Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-557-RC1, 2020

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Assessment of meteorological extremes using a synoptic weather generator and a downscaling model based on analogs" *by* Damien Raynaud et al.

Anonymous Referee #1

Received and published: 6 January 2020

Review of "Assessment of meteorological extremes using a synoptic weather generator and a downscaling model based on analogs", by Raynaud et al.

This paper presents analyses the performance of three stochastic weather generators based on circulation analogs to simulate daily temperature and precipitation over the Aare river basin (Switzerland). The paper is overall interesting (comparison of three models of increasing complexity) and clearly written. Yet, I think that the experimental set up could be improved and some discussions do not seem to be supported by the results or the figures. Therefore, I feel that there is ample room for improvement of the manuscript to optimize its impact.

Major issues

I do not think that stochastic weather generators (especially those based on analogs) are efficient or even useful to simulate long (i.e. multi-annual) sequences of climate variables, because they cannot take low-frequency variability (due to the ocean or global warming) into account. Instead, they can be very useful to simulate very large ensembles of short sequences in a stationary climate. The manuscript never compares long term variability of model simulations and observations, but focuses on seasonal probability distributions. Therefore, the introduction and interpretation should focus on the challenge of reproducing the probability distribution of climate variables, rather than a centennial reconstruction that is not even analyzed. This would also be more relevant for potential users (as claimed in the abstract and introduction), and would make room for comparisons of probability distributions (past vs. present vs. future).

Does the comparison of seasonal precipitations (Fig. 6) depend on choices of predictors to compute analogues, or even how the seasonality is taken into account?

I am surprised that the discussion of the results is so qualitative: the authors show boxplots or return value plots that yield rather small changes, but never compute actual scores of performance that would quantify the performance of the simulations. Continuous Rank Probability Scores (CRPS) or Tallagrand diagrams (or just quantile plots) would be more useful than a subjective appreciation of Fig. 7. I see no discussion of uncertainties of the results (e.g. with respect to model parameters).

My bet for the strange performance of SCAMP+ to simulate a reasonable range of summer temperatures is that summer temperature follow a distribution that depends on the mean state (e.g. Parey, S., Dacunha-Castelle, D., & Hoang, T. H. (2010). Mean and variance evolutions of the hot and cold temperatures in Europe. Climate dynamics, 34(2-3), 345-359.). Just perturbing with a Gaussian distribution with a fixed variance lowers the variance, with respect to the true temperature variance.

Specific points

My notions of Alpine geography are rather limited. Indications of longitude and latitude in Fig. 1 would be useful.

Using geopotential heights for analogs is certainly a good idea, but the authors should be aware of long term trends (due to temperature increase), which induce biases in analog computations, especially in ERA20C. The authors could consider removing such a trend.

The authors compare (with two different visualizations) 1 day, 3 days, 5 days (Fig. 8) and 92 days (Fig. 7a) precipitation values. What is the cut-off duration for which the three weather generators give similar results (Fig. 7a)? If a generalized Pareto distribution was fitted to precipitation, would the ANALOGUE or SCAMP weather generators be within confidence intervals?

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