RESPONSE TO REFEREE 3

We would like first to thank the reviewer for her/his reading of the manuscript, providing us comments and remarks that helped us clarify the methods used and the objective pursued.

Despite the rather positive comments of the reviewer, we noted a possible miss-interpretation of our methods:

"Prior to application of the RCM data as forcing of GR4J, the precipitation data is bias corrected testing a quantile-mapping method and a quantile perturbation method. Simulations are run with uncorrected and bias corrected (quantile perturbation) data."

"The quantile perturbation method needs evaluation on historical data prior to its application to projections though. In case the quantile perturbation method cannot be verified, this is also an important result, but in that case the study should not consider bias correcting the projections."

We believe there is a misunderstanding here. The quantile perturbation method does not consider the bias of the climate model, i.e. the comparison of model outputs with the observed climate (then it does not rely on the assumption of the bias stationarity). Therefore it is not a bias-correction method for downscaling climate model data; it belongs to the family of the 'delta change' methods (Willems and Vrac 2011). The principle of the method is to modify the observed time series by a climate change signal, in the classical delta change approach the mean is modified by a change factor, in the quantile perturbation approach it is the different quantiles of the distribution that are modified by different change factors. This method has been applied several times in the recent years for hydrological impact studies:

1. *Willems P., Vrac M.: Statistical precipitation downscaling for small-scale hydrological impact investigations of climate change. Journal of Hydrology 402, 193–205. 2011.*
2. *Liu T., Willems P., Pan X.L., Bao An. M., Chen X., Veroustraete F., Dong Q. H. Climate change impact on water resource extremes in a headwater region of the Tarim basin in China, Hydrol. Earth Syst. Sci., 15, 3511-3527, doi:10.5194/hess-15-3511-2011. 2011.*
3. *Chiew F.H.S., Teng J., Vaze J., Post D.A., Perraud J.M., Kirono D.G.C., Viney N.R. : Estimating climate change impact on runoff across southeast Australia: Method, results, and implications of the modeling method, Water Resour. Res. 45, doi:10.1029/2008WR007338. 2009.*
4. *Taye, M. T., Ntegeka, V., Ogiramoi, N. P., and Willems, P.: Assessment of climate change impact on hydrological extremes in two source regions of the Nile River Basin, Hydrol. Earth Syst. Sci., 15, 209-222, doi:10.5194/hess-15-209-2011, 2011.*

In addition our results have shown that the hydrological model cannot reproduce the observed discharge when it is run with the raw RCM outputs (as shown in figure 10). Therefore it would be irrelevant to make future projections from the raw RCM outputs only. Since the bias-correction method we tested (CDFt) did not yield satisfactory results in a calibration/validation experiment over the observed period (figure 11 and table 4), we used only the quantile-perturbation method to modify the observed time series according to the climate change signal. Therefore the hydrological model is run only with these perturbed series to make future projections.

1) Title: The title suggests a focus on the climate model simulations from Med-CORDEX but the manuscript deals with precipitation and temperature only, the impact is only studied with

respect to discharge and in a small catchment (i.e. smaller than 1 grid cell in the 50 km resolution RCM simulations). The manuscript rather deals with bias correction methods and their applicability to a semi-arid catchment in Morocco. Further Med-CORDEX is an initiative where a lot of RCMs are applied and also forced with different GCMs from the CMIP5 GCM simulations. In this study only one RCM from the ensemble is used and only forced with data from one GCM. So the title is misleading and needs to be changed accordingly.

We agree with the reviewer that the title may be misleading the reader despite the fact that our methodology is clearly explained throughout the text. Consequently we slightly modified the title in order to be more specific:

"High-resolution Med-CORDEX regional climate model simulations for hydrological impact studies: a first evaluation of the ALADIN-Climate model in Morocco"

It is worth noting that the Med-CORDEX initiative is only starting and that, up to now, only ALADIN-Climate has 12km resolution scenario simulations completed and available. Check domains "MED-11" and "MED-088" in http://www.medcordex.eu/dbsearch_medcordex_db2.php or http://www.medcordex.eu/simulations.php. New 12 or 10km simulations with 50km twin runs will arrive soon (at least from CCLM, RegCM and PROMES) for Med-CORDEX. The 12km scenario simulations from the Euro-CORDEX initiative covering also Morocco (Jacob et al. 2013, REC) are completed but not available yet for users.

