We thank the reviewers for the constructive comments, which we considered in the new version of our manuscript.

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Report 1

General comments :

The authors have made a good job in accounting for the reviewers' comments. The article is clearer and easier to read. My only significant point is the comparison with ECMWF and in particular what regards Fig 8 that seems surprising to me given the previous results of Section 4.5 (see below).

Detailed comments :

- abstract : « Results show significant positive skill score » : do you refer here to the comparison with ECMWF or with the persistence/climatology ?

⇒ we refer to the comparison with persistence and climatology. This is clarified in the manuscript.

- l 100 : brackets

⇒ ok

- l 136 : SGW

⇒ ok, changed to SWG.

- l 151 : brackets

⇒ ok, we verified the reference formatting.

- eq (2) is still wrong. You have P and xa on the left hand side while you have P_{a,t} and xa on the right hand-side. Both sides should match.

⇒ The equation is corrected to be consistent.

$$CRPS(P, x_a) = \int_{-\infty}^{+\infty} (P(x) - H(x - x_a))^2 \, dx$$

where x is the forecast, x_a is the observation, P is the cumulative distribution function of x, H is the Heaviside function of the occurrence of x_a (H(z) = 0 when z<0, and H(z)=1 when z>= 0).

- eq (3) : please specify that bar is the mean

⇒ ok

- l 173 : brackets

⇒ ok

- Table 2 : why do you consider two periods for ERA5 ? ERA5 extended might be enough. In the caption : not only winter.

⇒ At the time of writing, Dr. Florian Pappenberger (from the ECMWF) warned us that the extension of ERA5 prior to 1979 was "experimental" as it was obtained with different constraints than for 1979-now. In practice, the Copernicus Data Store also indicates that ERA5 data from 1950 and 1978 is experimental. In that respect, it made sense to conservatively keep the two periods of ERA5. For simplicity, we now only consider the extended ERA5 product (1950-now).

The caption is corrected.

- l 245 brackets

⇒ ok

- l 272 « albeit significant » : what did you test exactly ?

⇒ This was reformulated.

- l 285 : brackets

⇒ ok

- l 296-297 : « We found that the values of CRPS of ECMWF forecast and SWG forecast are 80%, 39% 50% and 40 % equal or near to zero for respectively Orly, Berlin, Madrid and Toulouse » : there are two forecasts and 4 cities but you give only five % so I don't understand what they correspond to.

⇒ This has been clarified in the text: for lead times of 5 days, CRPS values are very small XX% of the time.

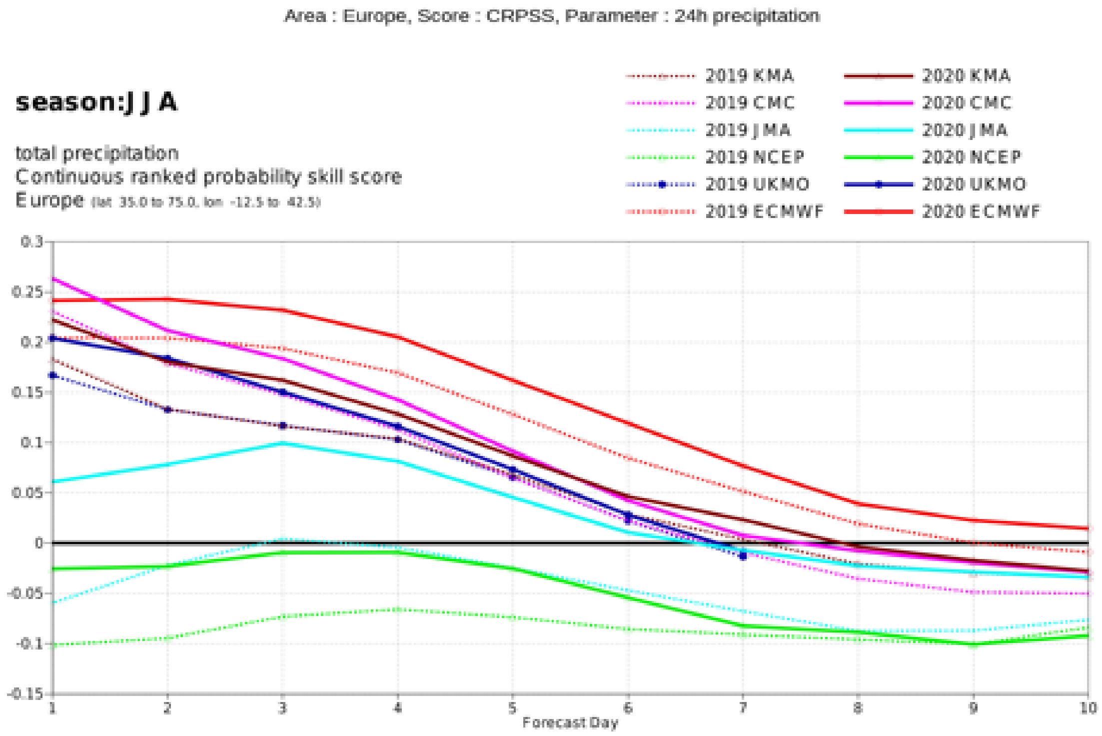
Also do you mean CRPSS ?

