Hydrology and
Earth System
Sciences

Discussions

Interactive comment on "The Analogue Method for Precipitation Forecasting: Finding Better Analogue Situations at a Sub-Daily Time Step" by P. Horton et al.

Anonymous Referee #1

General comment

In classical applications of the analog method, analog situations of some target day are identified in an archive of days defined on the same temporal window, namely 6H00 a.m. to 6h00 of the following day. This window is classically fixed to be close to the temporal window considered by meteorologists for the measurement of rainfall at daily gauges. A number of analog situations potentially also exist when other temporal windows are considered, e.g. 12am to 12 am. The paper explores the possibility to increase the prediction skill of atmospheric analogs using a Moving Temporal Windows. As atmospheric predictors are available at a 6hourly time step, 4 different atmospheric situations are thus available for each day instead of one (6h>6h, 12>12, 18>18, 24>24).

The authors show that when the same archive period is considered, the increased number of potential analogs (x4) for any target day leads for a significant improvement of the prediction skill.

They also discuss the issue of the length of the archive. The archive which has to be available, for both the predictor and the predictand, at a 6 hourly time step covers obviously a much smaller time period than classical archives of daily rainfall (roughly 2 times smaller in the present case). The authors show that the benefit of a MTW is reduced by the limited length of the high resolution archive.

The analysis is done for a couple of precipitation stations in South-Western Switzerland. It focuses on differences between the classical approach and the MTW one, describe how results depend on the "dynamism of the atmospheric situation" or on seasons, explore if a disaggregation of the longer lower resolution archive would be worth to improve prediction skill.

The paper gives a very original and valuable contribution to the issue of probabilistic weather prediction with the analog approach. It is globally sound and describes in a intelligible way different aspects of the problematic. Figures are clear as tables (perhaps too many tables). Some points are however not optimal and should be modified/clarified and or completed. They are listed below. For this reason, I would recommend a major revision of the manuscript.

Specific comments

Introduction.

To my opinion, the introduction is not as an introduction should be.

- 75% of the present introduction describes the analog model that will be used afterwords in the work (it starts from line 35 and goes to line 78! Additional details are given from l88 to 92). The detailed description of the method should belong to a "Data and Method" Section.

- Most references involve one or more co-authors of the present paper as if the authors were not aware of the great amount of work that was done in the past years (decade) with this method.

- The issue discussed in the manuscript goes beyond this "fixed/moving" window issue. It more generally consider influence of the size of the data set (including the length of the archive) on the prediction skill. I am not aware of works that explored this issue but references to those, if any, and associated results have to be presented in the introduction.

- The final objective of the work is to increase the prediction skill of the method. Other means are possible for this. They should be also mentioned.

To my opinion, the introduction has thus to be rewritten. The detailed description of the method goes after. References to other works worldwide involving the analogs for general concepts or aspects of some relevance for the present study have to be integrated as well as possible (alternative) ways to improve their skill.

MTW strategy vs longer archive.

This analysis poses the question of the length of the archive. The MTW allows having 2 times more analogs than a two times longer low resolution archive. It would have been interesting to put in perspective the present results with results of other works where this issue has been explored. Do you find similar gain here. We can imagine that the MTW strategy would not be as performant as a 4 times longer archive for two reasons :

1/ 2 overlapping situations of a given day (that beginning at 6h UTC and that beginning at 12h UTC o the same day) are likely to be highly correlated and may therefore contain more a less some redundant "large scale-small scale" information. The MTW strategy is thus not equivalent to a 4 times longer period at a daily time step. What would be the results if only the 2 temporal windows (6>6 and 18>18) (or for instance also (12>12

and 24>24)) are considered ? In such a case, the risk for redundancy is lowered and we could expect that this extended dataset (size is multiplied by two with respect to the initial daily one), provides a higher skill gain than the one obtained from the next archive extension (x2 to x4 as in your work). Could you precise what is the gain obtained from a MTWx2 and a MTVx4 approach ?

