Clim. Past Discuss., 11, C3119–C3124, 2016
www.clim-past-discuss.net/11/C3119/2016/


# *Interactive comment on* "Probabilistic precipitation and temperature downscaling of the Twentieth Century Reanalysis over France" *by* L. Caillouet et al.

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Received and published: 1 February 2016

The referee comments are recalled in italics and followed by the authors' responses.

*The paper presents a downscaling technique in order to reconstruct precipitation and temperature fields in France over the 20th century. The downscaling technique is a certain parametrization of the analogue method that is improved in order to reduce biases in the interannual cycle and to improve interannual correlation. Two improvements are assessed: the first relies on a calendar selection and the second adds two new analogy subsampling steps based on SST and the two-meter temperature. Both approaches provide interesting results that may be applied in different contexts.*



*The application of the analogue method for temperature downscaling is rather new, and addressing biases issues is an important point. The paper is thus worth publishing. It is globally well written and well structured. Some improvements are suggested.*

The authors would like to thank Referee 2 for his/her positive comments on the manuscript. We also thank him/her for the specific and technical comments that will lead to improve the manuscript.

*General issues:*

*- It is not always clear at what time step you are working. Most of the time it is a daily time step, but sometimes monthly? Is the monthly modeled time series an aggregation of the daily one, or a downscaling at a monthly time step? When it is the latter, how do you perform that?*

The downscaling step produces 25 analogues dates for each target date considered in the 1871-2012 period. These dates are then converted into daily precipitation or temperature values. The monthly time scale is then a sum/mean of these daily precipitation/temperature values. The different methods (First domain, Calendar and Stepwise) are however mainly compared at the monthly/seasonal time scales where differences are the most prominent and improvement first needed. This will be clarified.

*- As you present the SANDHY method, is sounds like a method apart, as you do not replace it in its wider context. SANDHY is just a certain parameterization of the analogue method, which has many other variants. There are a few steps between the idea introduced by Lorenz and the work of Ben Daoud, and you may recapitulate some in section 3.1, and put SANDHY back in the general context of the analogue method.*

Thank you for the suggestion. The beginning of the section will be modified accordingly, by citing more downscaling works based on the analogue approach. The analogue approach implemented in SANDHY however stands out of the bulk of analogue downscaling methods through its stepwise approach where analogue subsets are sequentially refined through different steps and associated predictors.

*- There is a classic confusion of the term "large-scale", as it truly means: "A large scale map only shows a small area, but it shows it in great detail. A map depicting a large area is considered a small scale map." (see also http://basementgeographer.com/large-scale-maps-vs-small-scale-maps/). The term local-scale is fine, but large-scale is confusing.*

We are here in the unfortunately commonplace case of different meanings shared by the same word across different disciplines. The IPCC AR5 WG1 glossary (IPCC, 2013) defines "downscaling" as follows:

Downscaling is a method that derives local- to regional scale (10 to 100 km) information from larger-scale models or data analyses. Two main methods exist: dynamical downscaling and empirical/statistical downscaling. The dynamical method uses the output of regional climate models, global models with variable spatial resolution or high-resolution global models. The empirical/statistical methods develop statistical relationships that link the large-scale atmospheric variables with local/regional climate variables. In all cases, the quality of the driving model remains an important limitation on the quality of the downscaled information (our emphasis).

In accordance with the common practice in the climate discipline (see also all climate downscaling publications), we will therefore keep the term "large-scale" when writing about the scale of predictors from the 20CR reanalysis or ERSST reanalysis.

*Minor issues:*

*- Intro of section 2 (p.4429) is very confusing. Please reformulate.*

It will be rephrased.

*- p.4430 l. 27: the date is not correctly written*

Indeed, this will be corrected.



*- p.4433 l.15: "the the"*

This will be corrected.

*- p.4435 sec 3.3.1: when you talk about the first domain, is it the optimal one per region, or the first globally? Please specify.*

The first domain is the optimal one per zone. This will be clarified.

*- p.4438 l.9: "here" instead of "her"*

This will be corrected.

*- p.4442 l.23-26: this sentence is not clear. Please specify.*

Monthly RMSE are computed to compare monthly precipitation/temperature time series and monthly homogenized series. These scores are then yearly averaged. To have an idea of the average daily error for precipitation, the RMSE in mm/year is divided by the number of days in each corresponding year to get a RMSE in mm/day. The sentence will be modified to be clearer.

*- p.4443 l.12: I would not say "only" 1.0°C, as the relative difference compared to 1.1 or 1.3 is not that big.*

This will be corrected accordingly.

*- p.4445 sec 5.1: the summer around 2000 seems also badly simulated.*

Indeed, years others than the ones discussed here may present relatively large errors, but it was not possible to comment any single discrepancy. A focus was therefore made on extreme years. That said, this specific discrepancy for springs and summers around year 2000 may be related to soil-atmosphere retroactions which are not taken into account in such a one-way downscaling approach. A sentence will be added to the manuscript to suggest this interpretation.

*- Figure 1: it would be easier to read with the 0 ( of stations) at the same level as the x*

*axis*

A horizontal line on y = 0 will be added to the graph to increase the readability of the figure.

*- Figure 4: the legend can be improved: the lines are really thin and we don't see the colors well. Moreover, the box around the lines are not necessary and are even a bit confusing.*

*- Figure 5: same as Figure 4*

*- Figure 10: same as Figure 4*

Indeed, this will be improved.

*- Figure 11: Mainly an issue when printed... Can you widen the range of colors in order to better see the differences? Additionally, it may be easier to read without the borders around the dots.*

We already tried several colour ranges to improve the readability of this figure. This is one of the clearest we found. When the borders around the dots are removed, the yellow points (South East of France during the summer) are almost invisible. This figure is indeed easier to read in a full A4 page.

*- Figure 12: Mainly an issue when printed... The dots being really small, we mainly see their borders instead of the color inside, which makes it very difficult to read. What if you remove the borders and change the colors to avoid white?*

As for the precedent figure, we tried different colour ranges. Critically, the chosen one is the same than for Figure 11. Having larger points would lead to a loss of information as the different stations would not be easily distinguishable. This figure is actually easier to read in a full A4 page.

References



IPCC: Annex III: Glossary [Planton, S. (ed.)]. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013

Interactive comment on Clim. Past Discuss., 11, 4425, 2015.