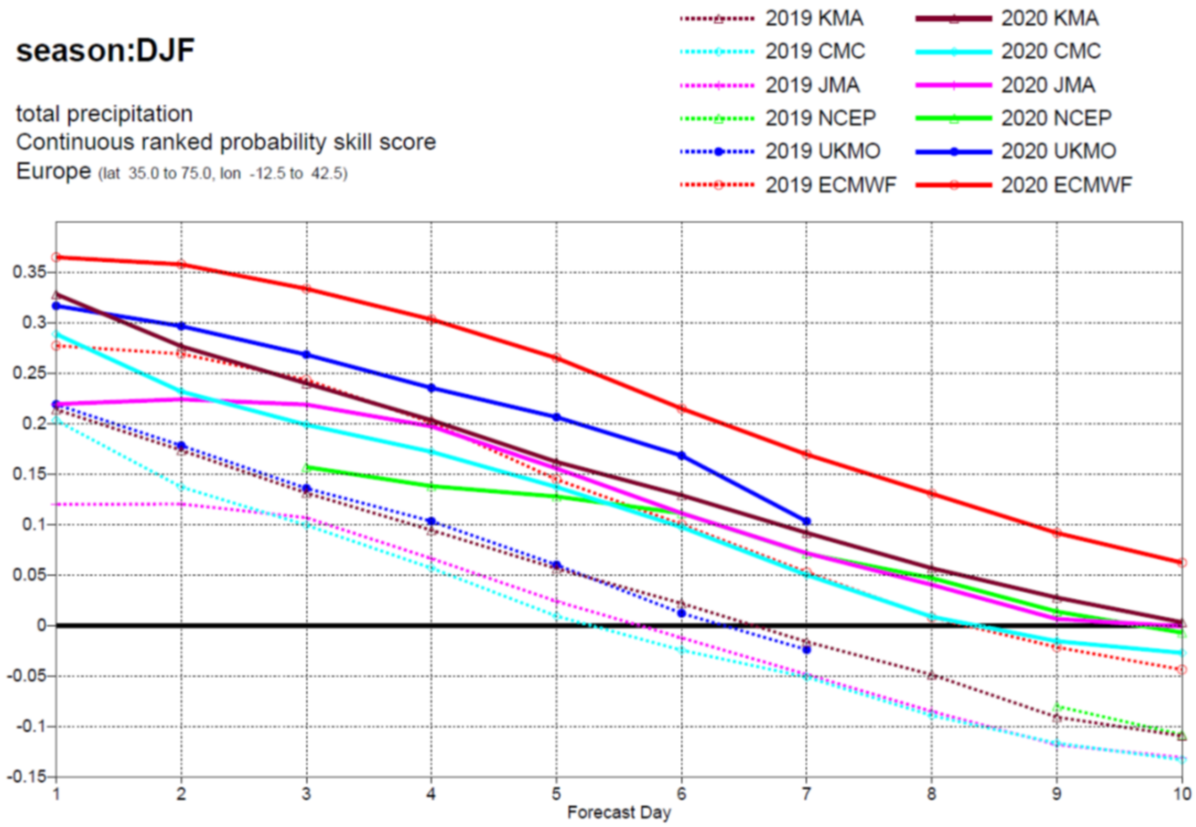
⇒ We compared CRPS not CRPSS. This will be clarified and emphasized in the text.

- l 291 « They are about 0.16 in the summer (JJA) and 0.25 in the winter (DJF) for a lead time of T = 5 days » : are these numbers right ? This seems quite bad (=low) for CRPSS. I'd have expected better CRPSS given Fig 7.

⇒ Those are the values of ECMWF not ours; they are not related to Fig 7.

The values of the CRPSS come from the ECMWF forecast for summer (June July August - JJA) and winter (December January February - DJF) for Europe (Lat 35.0 to 75.0, lon -12.5 to 42.5) for 2019 and 2020. We read the values from the following figures (taken from the ECMWF website (https://apps.ecmwf.int/webapps/opencharts/products/plwww_3m_ens_tigge_wp_mean?area=Europe&parameter=24h%20precipitation&score=CRPSS) and the technical report from ECMWF (Haiden et al, 2020). Those two figures below show the rather large range of skill score values across models. We used the ECMWF values to qualitatively compare the skill of the SWG forecast. We mentioned that those values are for a large region (whole Europe). However, the aim is to say that we are consistently close to those values, as we are making forecasts for local sites. This was clarified in the text.


Area : Europe, Score : CRPSS, Parameter : 24h precipitation
season:J J A
total precipitation
Continuous ranked probability skill score
Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)
2019 KMA
2019 CMC
2019 JMA
2019 NCEP
2019 UKMO
2019 ECMWF
2020 KMA
2020 CMC
2020 JMA
2020 NCEP
2020 UKMO
2020 ECMWF
Forecast Day


season:DJF
total precipitation
Continuous ranked probability skill score
Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)
2019 KMA
2019 CMC
2019 JMA
2019 NCEP
2019 UKMO
2019 ECMWF
2020 KMA
2020 CMC
2020 JMA
2020 NCEP
2020 UKMO
2020 ECMWF
Forecast Day

- l 293 : « The CRPSS of SWG for a lead time of T = 5 days showed in Table 2, and this suggests.. » : syntax issue

=> This is corrected.

- Fig 7 : The unit of CRPSS is not mm

⇒ it is a CRPS not a CRPSS. By definition, CRPS has the same units as precipitation (here mm/day).

- Fig 8 : I'm sorry but I still don't understand these results (see my previous review). If I understood correctly, CRPSS here is 1-mean(CRPS ECMWF)/mean(CRPS SWG) so a CRPSS value of 0.5 means that mean(CRPS ECMWF)=1.5*mean(CRPS SWG). Given Fig 7, it's hard to believe that for Orly mean(CRPS ECMWF)=1.5*mean(CRPS SWG). From my eyes, they are almost equal so I'd have expected a CRPSS value for T=5 around 0. For Madrid, it seems to me that the average CRPS is much lower for ECMWF than for SWG so again I'd not have expected negative CRPSS.

Maybe my eyes are confused. If so it could be useful to add a line showing the means in Fig 7. Another possibility would be **to replace Fig 7 by boxplots**.

⇒ This is indeed an intriguing point. The CDFs of CRPS values show a lower median for the ECMWF than SWG simulations. This is what a visual inspection shows. Yet, the mean CRPS is higher for ECMWF than for SWG simulations, because of outlier values of CRPS for ECMWF. CRPSS compares the means, not the medians. This will be illustrated with an improved Figure 7.

For the case of Orly, I'm also still surprised (see my previous review) about the strong change in CRPSS between 5-10-20 days. **In your next response, I'd be happy to see the equivalent of Fig 7 for T=10 and 20**.

⇒ ok

For clarification, we do the comparison based on the CRPS values of the SWG forecast and the ECMWF forecast. Then we compute the CRPSS between the mean CRPS of the ECMWF forecast and the mean CRPS of the SWG forecast.

In the following table (Table 1) , we compare the CRPSS values (computed between the mean of CRPS of ECMWF forecast and mean CRPS of SWG forecast). We considered the SWG forecast as a reference for the ECMWF forecast.

For a lead time of 5 days, as shown in the following table, we find that:

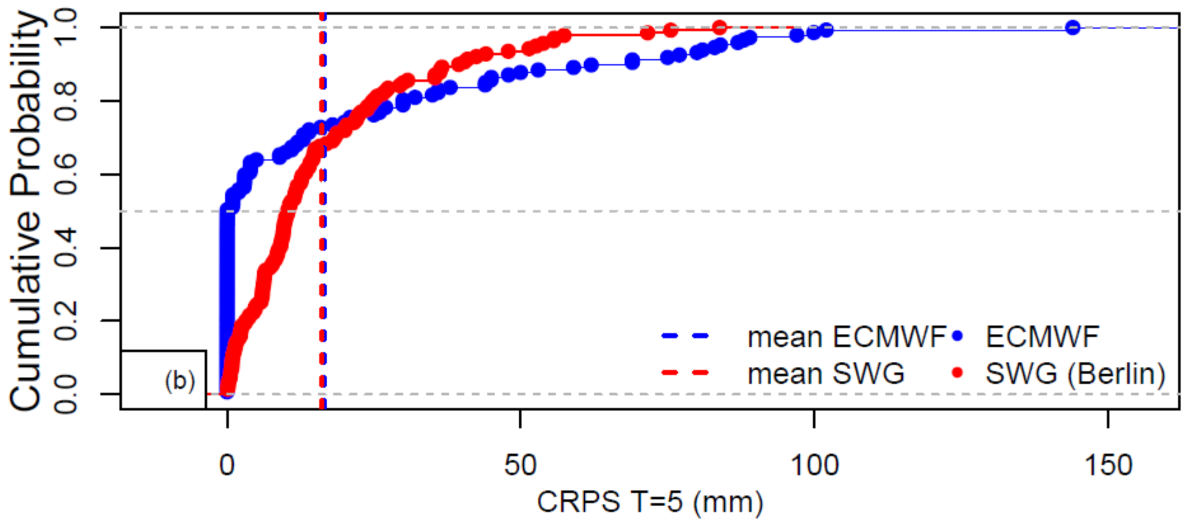
the CRPSS values are different from one station to another. We find a negative value of CRPSS for Orly, Berlin and Madrid, which means that the SWG has a skill compared to ECMWF forecast, which is not the case for Toulouse, where the ECMWF forecast is still significant. To explain those results, we took a look at the boxplots as suggested and the means of the CRPS of two forecasts (Table 2).

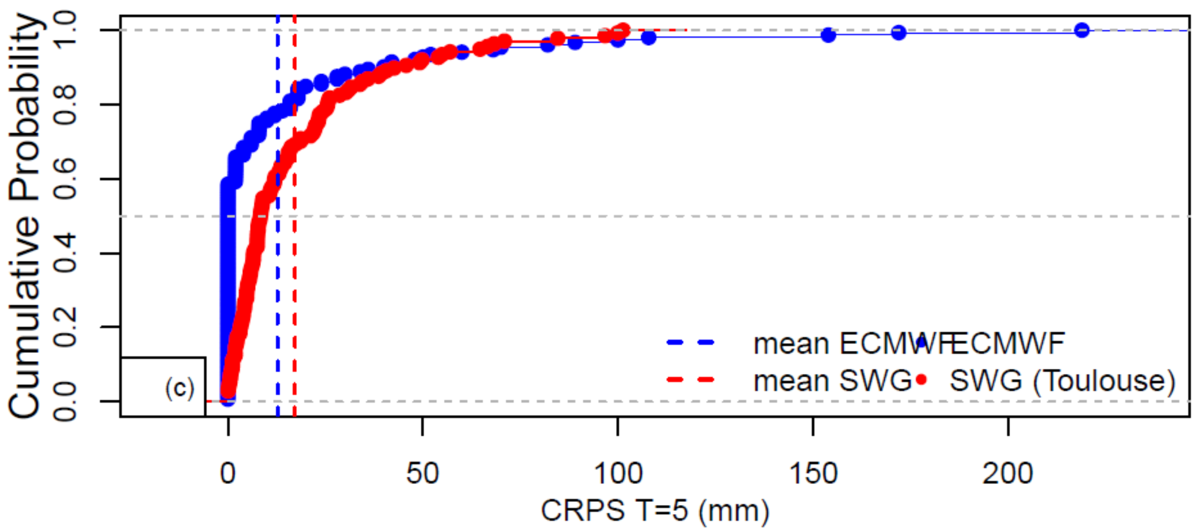
Table 1. CRPSS between forecast of ECMWF and SWG forecast for T = 5, 10, 20 days.

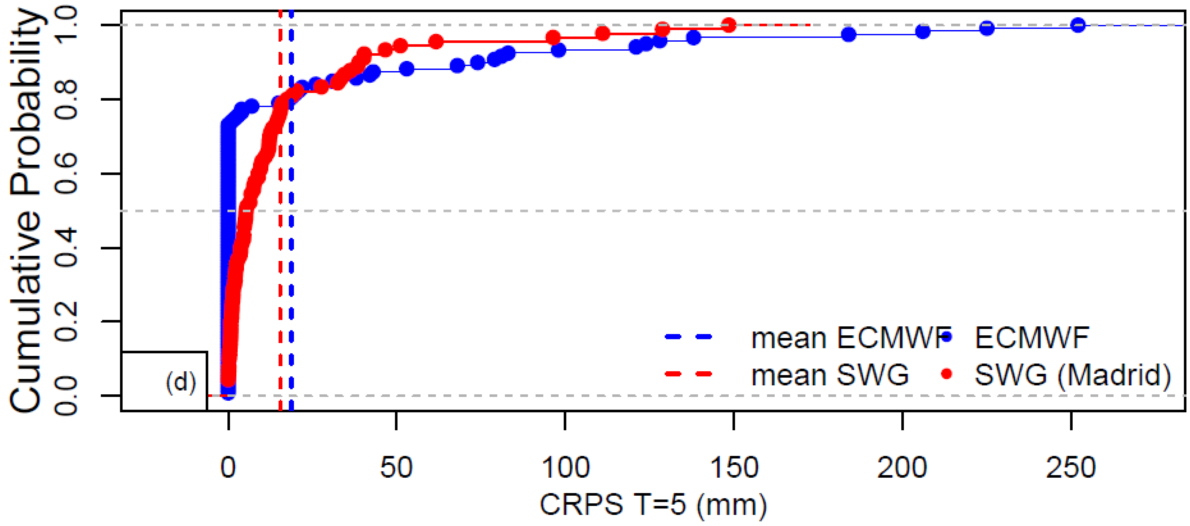
	Orly	**Berlin**	**Madrid**	**Toulouse**
CRPSS T = 5 days	-0.09	-0.02	-0.2	0.25

CRPSS T = 10 days	-0.17	-0.54	-0.33	0.23
CRPSS T = 20 days	-0.50	-0.36	-0.1	-0.08

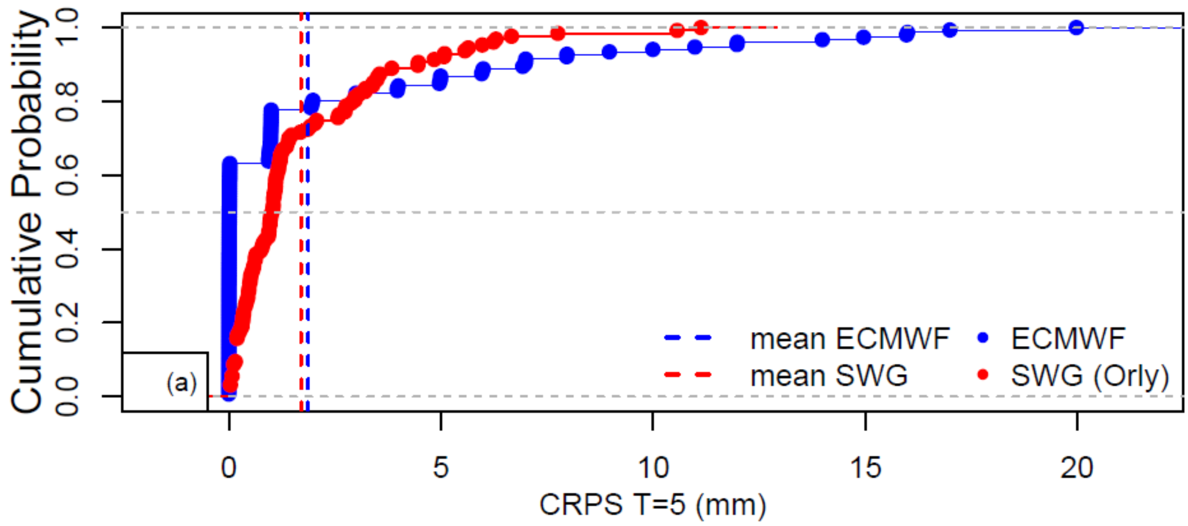
- **CDF for lead time of 5 days:**

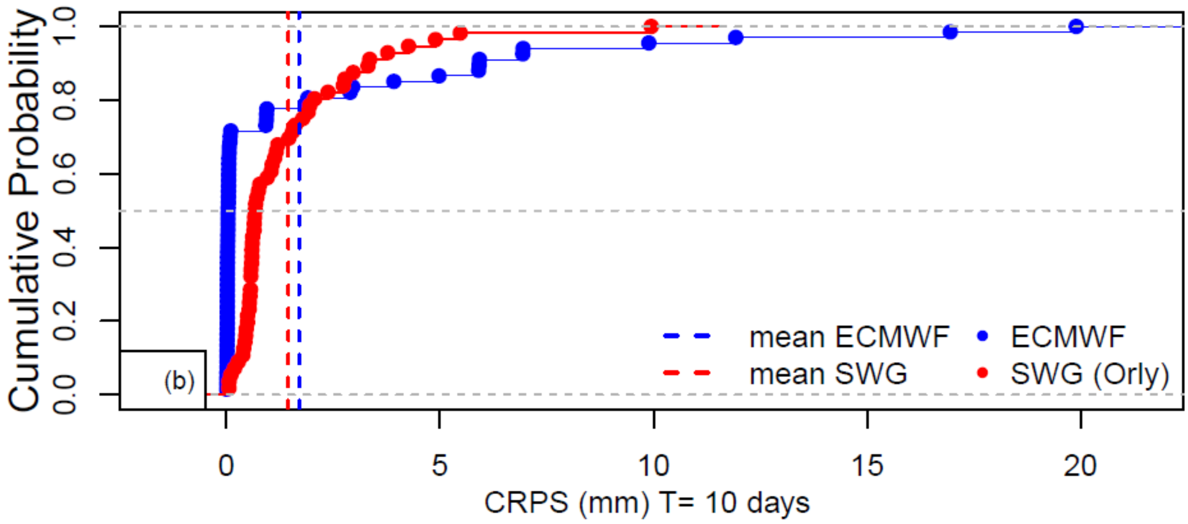


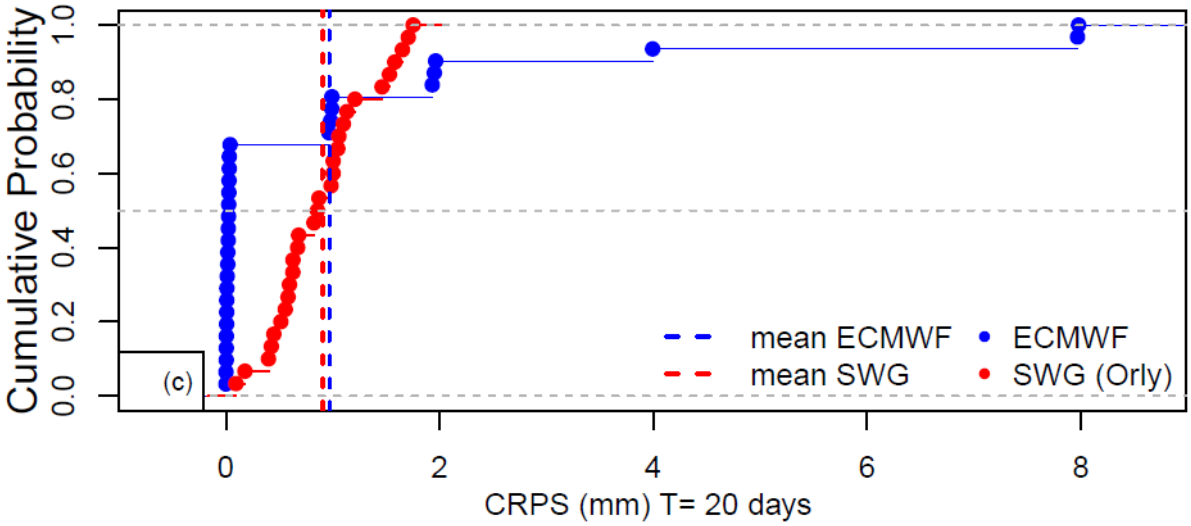




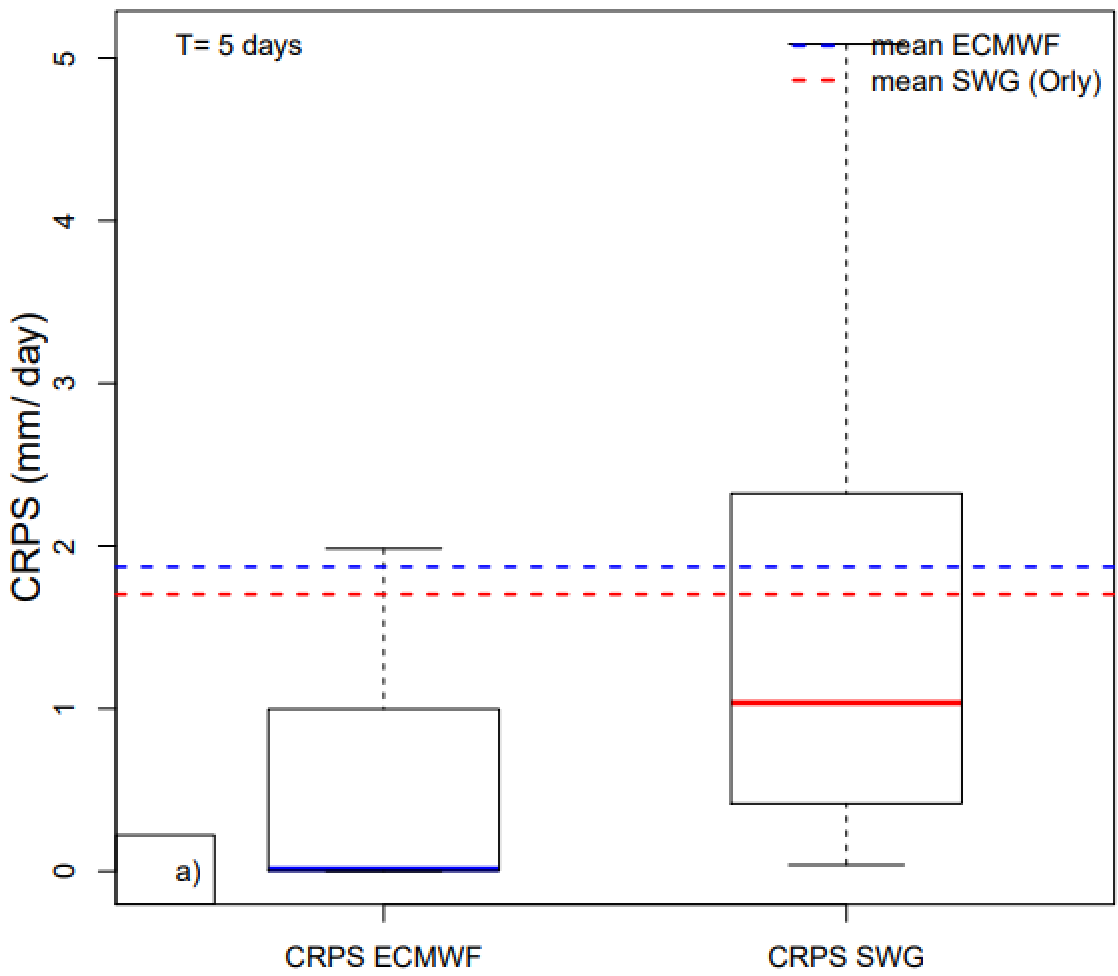
- **CDFs for lead time of 5, 10, 20 days for Orly (Example):**