Jacob D. et al. (2013) EURO-CORDEX: New high-resolution climate change projections for European impact research. Regional Environmental Change (on-line in July 2013) doi: 10.1007/s10113-013-0499-2

We also want to stress, again, that we did not used only bias-correction methods, but also an approach belonging to the family of 'delta-change' methods, that does not at all consider the bias of the model in present climate.

2) Abstract, line 4/5: this sentence should be deleted. It suggests that here data from ensemble runs from Med-CORDEX are used, which is not the case.

This sentence has been modified to=

"This study provides the first evaluation for hydrological impact studies of one of these high-resolution simulations ". Again we would like to precise that we use here the only available run at this resolution. Data can be freely downloaded from www.medcordex.eu.

3) Abstract, lines 9-15: It should become clear that this study is only carried out for a small catchment covering 1 and 9 grid cells from one RCM respectively. With such a small catchment these high goals cannot be reached. Namely if one keeps in mind, that climate data from RCMs needs to be averaged in space over some grid cells (see e.g. Maraun, 2012). RCMs output – and therefore their impact – should not be evaluated on single grid cells.

We never attempted to hide this fact, we wrote page 5697, line 23=

"Indeed it is worth noting that at a 12-km resolution, 9 grid meshes are inside the catchment of interest whereas, at a 50-km resolution, the catchment is smaller than a grid mesh (2500km2)."

In the conclusion =

"We are however aware that individual RCM simulations do not allow to take into account two of the main sources of uncertainty in regional climate change, that is to say the choice of the RCM and the choice of the forcing GCM (Déqué et al. 2012)."

It is a medium scale catchment (1800km² cannot be considered "small") and different runs of the same regional climate model are analyzed. Our goal, as mentioned in the introduction, is mainly methodological and as the reviewer wrote, it can be considered as a pre-study for the use of the ensemble simulations from MED-CORDEX (which are not yet available, here we used the first model runs available). We agree that with the RCM at 50km looking at the scale of a single grid cell can be hazardous and, as shown by our results, there is a much greater uncertainty at this scale. However when analyzing the RCM at 12km, then 9 grid cells are considered and are spatially averaged, we agree it is best to average in space several grid cells, this is what we did in the present study. Our results are important for impact modelers since in the Mediterranean region (except the Rhone, Ebro, Po and Nile rivers) the catchments are typically of medium (few thousands km) to small (less than hundreds of km) sizes, therefore our study highlight the improvements brought by high resolution climate simulations.

We modified the abstract=

This study provides the first evaluation for hydrological impact studies of one of these high-resolution simulations in an 1800km² catchment located in North Morocco. Different approaches are compared to analyze the climate change impacts on the hydrology of this catchment using a high-resolution RCM (ALADIN-Climate) from the Med-CORDEX initiative at two different spatial resolutions (50km and 12 km) and for two different Radiative Concentration Pathway scenarios (RCP4.5 and RCP8.5).

4) Page 5690, lines 7/8: Why is only this catchment used, if the goals are to evaluate an RCM and study its hydrological impact? Why are not the other 5 larger dams used as well?

