**Climate
of the Past
Discussions**

Interactive comment on "A novel approach to climate reconstructions using Ensemble Kalman Filtering" *by* J. Bhend et al.

J. Bhend et al.

jonas.bhend@csiro.au

We thank Reviewer 1 for the very positive comments. The responses to the specific comments follow below. Paragraphs from the original review are marked with '$$'; our comments follow immediately after the respective paragraphs.

$$ Specific comments

$$ p.2838 l.22 "Our main goal is to learn how to best assimilate climate proxy information into model simulations." I believe, this is not the goal of the paper, since the authors do not consider different ways of assimilating observations.

Rephrased to: "Our main goal is to learn to what extent and under what conditions proxy data provide sufficient constraints for a data assimilation approach to climate

reconstructions using the EnSRF algorithm."

$$ p.2841 l.5 "We analyse the potential of the data assimilation technique using perfect observations ... also using pseudo-proxies ...." This is the only place in the paper where perfect observations are mentioned; no results are presented when perfect observations are assimilated.

Deleted the reference to perfect proxies in the introduction and highlighted the use of perfect proxies in the restructured and expanded paragraph on the covariance localisation (the only place in the manuscript where perfect proxies are actually used).

$$ p.2842 l.22 "H ... is the forward model ...." H is not the forward model; H is an operator that maps model field to observation space.

Changed to: "H, a matrix of size n x m, is the operator that extracts the observations from the model state x." While we agree that in our setup H is simply an operator extracting temperature at proxy locations from the model fields, we would like to stress that in general H could be implemented as a proxy forward model (e.g. Tolwinski-Ward et al., 2010). As we do not investigate more complicated (nonlinear) formulations of the proxy-climate relationship, we only refer to proxy forward models in the outlook.

$$ p.2845 l.14 "Furthermore, data assimilation leads to more wide-spread and larger reduction in spread in boreal winter." Comparing to what? Than in boreal summer?

Changed to: "Data assimilation leads to more wide-spread and larger reductions in ensemble spread in boreal winter than in boreal summer."

$$ p.2845 l.22 "These aggregated indices have been chosen ... for ease of comparison with other climate reconstructions looking at northern Hemispheric temperature." No comparison is presented in the paper.

Changed.

$$ p.2848 l.21 "In data assimilation framework, this proxy-climate relationship is char-

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

acterised ...." First of all, H is not the forward operator (see the comment above). Second of all, the relationship is characterised by the background error covariance matrix Pb and the observation error covariance matrix R.

We agree that the climate–proxy relationship depends on Pb as well as stated by the reviewer. However, we emphasise that, in general, the climate–proxy relationship also depends on the operator H as can be seen from the update in equation (1). We thus change the above to: "In our data assimilation framework, the proxy–climate relationship is characterised by the operator H and the update of the unconstrained model simulations further depend on the observation error covariance R and the background error covariance Pb. "

$$ p.2849 l.5 "This is due to ...." I believe, the authors should not exclude from this list that the pseudo-proxies are computed from the reference simulation.

Changed previous sentence to: "It is noteworthy, that positive correlations occur also in the unconstrained simulations (grey boxes and right-facing arrows), indicating that the individual ensemble members co-vary with the reference simulation."

$$ p.2849 second paragraph On order to have consistency in the paper I propose to use a localization procedure for the indices as well. Furthermore, the authors mention that they performed experiments with and without localisation for the intensity of the northern Hadley Cell only, since without localisation it gives the negative skill. But what about other indices? How does localisation influence them?

We will change the revised manuscript accordingly with a simple localisation procedure for the large-scale indices.

$$ Additional plot It could be interesting to look at how the skill changes over time. Does it converge? Therefore, I suggest to make an additional plot with the skill as a function of time.

Indeed a plot of skill versus length of time period analysed could prove very helpful in

judging the influence of sampling (due to the limited time period) on validation metrics. We will discuss the sampling issues in more detail in the revised manuscript.

$$ Fig.5 The figure should be enlarged. Y-scale could be chosen from -1.5 to 0.7 instead of from -2 to 1.

Changed.

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper