

Referee 1

Thanks you for the review and your suggestions. You can find our answers to the comments below.

#### MAIN POINT

1) An advantage of daily-scale reconstructions is that one can also analyse the temporal persistence of climate anomalies. An open question is whether the analog + Kalman filter method is able to capture the serial correlation of the temperature reconstructions or the distribution of length of dry or wet periods, the so called storm inter-arrival times. This can be relevant for the study of droughts, for instance.. Indeed the example presented in the manuscript seems to be characterized more by the length of the anomalies than by its intensity. Also, if the data presented here are to be used to drive an agricultural model, a good representation of the temporal persistence may be important.

I would thus suggest to include one figure with some of those results.

*Thank you for this comment. We conducted the following additional analyses on the cross-validation data for the five networks shown in Fig. 1:*

*- for precipitation: we calculated the probability of a dry (wet) day followed by a dry (wet) day ( $P_{ww}$ ,  $P_{dd}$ ) and compare these values for the different network set-ups (see Moon et al. 2019) in space and time.*

*- for temperature: we calculated 1 to 20-day lag autocorrelation for the different network set-ups and compare these values in space and time.*

*The results from the cross-validation for both analyses showed lower persistence compared to the original data, which is to be expected since no information on the temporal structure enters the reconstruction. Nevertheless, the found differences are very small. To avoid making the manuscript unnecessarily long, we added two figures to the Appendix, but discuss these briefly in Section 4.1.*

#### MINOR POINTS

2) Are the data in the present reconstruction and in the data that flowed into EKF400v2 independent?

*2) In EKF400v2, observations are assimilated at the same locations as in the here presented dataset (see Valler et al. 2019). For example, for Milano and Hohenpeissenberg, these are the same observations. However, we also use updated time series that include newly digitized data (see Brugnara et al. 2020, 2022). In Table 1, the source of the data is listed. We did not add a sentence in the respective chapter. However, there is a new chapter comparing the long-term variation of the data sets, where it is stated that they are not independent.*

3) The best estimate in the analog method is the closest analog, but the model error covariance matrix in the KF is estimated from the 50 closest analogues. Isn't this an inconsistency? Shouldn't the central estimate be for instance the median of the 50 closest analogs?

*In contrast to model simulations, where all members could be considered equally likely, the fields generated by the analog resampling differ in their reconstruction skill. For days with large differences in the similarity measures (Gower distance/RMSE), we can assume that the best analog day represents the historical field at the observation locations better than for example the 50th analog. The update of the mean is based on the entire 50 analogs (equation 3), whereas for the final reconstructed field (the analysis), we use only the first analog of the updated anomalies (equation 4). In order to consider all 50 analog days, in our approach, one should give weights to the analog days depending on their similarity measures. We did, however, not test whether this*

would increase the reconstruction skill. Furthermore, using one analog day yields a physical consistent field. This is not the case if the mean or the median of the 50 analog days is used.

4) Crops need a certain amount of energy in the form of temperature to reach their different phenological stages

In my limited understanding, temperature is relevant for the speed of the the metabolic reactions in the plant. The energy itself stems from the solar radiation

*We reformulate the sentence as follows:*

*Crops require a certain amount of accumulated heat to reach their different phenological stages. The growing degree days (GDD) index can be used to express this heat accumulation needed until a phenological stage is reached (Wypych et al. 2017). GDD is calculated as the sum of daily mean temperature above a certain threshold of daily mean temperature (e.g. Bonhomme, 2000).*

5) The area, where a GDD of 1000 is never reached, is much larger, meaning, that some cereals never fully developed.

Two commas in the sentence need to be deleted: The area where a GDD of 1000 is never reached is much larger, meaning, that some cereals never fully developed.

*Thank you, we corrected this sentence in the updated manuscript.*

6) I think that a sentence in English can not begin with a number. The title should read 'Two hundred and fifty years of..' .or it should be modified, for instance, by 'Daily weather over 205 years...'

*We changed the title to "A 258-year-long data set of temperature and precipitation fields for Switzerland since 1763".*

Referee 2

Thanks you for the review. You can find our answers to the comments below.

