Clim. Past Discuss., 10, C2359–C2367, 2015
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Climate of the Past
Discussions

Interactive comment on "Reconciling reconstructed and simulated features of the winter Pacific–North-American pattern in the early 19th century" *by* D. Zanchettin et al.

D. Zanchettin et al.

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We thank the Reviewer for his/her appreciation of our work and appreciate his/her helpful comments. Below, we reply to his specific comments, reported before our response and numbered.

1) Pg. 4430, Ln. 20: It would be useful to have a little more information in the manuscript about how TT2010 explained the dynamics of the impact of the Dalton Minimum on the PNA. It is mentioned that the solar minimum was implicated in the event, but a slightly more complete discussion of the full dynamical chain from the TOA forcing to the PNA response would be useful.

Re: TT2010 did not discuss the full dynamical chain from the TOA forcing to the PNA response, which is also beyond the scope of this study. If we are encouraged to submit a revised version of the manuscript, we will shortly extend the part on the TSI-PNA link, based on the discussion in TT2010.

2) Pg. 4433, Ln. 17: Three regions are vague here. Please refer to a figure or be more specific about the regions considered. This is clarified later in this text, but it would be useful to have it at this point.

Re: Will do

3) Pg. 4433, Ln. 24: My biggest concern with the manuscript comes at this point. The authors do not reasonably justify why they use perfect pseudoproxies. It is standard practice to perturb the pseudoproxies with noise to mimic the imperfect connection between climate and proxies in the real world. This has been shown to be important in numerous studies regarding the impact on reconstruction skill. This is reviewed in Smerdon (WIRES Clim. Ch., 2012) and recent studies that have attempted to more realistically emulate the character of noise in real-world proxies have shown important additional impacts. For instance, Wang et al. (Climate of the Past, 2014) and Evans etal. (GRL, 2014) have both addressed the realism of various reconstruction problems and shown that more realistic additions to the pseudoproxy construction yield reduced skill. The latter study is particularly relevant to the present work, given that the authors model tree-ring chronologies and show that more realistic tree-ring predictors reduce the skill of their pseudoproxy reconstructions. The authors should further justify their use of perfect pseudoproxies or include an experiment with the addition of noise to the pseudoproxy predictors.

Re: As we stated on page 4434, lines 21-24 of the discussion paper, "we aim at testing PNA reconstructions based solely on local geophysical predictors from northwestern North America, not at replicating the linkage between biological sensors and the local environmental forcing at the basis of the TT2010 reconstruction". So, our goal is to compare pseudo-reconstructions and targets under the idealized hypothesis that the considered proxies provide perfect information about the local climate conditions. This is why, on discussing our results we focused only on those predictors yielding the highest skills among the considered random sets: we wanted to delineate the upper bound of this reconstruction method, revealing the "inherent limitations of a PNA reconstruction method solely relying on local geophysical predictors from northwestern North America" (page 4444, lines 16-18). Including realistic noise levels in proxies would complicate this already complex/thorough investigation, and shift the focus away from this true aim. We are, however, aware that the linkage between biological sensors and the local environmental forcing is fundamental in any climate-proxy investigation. If we are encouraged to submit a revised version of the manuscript, we will therefore include results from an additional analysis we have performed to support and improve the discussion on this that was already provided in our discussion paper on page 4445. We explore the sensitivity to noise by proposing a series of idealized pseudo-proxy experiments, where different levels of white and red noise (following von Storch et al., 2009) are added to the original predictors' series in the validation period. We plan to report the results in an additional supplementary figure, which is shown below (Figure S13, see supplement for eps version). It is clear that the reconstruction skills are most sensitive to the level of noise introduced rather than the type of noise, at least when the relative amount of noise introduced remains low. For a signal-to-noise ratio of 1 (Figure S13c,f), most reconstructions are unskillful for the case of red noise and skillful for the white noise, although in both cases the explained variance for the validation period never reaches the 50% level. Some skills remain for signal-to-noise ratio larger than one.

4) Pg. 4436: It would be useful for the authors to consider the stationarity of the PNA teleconnection pattern to both temperature and precipitation. Related studies that have looked at the stationarity of the ENSO teleconnection pattern to North America have found that the PMIP3 LM simulations are characterized by a widely varying range in the temporal character and strength of the teleconnection (Coats et al., GRL, 2013). Simi-

lar results for the PNA would have implications for the interpretation of the pseduoproxy reconstructions and model-data comparisons that the authors perform.