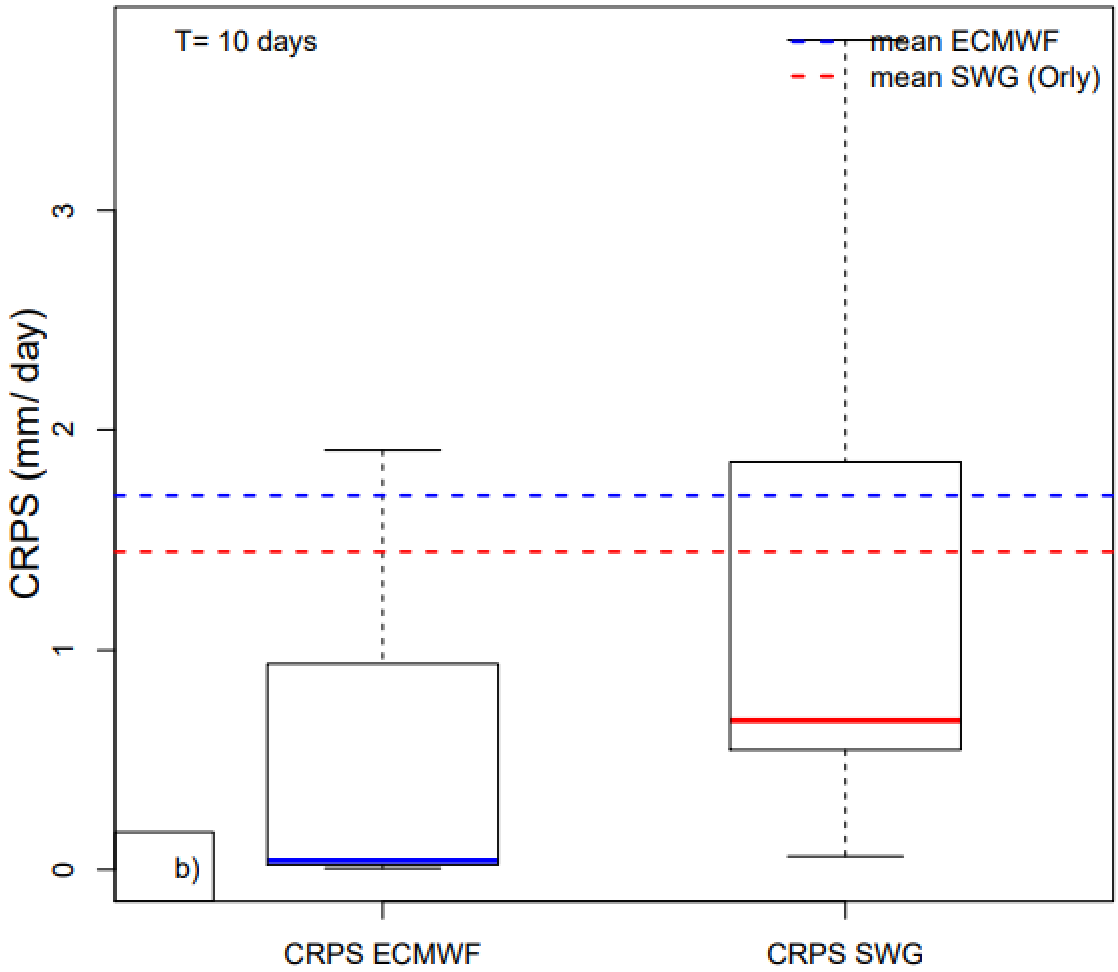






- **Boxplots between CRPS of ECMWF and SWG taking Orly as example (outliers above 5mm/day do not appear on the boxplots):**




T= 10 days
mean ECMWF
mean SWG (Orly)
CRPS (mm/ day)
0
1
2
3
b)
CRPS ECMWF
CRPS SWG