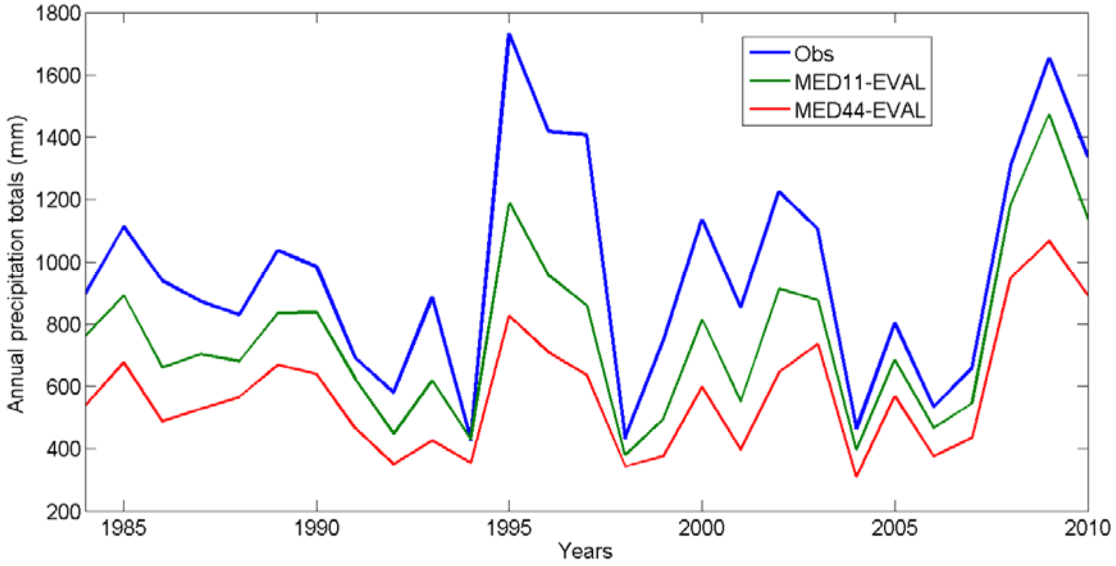
We would be really happy to extend this study on many more catchments in Morocco, but also in North Africa. However, as the reviewer might be aware, the acquisition of good quality and long term hydro-climatic data for scientific purpose is very often problematic in this region and in Africa in general. This is due to several different reasons: low density of monitoring networks, database maintenance problems that may corrupt some of the data, lack of cooperation between operational managers and academic researchers etc. These are among the reasons why very few studies are considering catchments in North Africa, and this is why we try to bridge this gap. We used a test catchment for which good data is available, for a relative long term period in the region.

5) Line 24 on page 5690: ": : :model bias is stationary in time (Maraun et al., 2010): : :" :First of all the term "bias" has to be defined. Bias of a climate model is the systematic mean difference between the simulated and observed mean climate (by definition the mean over 30 years). So to show that a model bias is stationary in time, a long time series is needed. Then for 30 year periods (running mean) the monthly precipitation and temperatures biases need to be calculated.

We perfectly agree with the reviewer comment. Indeed here we used 27 years, and our results indicate that this is probably not enough to have a robust bias-correction of the RCM model for hydrological applications, using SST and DDST validation (as shown in figure 12). The monthly model bias over the whole period is displayed on figure 3 and 4 and described in section 4.1 of the results. In addition we also evaluated the monthly model bias between dry or wet years, as shown on figure 5. The model bias is not strongly different between dry and wet years. If computing the model bias in the MED11-EVAL simulation during the periods used for the SST test, 1984-1997 and 1998-2010, the bias is respectively -21% for the first period and -19% for the latter. Therefore one could conclude that the model bias is stationary in time between these two periods, however as the reviewer noted, to evaluate if the bias is stationary in time there is a need for long time series, for example 2 X 30 years. Here the time series are not long enough to state if the bias of the model is stationary or not over long time periods. We changed the title of section 4.3 to "validation of the precipitation bias correction method".

6) Page 5690, line 27: this cannot be done in the same way as for parameter calibration in a hydrological model. An RCM not necessarily simulates the same years or months as dry/wet months as observed. One needs to evaluate the statistics and mean values over a long term period (in your study 1984-2010), as it is done for example within CORDEX and has been done e.g. in ENSEMBLES.

