

Reviewer 1

The authors present a new reconstruction of daily sunshine duration, relative humidity, minimum and maximum temperature, and u- and v-wind with a 1x1 km resolution for Switzerland. The reconstruction covers the whole period since 1763, proposing thus a wide range of conditions that could be used as a baseline to analyse recent events or to estimate the impact of past changes on agriculture and fire development for instance. The methodology is similar to the one applied in a previous study. The skill of the reconstruction is evaluated in details to identify the interest of the approach but also the limitations. This is a very interesting product and it is well presented here. However, I would be happy to have a deeper justification of some of the choices and a longer discussion of the implications of those choices before the publication in the journal.

General comment.

My only general concern is about the consistency between the different variables. The authors mention (lines 469-471) that the ‘an advantage of our reconstruction is that the variables are largely physically consistent with each other since they stem from the same or similar analogue days’. However, this consistency is ensured between some variables like relative humidity and wind speed but not for others. The daily mean temperature and daily precipitation comes from a previous study with a slightly different methodology. Wind and relative humidity come from a different pools of analogues compared to minimum and maximum temperature and relative sunshine duration. The possible issues are discussed for daily minimum and daily mean temperatures as inconsistencies can be obvious for those two variables but a wider discussion is needed. It is also not clear why different fields comes from different pools of analogs (for instance I guess COSMO is providing all the required variables ?) or why an updated reconstruction of daily mean temperature and daily precipitation was not produced here to be have a more consistent product instead of using the existing reconstruction.

We will add a new Chapter 5 to the manuscript covering the topics consistency and uncertainty (previously the chapter on long-term consistency). This chapter will include a more thorough discussion considering both topics. In order to address the consistency between variables we will conduct case studies in the reference periods of the data sets where we evaluate at how the different variables behave with respect to a physically consistent data set, such as the variables obtained from the COSMO model, and the different daily gridded products from MeteoSwiss.

Furthermore, we will add to the manuscript a more in-depth description why different variables come from different data sets. This is mainly related to the fact that larger analogue pools show better reconstruction results. The COSMO model is only used as an analogue pool, because there are no other promising datasets.

Specific comments

Line 16. I would mention that the two historical fires occurred in summer (to make clearer the difference with the winter contemporary wildfire).

We will include that the historical fires occurred in summer.

Line 36. It is mentioned ‘mean and minimum relative humidity’. Is this correct ?

Yes, this is correct. We reconstructed these two variables because mean relative humidity is relevant for various applications, whereas we wanted to use and test minimum relative humidity for reconstructing the fire weather index.

Line 44. You should justify why you do not apply the data assimilation for those variables.

The units of these variables is percentage which has by definition upper and lower bounds. Since values, for example close to 100 % relative humidity or 0% relative sunshine duration occur regularly in the dataset, the data assimilation system would be needed to consider such non-gaussian distributions, e.g. by using logit-transformations. Furthermore, we do not have sufficient historical observations for humidity or relative sunshine duration and therefore, we could only assimilate daily mean temperature (and minimum or maximum temperature after 1864) onto the relative variable's fields. It would be interesting to further explore the methods to assimilate temperature data onto the relative humidity and sunshine duration fields, however this would require further in-depths studies on the exact implementation approach. This was beyond the scope of study in our case, which was mainly focusing on the reconstruction of minimum and maximum temperature and wind fields. However, we suggest it could be useful to test such methods in comparison to other methods (such as machine learning) to improve historical reconstructions of daily variables.

We will add a sentence discussing why we did not use data assimilation for the variables of relative sunshine duration and relative humidity.

Line 89. I do not follow to what corresponds the 361 values and later the 190 and 38 values. Which variables are selected and from which dataset ?

We will improve the explanation of what these values relate to by adding the following sentence:

This additional quality control led to many values being flagged. When access to the "Wetterarchiv" of MeteoSwiss was available, we checked whether these flagged values were digitization errors. We re-digitized 361 values where the error could be attributed to digitization. Furthermore, we re-estimated 190 values flagged by the spatial quality control to avoid losing relevant daily data. For example, when a possible digitization error was suspected but the original document was unavailable. In addition, 38 values were flagged as climatic outliers; these did not appear in the automated tests from the dataresqc R-package but were physically implausible based on the spatial tests. All flagged values were excluded from the reconstruction, except for those identified as daily repetitions.