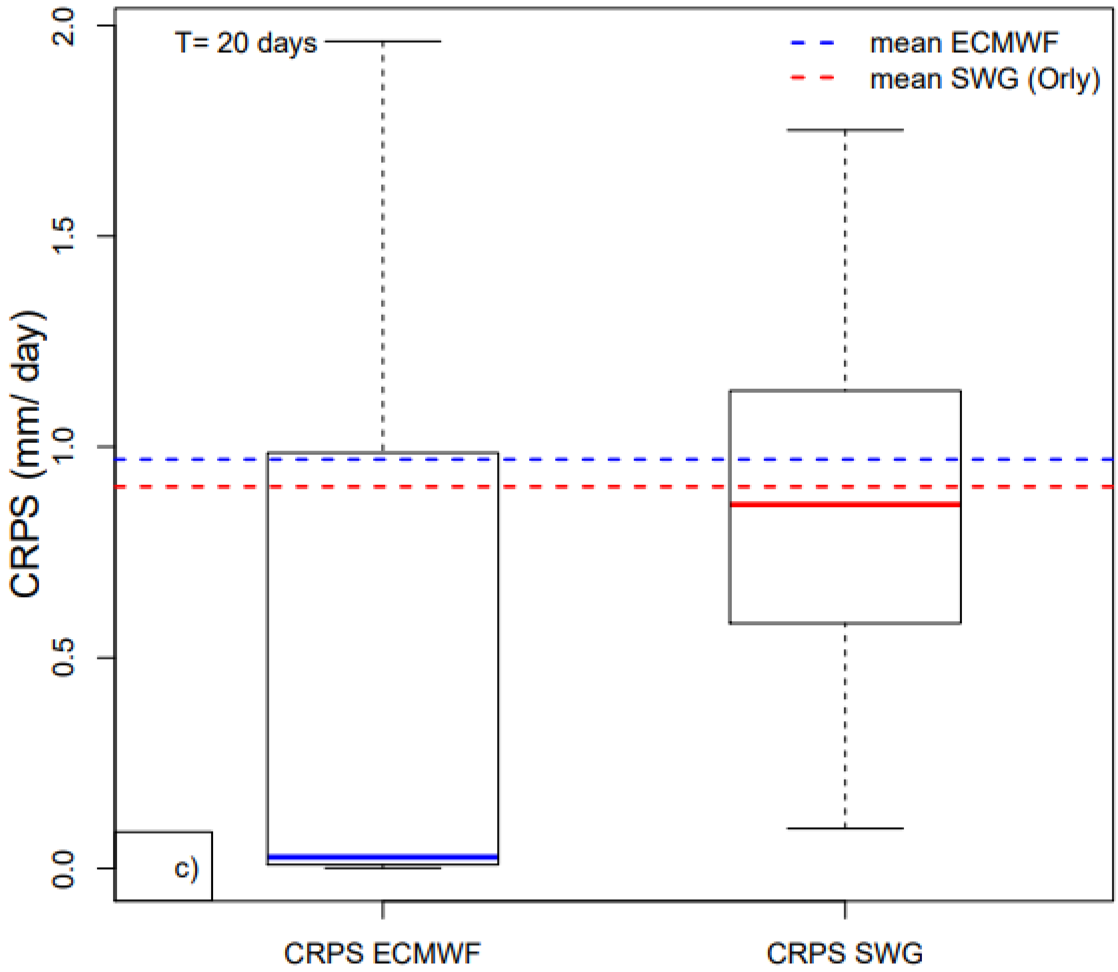


Table 2. CRPSS and average of ECMWF and SWG forecasts for T = 5, 10, 20 days.

	Orly	**Berlin**	**Madrid**	**Toulouse**
$\overline{CRPS}_{ECMWF}$ / Median	**1.87** / 0.04	**16.56** / 0.05	**18.73** / 0.003	**12.76** / 0.01
$\overline{CRPS}_{SWG}$ / Median	**1.70** / 0.67	**16.10** / 10.37	**15.49** / 5.45	**17.16** / 8.39
CRPSS 5 days	**-0.09**	**-0.02**	**-0.2**	**0.25**
$\overline{CRPS}_{ECMWF}$	1.70	18.1	20.03	14.87
$\overline{CRPS}_{SWG}$	1.44	11.67	15.04	19.45
CRPSS 10 days	**-0.17**	**-0.54**	**-0.33**	**0.23**
$\overline{CRPS}_{ECMWF}$	1.67	13.54	17.89	17.8
$\overline{CRPS}_{SWG}$	1.11	9.91	16.23	16.41

CRPSS 20 days	**-0.50**	**-0.36**	**-0.1**	**-0.08**

Comparing the average of the CRPS of ECMWF and CRPS of SWG, we find that they are close, however the average of the CRPS of SWG is still smaller than the one from ECMWF, that could be explained by the fact that the CRPS of ECMWF contains more outliers as shown in the boxplots. This explains why we have those values of CRPSS. However, ECMWF has the smallest median (as shown in the boxplots) CRPS.

#Report 2

Despite the revised version has improved some aspects of the manuscript, e.g. throughout the use of ERA5 from 1950 for comparison to NCEP, the methodological choices are still poorly explained. In my opinion, the work still needs to address a few important points before being accepted for publication in GMD.

In particular, I am still concerned about the choice of the analogs domain:

- First of all, it is not clear why this information is in the Results section, and not in the methods. I see there was a Paragraph 3.3 (erased), which is probably the right place where this details should be expanded.

⇒ We re-organized the manuscript by adding a new section "optimization of the parameter of the forecast" between the methodology and results. In this new section 4, we put all the details (choose of analogs, domain, the comparison between ERA5 and NCEP).

- Figure 1 is not useful to answer this question, since it only shows four boxes where the sensitivity to the large scale was tested.

=> The re-organization of the manuscript should solve this issue.

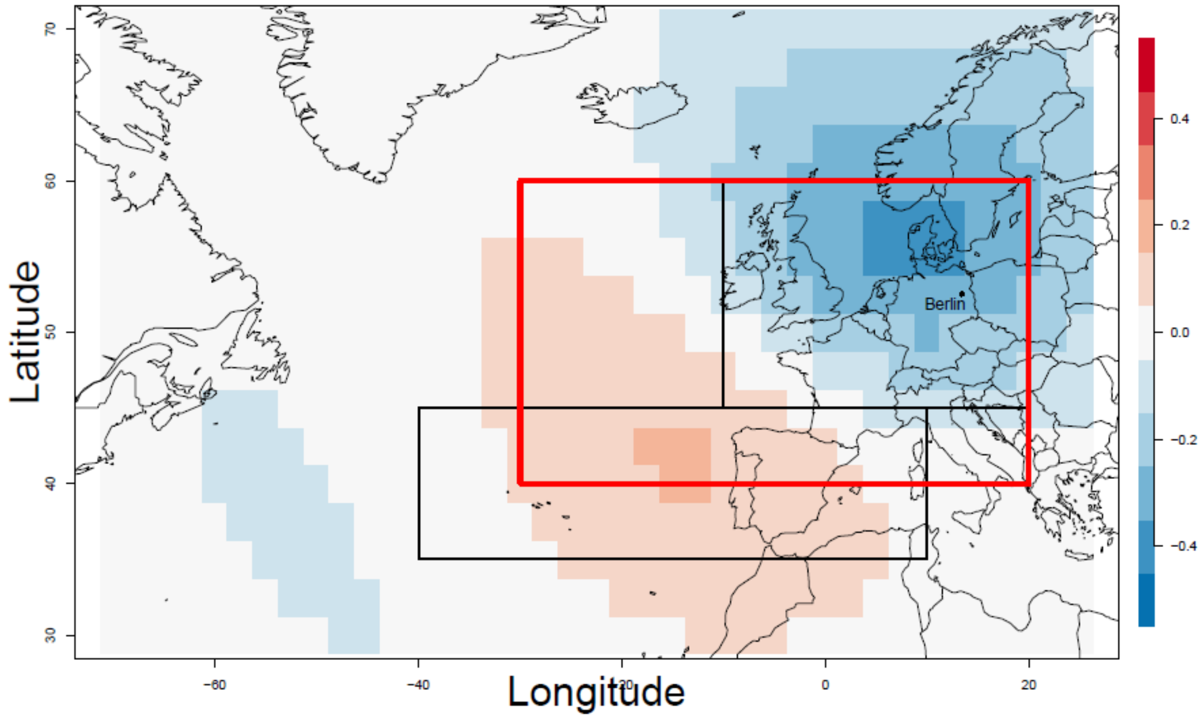
- Table 1 compares two of these boxes in terms of correlation, **to indicate that the chosen box is better than the biggest of the remaining three boxes.**

⇒ results from the small box are the same as the red one. This is explained in the text.