2/ An archive 4 times longer would possibly cover sligthly different climate contexts than those observed during any initial (shorter) period. For this reason, the longer archive is expected to also include atmospheric situations that are similar to the one of the target day, such similar situations being not in the initial shorter period for which high resolution archives are available

On the other hand, in a transient climate, the "large scale – small scale" link is likely to change and the predictions produced from analogs that are far back in the past are likely to be not really informative any more (or at least, not as informative as when they were used one or 2 decades ago). It could be therefore of some interest to keeping a smaller archive length to have similar [large-scale>small scale] configurations » the MTW is in this case also an alternative to extent the archive without relying on too old dates. … These issues should be discussed in the manuscript

Number of analogs

Line 337 the authors say : "A wider selection of analog situations containing those whose rank decreased, seemed profitable for the prediction performance". This is somehow not what is expected. Previous studies show that the poorest the analog days are, the more analog days you have to consider sothat your prediction remain reliable (but you loose in resolution and in CRPS score). So, we could expect in the opposite case, that the better the analogs, the less analogs you need to make a good prediction and the better the prediction will be. This is obviously not the case from your results as you still find a better score in increasing the number of analogs. It could suggest a limit of predictability from the method. It clearly also suggests that important

auxiliary predictors are missed. Could you comment this.

Detailed Comments

71. Explain both terms of the decomposition. Another well-known decomposition of the CRPSS is that of Herbasch. Please mention it also and clarify the advantage of that of Bontron. It is not clear at this stage.

75. Why using a non conventional notation for the CRPS score. Please use the classical one (CRPSS) or justify

79. Clarify to what corresponds a CRPSS=1 or <0

93. "the first reason ...". I do not understand this statement. Please clarify

110. A low resolution atmospheric reanalysis is used (NCEP/NCAR at 2.5°). What would be the increase in skill prediction with a higher quality reanalysis : resolution, model (interest of ERAint?). Would it be higher than the MTW strategy ?

105. Analog approach. It is not clear if all days are potential analog or if a seasonal stratification is considered for this identification. The results of your section 3.1.3 suggest that a seasonal stratification would be relevant (at least for summer). Could you comment ?

140. precise again the archive length for this section

146. "an increase in difference". I do not understand what kind of increase you comment. Please clarify

170. You use the mean intensity of rainfall as a proxy of "dynamism of the atmospheric situation". Another proxy could be the intensity of the variations within the geopotential fields (e.g. mean gradient value). Why did you not explore this ? It would better fit to your "dynamism" concept.

197. "In contrast to the earlier" : what is the reference AM you consider to state this

reduction / increase ?

208. STW > change for "analogy scores"

216. the differences ranges (delete the "s") : are they gain or losses. This is not clear at this stage. Please Clarify.

219. "moreover, it requires no additional predictor" > this is out of subject at this stage. Could be integrated / discussed in the discussion section. Next what is the gain that could be obtained from additional predictors. Should say a word on this point.

226. "the increasing positive trend of skill improvement" ???? should be "the increasing trend of skill ?". Please reword. I do not understand.

227. "is further improved" : when compared to what ?

230. "it seems as if the method..." > This sentence is likely not needed

246. has a slight effect" vs " have significantly increased" > it seems to be contradictory

251-253 : it is a conclusion of this section ?

259. section 3.2.3. why both sharpness and accuracy estimate should be comparable ? I do not see really the utility of this section. We do not know to what refers the accuracy / sharpness respectively, what we should expect as results... Not convincing.

279. Section 4.1. The disaggregation of daily prec. is an interesting strategy. Two simple approaches were considered in the present case without real success. What would be the perspectives of research for this issue ? This is probably missing in the present work. The disaggregation based on the proportional distribution is very not clear. What is the proportionality for ? I suspect that you assume that the rainfall intensity is constant throughout each day ? Is it right ? What is the length of the archive considered in this experiment ?

286 / 304. Clarify also the method used to make the disaggregation based on the

atmospheric proxy. What information is used ? how ? Do you scale each day the temporal profile of the proxy to disaggregate the daily precipitation amounts ?

347. perform instead of preform

349. "the first source of data. . ." The sentence is clumsy. Please reformulate. I do not see the link with "getting longer"

Figure 2 – in the figure / 3st graph > candidate "days" and not "day"

Figure 11 : - it is not clear for me. Does the recalibration lead to poorer scores ? - The two last plots are the same. > error

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