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Climate of the Past Discussions

Interactive comment on "Evaluating climate field reconstruction techniques using improved emulations of real-world conditions" *by* J. Wang et al.

Anonymous Referee #2

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The manuscript assesses four statistical methods to reconstruct past temperatures from annually resolved proxy records. This assessment is conducted in the virtual reality created by a climate simulation over the past millennium with the atmosphere-ocean general circulation model CSM1 by constructing pseudo-proxies records that mimic the spatio-temporal coverage of the proxy network used by Mann et al. (2008). The main conclusions can be summarized by stating that : 1) all methods show a warm bias in the past millennium and damped multidecadal variations. This is due to the 'regression dilution effect' by the presence of noise in the proxy records; 2) the skill of each method in simulating the global mean temperature s not directly related to its spatially resolved skill: in other words, a global skill may be brought about by

error compensation in different regions of the globe; 3) the character of the climate variations to be reconstructed - internal versus externally forced - has an influence on the skill. This appears reasonable, as the forced variability over the past millennium has probably a more global character and thus can be better reconstructed with a smaller number of proxies.

The manuscript can be considered as a prolongation of recently published papers along the lines set by Smerdon et al (2011) and Smerdon (2012) and others. In previous studies, the proxy network was either frozen in time and/or displayed no spatial variations in the signal-to-noise ratio. This is now considered in the present analysis. The manuscript is clearly written and is relevant to understand the strengths and deficiencies of some the reconstructions methods that have been applied so far. The authors are also candid about the limitations of their study, which in my view is the quite tame statistical structure of the pseudoproxies. I would say that the proxy community has in general the view that the proxy noise can have a much more complicated statistical structure. My recommendation is to publish the manuscript. I have just a few particular comments that the authors may want to consider.

My most important concern is the issue of 'teleconnections:

'the majority of proxies are at least 8000 km away from the temperature point yielding the highest ||. On the other hand, the distribution of ||max is unimodal and positively skewed. The distribution exhibits a mode near 0.4, while high values are quite rare (95 % of values are below 0.76). The average ||max is 0.45, corresponding to a P–T distance of 11 000 km. This indicates that the majority of proxies in the M08 network 1are not indicative of local temperature ; rather, the majority are indicative of long-range teleconnections (e.g. Liu and Alexander, 2007).'

The authors have explored the correlation patterns of the Mann et al (2008) proxy network and found that a substantial amount is correlated not with the observed local temperature but with the temperature afar. In some cases the location which the proxy

is supposed to be recording the temperature is located 8,000 km away. To be honest, I think the reader is here being asked to believe beyond what can be considered reasonable. I guess that the authors include this 'teleconnected network' in their analysis to meet possible claims that, although a particular proxy may not be recording the local temperature, it may still be useful. In that case, I would not object to including this pseudo-proxy network to explore the possible implications, but I would include in the text a disclaimer of the author's view about how realistic this really is. My impression is that most of those teleconnections are just statistical artefacts produced by calculating correlations with all grid-points around the globe

10 ' This is encouraging and suggests that global surface temperature may be skillfully reconstructed without requiring uniform spatial sampling over the entire globe. Nevertheless, just like the reconstruction skill vs. climate variation relationship discussed in Sect. 4.3.1 and the teleconnections discussed in Sect. 4.3.2,'

I guess that this statement is time-scale dependent, and that longer time scales require a smaller network for the same skill. The authors indicate somewhere else that they are focusing on decadal skill, but it is not clear whether this is still required for their conclusion to be valid.

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