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Climate of the Past Discussions

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

Anonymous Referee #1

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General comments

The paper considers the behaviour of an atmospheric model constrained by a data assimilation method, Ensemble Square Root Kalman Filter (EnSRF), using observations that are sparse both in space and in time. The authors deal with an idealised experimental setup when observations are computed from the reference simulation of the model and then perturbed with red noise. The assimilated pseudo-proxies are based on near-surface temperature; the analysed state vector contains near-surface temperature, precipitation over land, and four indices characterising atmospheric circulation: the strength of the northern subtropical jet, the northern Hadley Cell, the stratospheric polar vortex, and the dynamic indian monsoon index. The EnSRF is not used in its full form—the initial conditions are not updated according to the analysis—since the tem-

poral resolution of observations exceeds the atmospheric deterministic predictability. To evaluate the data assimilation performance the authors examine the skill and the correlation for different simulations.

When near-surface temperature is constrained by temperature-based pseudo-proxies using EnSRF, the skill is positive and the correlation is high, especially in the areas where pseudo-proxies are located. For precipitation and the indices except the intensity of the northern Hadley Cell, the skill is still positive, but smaller; as to the intensity of the northern Hadley Cell, the skill is negative.

The paper discusses also the importance of using a localisation procedure in order to reduce overcorrelation of the variables located far away from observations, which is well established in meteorological community.

The results presented in the paper are interesting enough to warrant publication. I, therefore, recommend publication of this paper with minor revisions.

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.

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.

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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.

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?

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.

p.2848 l.21
"In data assimilation framework, this proxy-climate relationship is characterised ...."
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 P^b and the observation error covariance matrix R.

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.

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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?

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.

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

Interactive comment on Clim. Past Discuss., 7, 2835, 2011.