure slightly less readable, inclusion of all three two-millennia reconstructions may give a more complete picture of the differences among the temperature reconstructions over the last 500 years in Figure 7.

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