

Interactive comment on “Technical Note: The analogue method for millennial-scale, spatiotemporal climate reconstructions” by Oliver Bothe and Eduardo Zorita

Anonymous Referee #1

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I think the paper addresses an important topic and provides a useful extension of the Analogue Method, combining the data and dates uncertainties. However, I think the paper lacks clarity in the description of the method (some fundamental steps as the generation of the confidence ellipses are not properly explained) and I have concerns about the pseudo-proxy setup.

In particular, I think the assessment of the method' skill (of course possible under pseudo-proxy conditions) is flawed: the same run used as “truth” is used inside the Analogue Pool leading, therefore, to a potential overestimation of the skill. In addition to that, I can not comprehend why the authors selected a pseudo-proxy network design

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(number of proxies, locations of proxies, period covered, uncertainties, etc.) that do not resemble at all the real-world case they later try to reconstruct. I recommend the authors to re-do the exercise generating a pseudo-proxy environment as close to the real-case as possible. Of course, later the here presented pseudo-proxy setup could be considered informative as how would the method perform if more proxies were considered, etc. but the generation of a closer to real situation is nonetheless essential and I suggest for it not to be bypassed.

General Comments

- The description of the method is not clear enough. How do you define the uncertainty ellipses? I don't see anywhere in the text the methodology followed to find such ellipses. Also, related to that, what's the difference between 90%, 99% or 99.99% uncertainty ellipses? Please, provide a clear methodology to follow to find them. What are the confidence intervals? Please, define.

- Why in the pseudoproxy setup you don't mimic the real-world conditions your are trying to reconstruct? I find it confusing that the pseudoproxy and real-world proxy locations and time-spans are not the same. As it is now, because the pseudoproxy and proxy cases differ, the results of the pseudoproxy analysis are not completely transferable to the real-world case. I suggest to generate a pseudoproxy network that is exactly the same as in the real-world case, and show the results in that case.

- The title of the manuscript talks about climate reconstructions. However, the manuscript deals only with surface temperature reconstructions. I suggest to modify the manuscript title to reflect this and to add some discussion on how the method could/could not be applied to reconstruct some other climate variables (particularly, how do you expect the results to change when reconstructing a more challenging variable as precipitation?).

- It would be interesting to compare with the results of having a fixed number of Analogues, for example 1 Analogue.

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- How do results change if using a less years for the sliding window-mean? For example 50-years-means? There is a mention to interannual data in the discussion session, but not comparison plots are shown.

- For the pseudo-proxy setting: The selected reality is the simulation Trace21k. Most of the Analogues come also for this simulation. It would be fairer for assessing the method's skill if the chosen reality is excluded form the Analogues pool. How do the results change if done so? When allowing the same simulation as reality to enter the pool, results might be overly optimistic. For some of the simulations listed there are several runs available, in that case one run could be selected as reality and the other pool of Analogues.

Specific Comments

Abstract: - In the first paragraph authors talk about the last 21 kyr. However, in the second paragraph the target is reduced to the last 15kyr. Please, rephrase or explain failure in the target. - The authors could emphasize that in the present for the reconstruction method seems to be no better than a long-term mean. - These fields reveal that uncertainty are also large locally. Please, change for ... uncertainty is also...

Introduction: - Please clarify the definition of nonillion

Section 2: - Here you sometimes use the word Analog instead of Analogue. Please, unify throughout the manuscript - Figure 1: Please, add latitude and longitude. Also introduce the acronyms P01 and E01, as so far they have not been introduced in the text. - Page 4: 'Our interest is in temperature', please clarify if it is surface, annual mean, etc. What is a temperature calibration? -Page 5: Please explain better the meaning of "at best centennial" Does this mean that there are no proxy records with resolution finer than 100 years? - Page 6: why not consider the same period for real and pseudo proxy setups?, how are ellipses of confidence constructed? Please, provide the appropriate ellipse equation for its construction. - Page 8: What is a credible interval? Please, define. - Page 10: The authors say: "randomly chosen pseudo age uncertainties". How

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are those selected? Is the random process a Gaussian distribution? Which mean and variance? This needs more clarification. Figure 3: Isn't it easier to show the plots in the form of line-plots? Specially plot a is difficult to read, as it looks like a huge black block, differences are hard to distinguish. Figure 4: Please, put all the plots in the same scale

Section 3: - Page 14: The authors indicate very little variability in the reconstruction median over certain periods. This probably arises due to too many Analogues are selected in those periods. How could you constrain the Analogue selection?

Figure 5: Panel c: please add name like "warmer case", "colder case" and the respective locations (lon, lat). Panel d: add the subtitle "Regional average" Panel e: add the subtitle "Grid point: (lon, lat)" In panels d and e: I can't understand what the authors mean by "examples". Why some of the examples look like dots and some as dashed lines? Are the dots (dashes) associated to the warmer (colder) case shown in panel c?

It would be interesting to discuss the moments when the Target is outside the envelope (Figure 5a)

Figure 6: Please, add the units directly above the colorbar. Also, indicate the year that is being shown as Example.

Figure 7: Please put all the plots in the same scale.

Figure 8: Similar considerations as in Figure 5.

Figure 9: similar considerations as in Figure 6.

Page 24:

In the summary the authors say that the method succeeds in the pseudo-proxy setup. I think that sentence might be overestimating the skill of the method, as the authors used one model run (Trace21k) both as truth and as proxy pool. Please, remove the truth from the possible pool of Analogues to be able to properly analyse the method's skill.

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For the real-case the authors say the reconstructions fail. How can you assure failure when you don't know the truth? I think the sentence should be re-phrased and the only thing that can be known for sure is the failure to find Analogues within the selected pool. I think that it needs to be made clearer that not knowing the truth in the real-case is exactly the reason for making pseudo-proxy analysis. Which leads, again, for the importance of the pseudo-proxy setup (design of the network, period covered, etc.) to be as similar as possible to the real-case.

Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-170>, 2020.

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