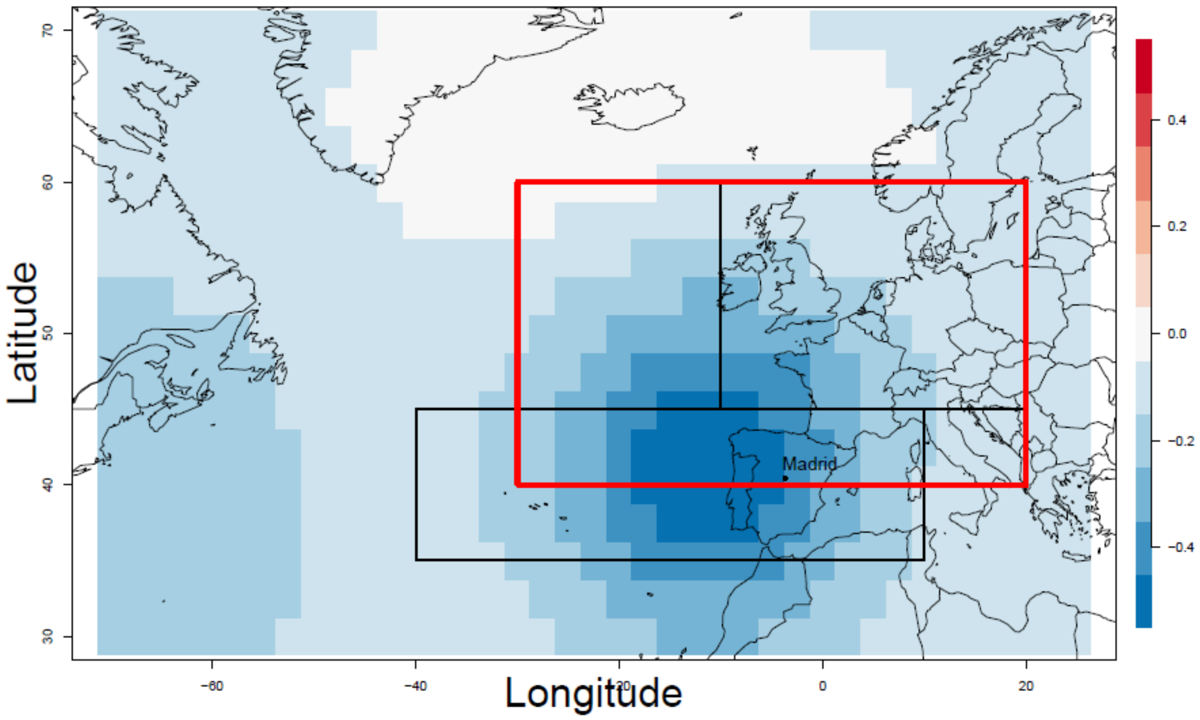
- What I'd like to see, is a regression map of Z500 for rainfall in each of the four cities. This map will finally show the relationship between gridpoint precipitation and Z500 in the Euro-Atlantic region. **This map could be done for one season, while the other season may be shown in the supp. mat.**

⇒ ok

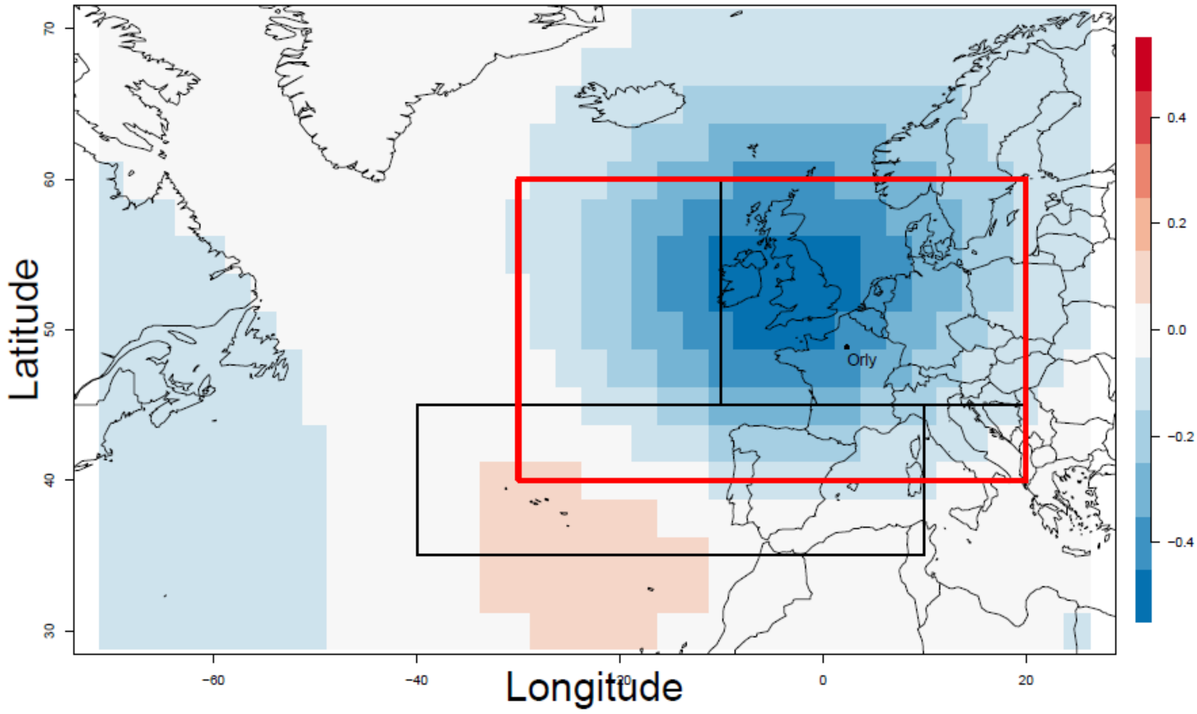
Here we show the maps of rank correlation between the daily average of Z500 over the Euro Atlantic region and the precipitation in each studied station in order (Madrid, Berlin,Toulouse and Orly). We did the analysis for different seasons also and used a threshold for precipitation (> 1 mm/day). We find a maximum correlation amplitude of -0.5 for Madrid and Orly. We find a correlation of -0.4 and -0.3 for Toulouse and Berlin, respectively. The correlation is significant as we have a p.value < 0.05 for the different grid points. This indicates the relation between Z500 patterns and precipitation especially in western Europe and that a decrease in Z500 is linked with precipitation.