Re: We agree that non-stationarity of teleconnections is a possible important factor to take into account. This was already mentioned in the original discussion paper based on work by, e.g., Raible et al. (2014). The temporally varying R2 skills of the pseudo-reconstructions in Figure 8 can also be interpreted as reflecting the non-stationarity of teleconnections. If we are encouraged to submit a revised version of the manuscript, we will shortly expand the discussion in the manuscript based on results by Coats et al. (2013). However, following on our reply to the previous point, adding such a factor in our analysis would add quite some complexity, and possibly the outcome would be lowering the skills while adding uncertainty to the reconstructions, i.e., again shifting focus away from our scope to delineate the upper bound of this reconstruction method.

5) Pg. 4438, Ln. 20: The PNA is dominant over which collection of modes considered?

Re: Over the four modes we considered (PNA, NPI, ENSO, NAO). We will specify this in that portion of the text.

6) A final point is necessary regarding the authors' argument about internal variability. I do not take issue with their interpretation, but it also appears that the models never produce a period of consistently positive PNA values as evidenced in the PNA reconstruction. They might consider asking whether any of the models produce periods of such positive excursions (in magnitude and/or extent), regardless of their timing. If indeed the persistently positive anomalies are a part of internal variability, they should occur at some other time in the simulation (or in the control simulations). If they do not occur, then perhaps there is more of a fundamental disagreement between the models and the reconstructions that is either the result of model failures or reconstruction uncertainties. The authors may wish to consider a similar analytical approach as outlined in Coats et al. (J. Clim., 2015), who similarly evaluated the ability of the PMIP3 models to produce multidecadal drought periods in the American SW in LM and control

simulations.

Re: This issue was meant to be addressed with Figure 9, which focus on interdecadal positive PNA phases (i.e., positive phases with duration comparable to that of the reconstructed PNA during the early 19th century) detected along all simulations, regardless of their timing. If we are encouraged to submit a revised version of the manuscript, we will provide a modified Figure 4 which includes, in panel a, occurrences of prolonged periods of strong positive PNA. The modified figure will show that prolonged positive PNA periods occur along the whole integration period, and their occurrences are generally not consistent across the ensemble members. Furthermore, following the analysis by Coats et al. (2015), we will provide an additional supplementary figure (Figure S14, see below), showing the frequency of occurrence of prolonged positive PNA phases according to different durations. The figure shows that prolonged positive PNA periods longer than 20 years are extremely unlikely events in the ensemble. If we are encouraged to submit a revised version of the manuscript, we will add a short paragraph in the discussion about this, including reference to Coats et al., 2015.

7) Technical Note: Many of the figures have very small axis labels, legend text, tick labels, titles, etc. I would strongly encourage the authors to think about improving these problems across all of the figures for better viewing and interpretability.

Re: We will update the figures wherever it seems to be necessary to improve readibility. We intend to “tune” again the aspect of the figures in this sense when it is clear how they will appear in their final published form, if the manuscript is accepted for publication in Climate of the Past.

Figure captions

New supplementary Figure S13 – Skill metrics for an ensemble of TT2010-like reconstructions following Figure 7b but highlighting the impact of predictors’ noise on the pseudo-reconstructions. Different panels illustrate results from different types and levels of noise, which is only added for the validation period. Top: white noise; bottom:

red noise; noise contributes to 10% (a,d), 25% (b,e) and 50% (c,f) of the predictors’ total variance. Results are for 1000 pseudo-reconstructions without pre-selection of predictors based on calibration skills. The numbers inside each panel indicate the minimum and maximum R2v values obtained for each model. Insets in each panel map the three boxes from where gridded data are sampled to be included as predictors, with the name reported in each box (tas: surface air temperature, pr: precipitation). Red noise is assumed to be an autoregressive lag-1 process, generated following von Storch et al. (2009). Specifically, the value of the lag-1 autocorrelation is drawn at random from a beta distribution (parameters 7 and 3), in the interval (0,1). Ref.: von Storch, H., E. Zorita, F. González-Rouco (2009) Assessment of three temperature reconstruction methods in the virtual reality of a climate simulation. Int. J. Earth. Sci. (Geol Rundsch) 98:67–82, doi:10.1007/s00531-008-0349-5

New supplementary Figure S14 – Relative occurrences of prolonged positive PNA phases in the different simulations. An event of duration l is individuated when the standardized (with respect to the period 1725-1999) smoothed PNA index (11-year running mean) remains above the value of 1 for l consecutive years.

