Review of « Assessment of stochastic wether forecast of precipitation near European cities, based on analogs of circulation » by Krouma et al.

General comments :

The article assesses the skill of a stochastic weather generator to forecast precipitation in 4 cities of Western Europe. The SWG is based on random sampling of analogs of geopotential height. It was developed in another article by Yiou and Déandréis 2019, where it was applied to temperature. This study complements the latter for precipitation. As a refinement, a time embedding of 4 days is considered in the distance for the search of analogs (however the considred distance is not a mathematical distance anymore - see below). Skill scores are evaluated for lead times of 5 to 20 days. Results show positive skills up to 10 days. A comparison to ECMWF forecasts is provided but I have some concerns about this part (see below).

The study is interesting, clear and well written. Precipitation forecasting is an important subject of research and I support the idea basing SWG on analogs. However I have several main concerns :

- The results are mainly shown for NCEP which used to cover a longer period than ERA5. However ERA5 is now available since 1950. Given its much better resolution, I recommend considering ERA5 for all the results.
- I'm surprised that all the applied tests (Table 1 and p 14) have pvalues equal to 2.2^{-16} (I guess you mean 2.2 10^{-16}?). Isn't that strange ? More importantly, I doubt that Kolmogorov Smirnov gives such low pvalues given the differences in the CDF of Figure 6.
- I'm concerned about the comparison with ECMWF forecasts since ECMWF are gridded data, whereas SWG is based on point data (ECAD). Have you considered comparing ECMWF forecasts with SWG based on E-OBS, since both have an horizontal resolution of 0.25°x0.25° ?
- The evaluation of CRPSS conditional on weather regimes is interesting but I wonder whereas considering the weather regime of the last day of the sequence (t0+T) is representative for the weather regime of the whole sequence.

More minor, some references are missing (see below). There are issues in the units of CRPS. There are several equation issues.

Detailed comments :

- l 65 : Reference to Klein Tank is missing
- l 67 : please specify that ECAD provides point (station) data
- l 72-81 : actually ERA5 is now available since 1950.
- l 84 : Reference to Herschbach is missing. By the way, is it the right reference ?
- l 87 : so ECMWF forecasts have the same resolution as EOBS.
- l 104 eq (1) : This is a good idea to account for several days in the distance, however D in (1) is not anymore a mathematical distance. Of course this is not mandatory for analog search, however why not using [sum_x sum_i {Z500(x,t+i)-Z500(x,t'+i)²}], which is a mathematical distance? By the way, could you pelase provide a comparison of the results with the Euclidean distance (based on 1 day) vs. the D distance (based on 4 days)? And why 4 days ?
- l 111-118 : explanations are quite confusing. I had to read Yiou and Déandréis to understand. Please consider rewritting the method.
- Figure 1 : a) please consider placing the red rectangle somewhere else within the 30 days for clarity since its date is not necessarily the same as the target day. b) the largest window doesn't match the coordinates given l 80. I would be happy to see some results on the other windows of analogy. Otherwise I think it's not worth showing them. Also there are several syntax issues in the caption
- l 122 : please specify that persistence is computed over year k (unlike the climatology which is computed over all years)
- l 124 : « control forecast » I dont't understand

- l 137 : I guess that averaging the 100 trajectories smooths out the predictions. So at the end, is there a real gain (in terms of CRPSS) compared to considering only one analog ? (maybe that's already studied in another article, I haven't checked)
- l 150 : P(x) should be P(x,t) for day t. Please also rephrase the sentence
- l 153 eq (2) : the equation is confusing. Should be CRPS(P,t) and t should be in the right side as well. The inferiori limit is 0 for precipitation.
- l 159 : seasonality → climatology
- l 162 eq (3) : Equation issues. there should a sum over the days (or mean) in the numerator and denominator
- Table 1 : is it Pearson correlation ? I'm surprised that all pvalues equal 2.2^{-16} (I guess you mean 2.2 10^{-16}?).
- l 198-201 : this paragraph should go after l 204. Please refer to Fig 3.
- l 212 : syntax issue
- Table 2 : I guess this is for NCEP ?
- l 228 : remove the brackets
- l 230 : so you obtain 100 classifications. How do you deal with that ?
- l 241 : is the weather regime at time t0+T representative of the sequence from t0 to t0+T. Why don't you consider the most frequent WR within t0 to t0+T ?
- Fig 3 : please consider plotting both reanalyses on the same plot for ease of comparison. Actually for persistence ERA5 seems to give larger CRPSS. Caption : persistence in lowercase letter. Please use either « reeference » or « baseline » along the article. For the boxplots, why don't you consider correlation with the mean instead of the median (as the predictions of SWG) ? (but it should not change much)
- l 243 : don't you mean below the 25th quantile ? Where is this used ?
- Figure 4 caption : blank space after (BLO)
- l 251 and followings : I see there are differences depending on the WR but it seems to depend on the city. Can we have explanations why, e.g. CRPS for BLO is beteer in Orly ?
- Figure 5 : Units of CRPS are not mm. What is the lead time here ? Given l 243-244, I would have expected here to see boxplots for the two classes of predictability.
- l 257 : what is the reference for CRPSS ? (I guess climatology)
- l 261 : do I understand correctly that in ECMWF forecasts, CRPSS is given for the whole of Europe whereas CRPS are avalaible at every grid point ? As said above, I find difficult comparing the skills of ECMWF vs SWG given that the horizontal resulution is different (0.25°x0.25° vs point data). Comparison of ECMWF with EOBS at the same resolution may be easier .
- Table 3 : please specify the reference. You may want to add here the CRPSS of Europe with ECMWF.
- l 264 : CPRSS are actually hard to compare since they are not based on the same data (different resolution)
- l 266 « We found... » I don't understand the sentence (syntax issues). Anyway according to the CDF of CRPS in Fig 6, ECMWF seems significantly better (a much larger proportion of low values)
- l 270 again 2.2^{-16} ? Anyway, I think something's wrong here because the CDFs in Fig 6 do seem different. A difference of 0.2 between CDFs is large actually.
- l 276 and Fig 7 : I think something's wrong because ECMWF shows a much larger proportion of small CRPS for Toulouse and Madrid (see Fig 6). The difference in CRPSS for Orly between 5 and 10 days is very surprising.
- l 300 : designed
- Some references are missing. There is no year for Cassou.