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Climate of the Past Discussions

Interactive comment on "Towards High Resolution Climate Reconstruction Using an Off-line Data Assimilation and COSMO-CLM 5.00 Model" *by* Bijan Fallah et al.

Anonymous Referee #2

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In this paper, the authors test an offline DA approach using a high resolution regional climate model. The experiments test how error is reduced by assimilating pseudo and real observations.

The experiments are scientifically sound, but I have significant concerns about the applicability of the results in the current manuscript to the general paleoclimate reconstruction problem. What the authors have done in showing error reduction in some idealized reconstructions is a necessary first step in showing that the DA works, but I don't think the results shown here warrant publication. Many other previous studies have shown that DA for paleoclimate at a range of time and spatial scales works

(monthly to decadal and coarse to $\sim$1 degree resolution), so that's not really in question. In so far as the applicability is concerned, the experiments use a very dense observation network with very high SNR values, while the paleoclimate reconstruction problem has the opposite characteristics: low observation density and low SNR values. Typically reconstructions of this kind use a network based on actual proxy sites and SNR values of around 0.5. These choices have significant impacts on the skill of the reconstructions and the some of the conclusions that can be drawn from them. If a dense proxy network and a larger SNR are chosen, then this needs to be vigorously defended based on the scientific goals of the study.

However, with the current climate model simulations they have, the authors are well positioned to answer some important questions that would be directly relevant to paleoclimate reconstructions. Such questions include:

What benefits come from using the very high resolution simulations compared to the simulations that people have used so far? Can you get better reconstructions using very high resolution climate models? Are reconstructions that focus on specific regions more skillful than reconstructions designed on a global scale? Are certain variables better reconstructed in a regional framework? Etc.

So while I recommend that the paper not be published, I would strongly encourage the authors to resubmit the paper using reconstructions that are more clearly connected to the larger paleoclimate reconstruction problem.

Additional minor comments:

Section 3.2: Where does the localization function come from? What are x, y, and n? Does this function have compact support? Also, I don't think that one can choose an "optimal" localization independent of information about the observations.

The ensemble size appears to change between experiments. Is it possible to keep it the same size for all the experiments?

The figure captions are rather sparse. I'd recommend further explanation of the plots in the captions.

Many of the equations could benefit from a more condensed notation instead of writing out fully "Analysis" or "Trace", for example.

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