Lines 121-122. Is it possible to add a reference where this realistic representation is shown ?

We will add an additional reference that described the SrelD dataset.

Lines 126-128. Could you comment on the lower quality of the reconstruction using the data from COSMO-1 with ERA-5? I would have expected better results as a larger pool of analogs is available from the longer series. Additionally, it is mentioned 'using ERA-5 variables as predictors', I guess it is as boundary conditions for the COSMO-1 model.

In the cited study (Miralles et al. 2022), COSMO-1 wind fields were used to train a generative adversarial network (GAN) to predict hourly u and v winds based on ERA-5 variables as predictors. However, the evaluation results showed only limited ability to predict the wind

fields accurately. We performed our analogue reconstruction in the first place using the 60 years of daily wind fields from Miralles et al. 2022. However, cross-validation results for 2016-2020, comparing the analogue reconstructions using COSMO-1 and their wind fields separately, showed much better results when the reconstructions were based directly on COSMO-1 fields. Furthermore, whereas the reconstruction using COSMO-1 was able to capture (at least qualitatively) many known events, for example as show in Fig. 4, this was not the case for the reconstruction using the GAN-wind fields.

Whereas the study by Miralles et al. (2022) is certainly a very interesting piece of research on how to optimally implement an ML-model, in our case, it proved more useful to newly reconstruct the wind fields using the original COSMO-1 fields directly as an input into our analogue and data assimilation method.

Line 135. What is the impact of this choice ? Does it introduce inconsistencies compared to the previous reconstructions ?

Yes, it does introduce inconsistencies compared to our previous reconstructions. We will discuss this in an extended chapter 5 about consistencies in the data sets and we will in addition conduct an analysis of the consistency between variables based on two case studies, as already answered in the first comment.

Section 3.2 Could you explain how the number of analogs is selected (see for example lines 206-207)? You should also explain why two analogue pools were chosen and the potential consequences (see the general point above).

The lower number of analogues selected relates to the fact that based on our restrictions, there are not so many analogues available. To have a consistent number of analogues for every day, we used the lowest number of analogues available which is 20.

We will explain in more detail in the method section, why there are different analogue pools.

Line 248. Fig 1b and 1c correspond to year 1864 if I am right. I would write it explicitly for comparison with the two other dates (1767 and 1819).

We will adjust the headers of this figure to make more clear what exactly is shown. Furthermore, we will adjust Fig. 1 and add NW1 and NW3 as well.

Figure 2. It took me some time to see that panels a-d were for wind speed and panel e for wind direction. Is it possible to add the information directly on the plot ?

We will add this information to the Figure 2.

Line 284-285. This sentence is hard to follow. Does it make a reference to the previous study? In that case, I would expand the discussion to be more explicit.

We will add the reference to the previous study and reformulate the sentence:

“The differences between the available network sizes are significantly smaller than those observed for the precipitation and temperature reconstructions presented in Imfeld et al. (2023). While the smallest network NW 1, with only 11 observations, shows considerably

lower skills for all four metrics, the results from NW 3 and NW 5 are very similar (Fig. 3a-d). ”

Figure 3. Are the I-I panels showing percentile (and in that case why only numbers between 0 and 9). Is it deciles instead ? (same for Figure 6).

We will adjust the caption of the figure, saying it contains deciles and we will adjust the x-axis of the panels e-l to 0.1-1.0.

Figure 5. As for Figure 2, would it be possible to put on the figure the variables shown ?

Yes, we will do this.

Figure 8. Typo in the caption ‘fg’ instead of ‘g’.

Thank you.

Line 430. Is a date missing between the parentheses ?

It should be the citation of the year when the newspaper was published. We will adjust this citation.

Lines 448-450. The same sentence is repeated twice.

Thanks, we’ll delete it.