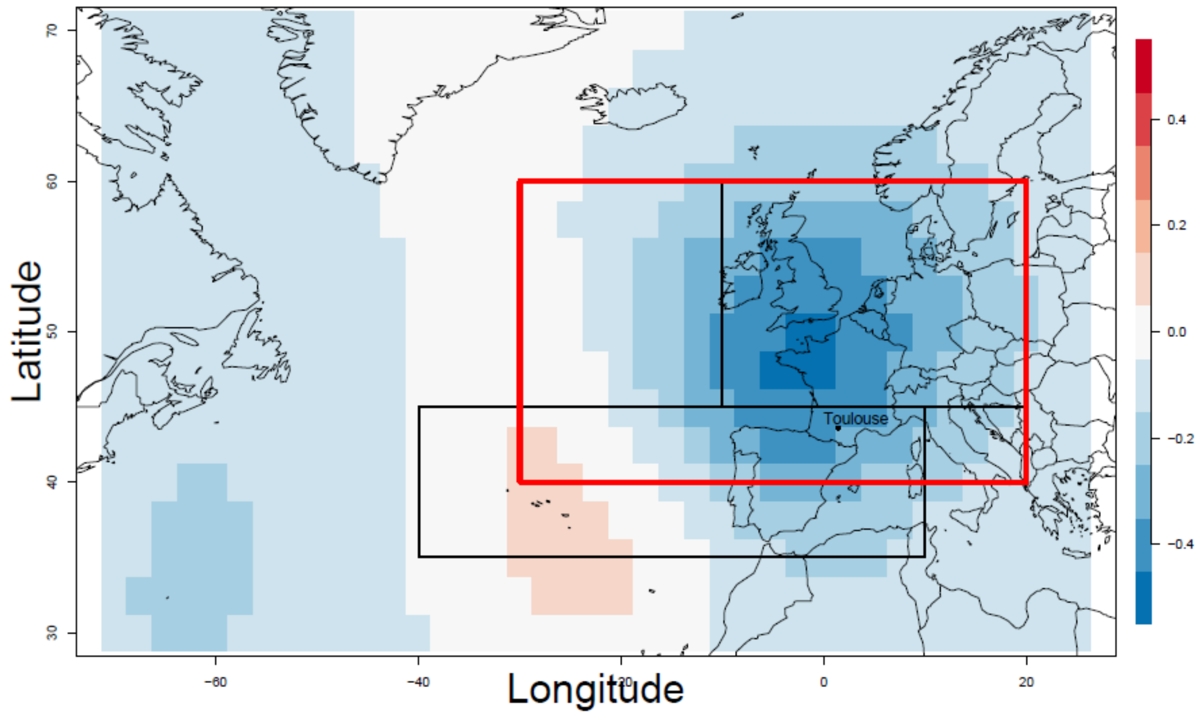


Latitude
Longitude
Berlin
0.4
0.2
0.0
−0.2
−0.4



Latitude
Longitude
Madrid
0.4
0.2
0.0
−0.2
−0.4





- Also, the fact that two seasons are analyzed in this work is not at all clear since the beginning. JJA and DJF come out of the blue in tables 1 and 2.

⇒ The choice of the two "extreme" seasons will be explained in the text. One pragmatic reason is to emphasize the seasonal dependence, which is moderate for the two extreme seasons. This leads to rather redundant figures/results with intermediate seasons.

- I appreciate the effort of explaining the choice of the 20 analogs, since a larger amount does not improve the results, but I think this description is incomplete. What about less analogs (5, 10, 12...)? Also, once we have 20 dates, are precipitation averaged over these days in order to obtain rainfall prediction? This should be explained.

⇒ **ok (we added this result in the new section "SWG parameter optimization")**
In the table below we are showing the score for simulations of the precipitation with SWG with different numbers of analogs 5 and 10. We notice that the scores (correlation and CRPSS) increase by increasing the number of analogs, which could be explained by raising the number of selection of analog dates. That justify the use of 20 analogs in this study. After selection of 20 dates, the predicted precipitation is the average of the precipitation on those analog dates (as we explained in section 3.2)

		Orly	Berlin	Madrid	Toulouse
Scores for simulations with 5 analog	Correlation	0.20	0.29	0.34	0.12
	CRPSS/ Persistence	0.34	0.29	0.32	0.34
	CRPSS/ Climatology	0.12	0.20	0.31	0.24
Scores for simulations with 10 analog	Correlation	0.20	0.29	0.38	0.13
	CRPSS/ Persistence	0.40	0.39	0.40	0.52
	CRPSS/ Climatology	0.23	0.31	0.39	0.45

- Section 3.4. The detailed description of weather regimes is not needed here, nor it is figure 2. In my understanding, WR are only needed to explain the forecast skill dependence on them, **therefore this section should ONLY describe how the authors assess the influence of WRs on the forecast quality.**
⇒ **We added this section, mainly to explain how we evaluated the relation between WRs and the forecast quality.**

Finally, as I reported in my first review, I would like to see some **more discussion on figure 4**. This plot is key and it needs better descriptions, some discussion (for example about why the forecast vs persistence improves/deteriorates with time, with no clear pattern) and more accurateness (e.g. line 294, "the CRPSS for persistence" should be "the CRPSS against the persistence reference").
⇒ **ok, we developed and explained further figure 4 (subsection 5.2). We linked the improvement / deterioration of the CRPSS with time to the number of rainy days in**

summer and winter. Indeed, we notice that the values of CRPSS against persistence reference (represented by squares) decrease with lead times in winter for the different studied areas, showing high values over 5 days. However, for summer, we notice that the values of CRPSS versus persistence increase with lead time, with high values over 20 days except for Berlin. This indicates that for the summer until 20 days the SWG forecast is still better than the persistence forecast (the average of the CRPS of SWG is smaller than the average of the CRPS of the persistence).
We computed the seasonal frequency of precipitation (defined as the number of days when precipitation exceeds 0.5 mm/day: table below). Precipitation exceeding 0.5 mm/day is more frequent in Berlin than in the other stations (close to 50% of the time for both seasons). This means that a persistence forecast is likely to be skillful, even for longer lead times, especially in the summer. Summer precipitation in Orly comes in cluster. Therefore, the trends in CRPSS values for different lead times are probably due to the intrinsic time persistence of local precipitation.

	Orly	Berlin	Toulouse	Madrid
% Rainy days summer	51	53	45	31
% Rainy days winter	38	45	31	13