### Main comments

Data assimilation is made here at the daily time step, in order to correctly represent day-to-day variations in temperature. Devers et al. (2021) showed that this is however not sufficient to guarantee the right longer-term (annual to multi-decadal) anomalies. More generally, this manuscript – along with the previous one – does not engage in any long-term assessment of the long-term datasets, i.e. an assessment of long-term variability and climate. This is in my view quite unfortunate as such a dataset may be quite valuable on both aspects (day-to-day and spatial variability, and long-term evolutions). I would not ask for properly validating the long-term behaviour of the dataset, as we all know that this is perhaps the most difficult task when dealing with highly evolving network measurements and quality. However, some insights about the long-term evolution of Swiss climate as reconstructed in this dataset would be highly appreciated, and would probably bring more information on the dataset quality, notably on its temporal homogeneity across the three main periods.

*We added chapter 4.3 “Assessment of long-term variability” where we show and discuss the long-term evolution of the Swiss climate as reconstructed in our data set and compare it to other data sets, e.g. the Swiss mean monthly temperature fields Trecabs since 1864, EKF400v2, and the temperature and precipitation reconstructions by Casty. The two later data sets correspond to the ones used in the case study. We found an error in the data set while creating this comparison. Please refer to the document “additional\_reply.docx” for the description of the error and the changes.*

The method developed here is accurately detailed in the data and methods section. However, it involves such a large number of steps (detrending, bias-correction, resampling, etc.), that at the end of the day, the reader is not sure anymore on the path followed by the original data. I am unsure on how this could be even more clarified in the manuscript. Maybe a schematic?

*We added a new Figure 2 to the manuscript showing a schematic of the entire reconstruction and cross-validation procedure.*

I appreciate the effort made in taking account of precipitation occurrence observations, notably through the Gower distance. On the precipitation topic, I was wondering whether assimilation of precipitation (and precipitation occurrence) have been tested here instead of the quantile mapping step.

*We did not assimilate precipitation data (as it is done in Devers et al. 2021) due to the low amount of precipitation observations available in the historical period before 1864, which is the main focus of the manuscript. However, data assimilation could improve the reconstruction from 1864 to 1960, where more measurements are available. We added in the conclusion that data assimilation for precipitation could be further explored.*

### Specific comments

- L220-222: Isn't it a source for non homogeneity in time?  
*Using the Gower distance and RMSE for the period after 1864, did not lead to substantial differences in the reconstructions. The main source of inhomogeneity in the data set stems from the temporal changes of the station network. Break points for individual locations are indeed detected at time steps for which the network changes considerably.*

- L280-281 and Fig. 4: It is not that clear if the analogy is made on these different subsets of stations (networks) for this cross-validation exercise and then applied on the whole Swiss domain (I guess this is the case). Please clarify this.

*The cross-validation is performed for the networks with different station density to demonstrate the change in the skill of the reconstructions for different time periods. The entire reconstruction is run on all available data. We will clarify this sentence.*

- L376-382: Figure 6 should be referred to here.

*We added the reference to the figure.*

### Technical corrections

- L217: “the partial distance of is” → “the partial distance is”

*We corrected this sentence.*

### References:

Brugnara, Y., Pfister, L., Villiger, L., Rohr, C., Isotta, F. A., & Brönnimann, S. (2020). Early instrumental meteorological observations in Switzerland: 1708–1873. *Earth System Science Data*, 12(2), 1179-1190

Brugnara, Y., Hari, C., Pfister, L., Valler, V., and Brönnimann, S. (2022) Pre-industrial temperature variability on the Swiss Plateau derived from the instrumental daily series of Bern. and Zurich, *Clim. Past*, 18, 2357–2379, <https://doi.org/10.5194/cp-18-2357-2022>

Devers, A., Vidal, J. P., Lauvernet, C., & Vannier, O. (2021). FYRE Climate: a high-resolution reanalysis of daily precipitation and temperature in France from 1871 to 2012. *Climate of the Past*, 17(5), 1857-1879.

Moon, H., Gudmundsson, L., Guillod, B. P., Venugopal, V., & Seneviratne, S. I. (2019). Intercomparison of daily precipitation persistence in multiple global observations and climate models. *Environmental Research Letters*, 14(10), 105009.

Valler, V., Franke, J., Brugnara, Y. & Brönnimann, S. (2021). An updated global atmospheric paleo-reanalysis covering the last 400 years. *Geosc. Data J.* <https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/gdj3.121>.