

## ***Interactive comment on “Statistical Reconstruction of Daily Precipitation and Temperature Fields in Switzerland back to 1864”*** **by Lucas Pfister et al.**

### **Anonymous Referee #1**

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The manuscript presents a gridded reconstruction of daily precipitation and temperature in Switzerland over the last 140 years approximately, based on available but sparse station observations. The methodology is based on the Analogue Resampling method, with post-processing applied Quantile Mapping and Ensemble Kalman Filter. The study is indeed very interesting – the idea of combining the Kalman Filter and the analog method is I think novel. The applied methodology is valuable. The manuscript is generally clearly written and well structured. Therefore, I am happy to recommend the manuscript for publication after some revisions, which I hope that the authors may want to consider.

C1

#### General comments:

1) The manuscript discusses at length the success and deficiencies of the reconstructions, both with the ARM and the post-processed reconstructions. This discussion is focused on the replication of the mean, variability and extreme events. I have one general comment in this regard. The ARM using just one analogue is in principle unbiased and should also replicate the correct variance, since it is simply a re-sampling of observations. Therefore, deficiencies in the replication of aggregated statistical measures, such as mean and variance, found in the same ‘pool’ period 1961–2017 can only be originated in the predictand field, the gridded temperature and precipitation products. (Of course, the skill in replicating the temporal succession and extremes is another question). Thus, the evaluation of the ARM by the leave-one-out method is actually not only a validation itself but also in combination with the gridded temperature and precipitation fields. Since the construction of these fields always involves some sort of regression or averaging of station data, the extremes and in general the variability is reduced compared to station data.

2) I understood why the station predictor data need to be de-seasonalized and standardized, as temperature and precipitation have different variation ranges. However, I did not understand why the gridded predictand fields also need to undergo this per-processing. In theory, once the ensemble of  $n$  analogues is identified, the same days can be selected from the pool of un-preprocessed predictand fields. Perhaps, the Kalman Filter algorithm requires that per-processing, but it is not obvious to me. A short explanation, if that is the case, would help the reader.

3) Through the manuscript, especially in the beginning I had problems to figure out which data are the ‘predictors’ and which the ‘predictand’. It becomes clearer later in the manuscript, but perhaps the authors would like to use this terminology or a similar one from the start. It will help those readers that are not that acquainted with the analog method

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Particular comments:

Some refer to the English usage, but I am not a native speaker, so the authors may want to double-check

line 3 'whereas prior to that local station observations'

the sentence is ambiguous : whereas prior to that year, local stations observations..

line 37 'The analogue approach makes use of this statistical relationship between large-scale and local weather or meteorological patterns, while the former is used to predict the latter.'

what is 'the former' and which 'the latter' ?

Line 81: 'Errors are estimated to be in the order of factor 1.7 for precipitation on) and 1.3 for precipitation above the 90% quantile..

I guess units are mm/day

line 104 data to predict the spatial fields and a record of the spatial data from which the reconstructions are drawn. the spatial fields we used daily station observations, while the RhiresD and TabsD datasets for 1961–2017 from M

I would set here which data are the predictors and which the predictands. Many readers would refresh their understanding of the method by going directly to this section

line 115 The day of interest and possible analogue days are required to be of the same WT to assure similar synoptic-scale

to ensure

line 158: where  $x$  denotes the updated state vector (analysis),  $x$  and  $y$  as described above and  $K$  is the Kalman gain or innovation matrix calculated from the ensemble. In this and the following equations,  $H$  describes the Jacobian matrix of  $H(x)$  and extracts

I am not sure this is the Jacobian matrix. In my understanding the Jacobian of a

C3

vector function of several variables is constructed by taking the partial derivatives along the vector dimensions. Here, I think the authors mean the projection operator or the selection operator

line 191 I think that QM becomes necessary because of the use of the Ensemble Kalman Filter. The ARM (best analog) would deliver the correct pdf (unbiased, correct stdev, etc). Also an ARM based on an ensemble of analogues would need QM. Is that true ? Perhaps the authors may want to discuss this point.

Line 338: From this, we can conclude, that reconstructions provide accurate precipitation fields for low to moderate precipitation

delete comma after conclude

line 340 'Extreme events, however, are underestimated by ARM reconstructions and show large errors also for post-processed data. As extreme events by definition occur more rarely, the number of suitable analogues is limited. As argued in for upper and lower extreme values. In general, errors could be significantly reduced with Kalman fitting. The average bias reveals, that while analogue reconstructions tend to overestimate negative extreme values and underestimate extremely high'

I am not sure that I completely agree (see previous comments). The ARM (best analogue) would automatically produce the correct pdf, It would miss extremes, and produce them at the wrong point in time, but the pdf should be the best possible (it is simply a re-sampling of the observations). I agree that the Kalman filter, and in general an 'ensemble ARM' would produce smaller RMSE at the expense of reduced variability, but trade-off belongs to the general statistical trade-off between bias and variance of an estimator.

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Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-124>, 2019.