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/10/C2359/2015/cpd-10-C2359-2015-supplement.zip

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Interactive comment on Clim. Past Discuss., 10, 4425, 2014.

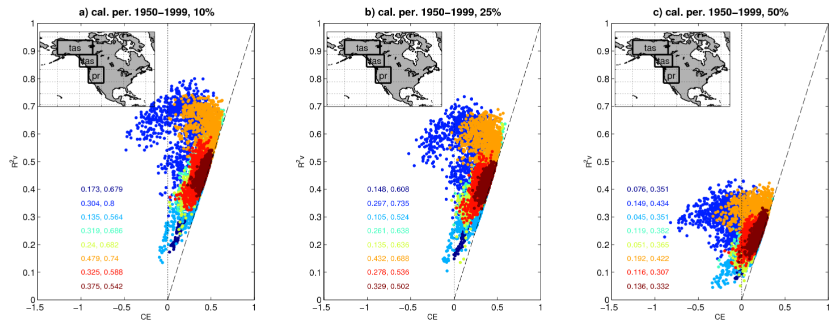

Fig. 1. Figure S13 part 1

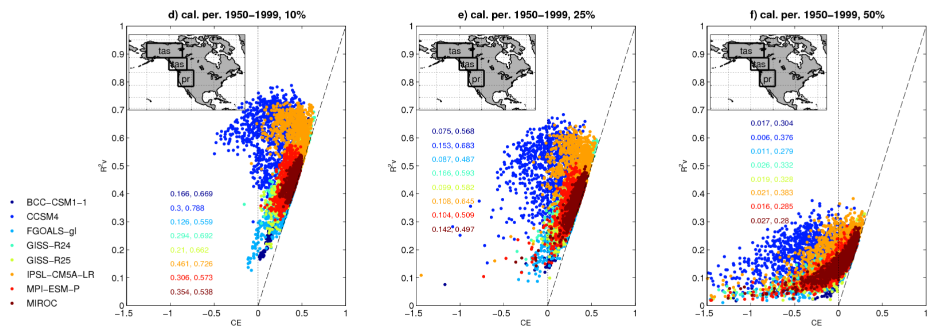

Fig. 2. Figure S13 part 2

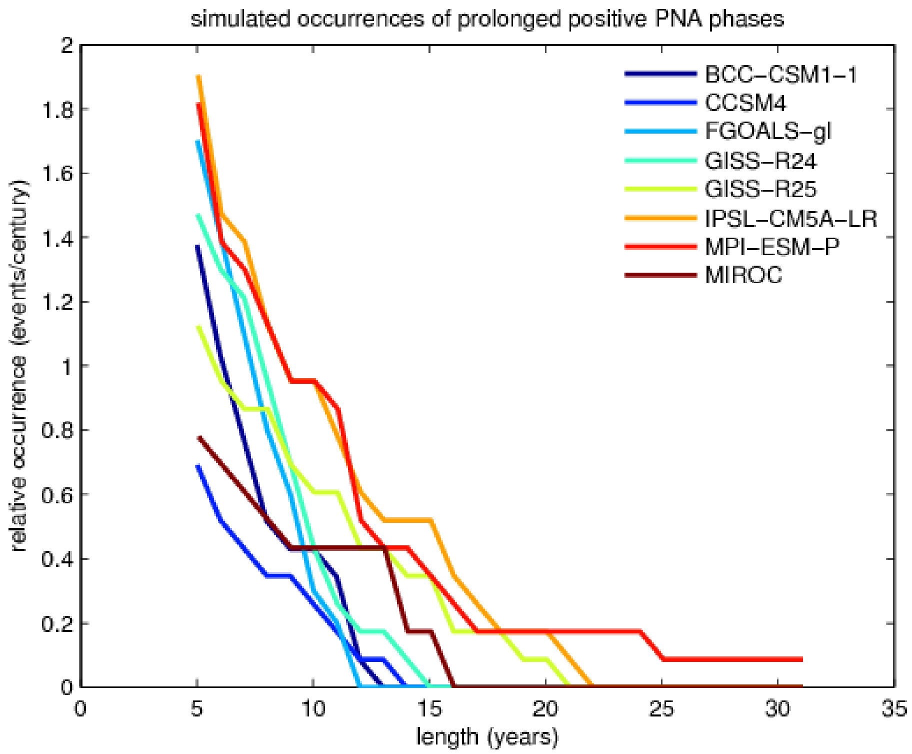

Fig. 3. Figure S14