Your statement is correct if considering RCMs driven by GCMs (historical runs), which do not reproduce the temporal sequences of events. It is wrong when considering RCMs driven by reanalyzes (evaluation runs in CORDEX frame) such as ERA-Interim, the simulations used in the present study to evaluate the stationarity of the bias-correction. In that case, the RCM simulations follow quite well (but not perfectly) the chronological sequence of dry or wet period's observed. Therefore the bias correction can be then evaluated in the same way as for the hydrological model parameters. The figure below show the time series of annual precipitation computed with observed data (blue), the RCM forced by ERA-Interim at the 12km resolution (MED11-EVAL, green) and the RCM forced by ERA40 at the 50km resolution (MED44-EVAL, red). The succession of wet/dry years is reproduced by the model, even if there is some bias in the precipitation amounts.



7) Page 5690, lines 28/29: No, Maraun (2012) did not do a split-sample test.

This sentence has been modified to=

"However this assumption can be tested by comparing the model bias during different time periods"

8) Page 5691, lines 1-6: Why then do you assume that the model bias is stationary in time in your study area and that it is enough to study 27 years in Morocco?

We do not make such an assumption. That is the reason why we evaluated the stationary of the bias-correction method in time with either a SST or a DSST validation approach. This is clearly explained page 5701, lines 18-25. The bias correction of RCMs with quantile-matching methods is probably now the most widespread method used in the literature. However, many authors do not verify its main important hypothesis (=the stationarity of the bias correction between different periods) prior to use this method to make future projections. Here we chose to evaluate this hypothesis at the catchment scale, which is the relevant scale in hydrology. Our results indicate that for hydrological impact studies in the Mediterranean region, one should not apply bias-correction without validation of the method, in particular in cases of short time series, and might consider alternative methods more adapted to the Mediterranean climate.

Driouech et al. (2010) only considered 14 individual rain gauges spread all over Morocco to be compared with the version 4 of the GCM ARPEGE-Climate model (at a 50km resolution). Maraun (2012) did not used observed data but a subset of RCMs from the ENSEMBLES project at a 25km resolution (HIRHAM5, RACMO2, REMO and RCA) driven by reanalysis data and ECHAM5. Here we evaluated the stationarity of the bias correction for one of most recent available RCM model (ALADIN-Climate 5.2) with a much better resolution (12 km), with observed data, and at a scale relevant for hydrological applications.

9) Page 5692, lines 20-27: It is mentioned before that this study is only carried out for a small catchment in North Morocco. So these issues will only be addressed for 1 and 9 grid cells respectively. This should become more clear in the 3 topics themselves then being hidden in the sentences before.

We do not try the hide anything in the text, results or conclusions. We modified the text to better explain this =

“Several methodological issues that have never been investigated for this region are addressed in the present study for a medium-size catchment”

10) Page 5693, Section 2.1: Here the climate of the study area should be described more detailed, i.e. it should be described in the connection with the past climate and its relation to large scale circulation patterns. Knippertz et al. (2003) found a relationship of monthly precipitation and the storm tracks (NAO related) over the Atlantic. It is also supported by Esper et al. (2007), that the droughts are related to the NAO and Atlantic sea surface temperatures. Looking at the annual precipitation data of the catchment from 1984 to 2010 one cannot see a significant trend due to the strong variability, but the first 10 years are drier than the last 10 years, interrupted only by a few wet years in the mid-nineties. The observed precipitation and temperature timeseries should be discussed.

We put more information about the climate of the region in the revised manuscript =” The regional climate is influenced by large scale circulation, Knippertz et al. (2003) found a relationship between monthly precipitation and the storm tracks over the Atlantic, related to the North Atlantic Oscillation (NAO). It is also supported by Esper et al. (2007), that the droughts are related to the NAO and Atlantic sea surface temperatures.”

However we think Figure 2 was not read correctly= the annual precipitation amounts are sorted from the driest years to wettest. In fact when checking the time series there is neither apparent trends nor obvious cycles (we added a new figure in the revised manuscript to show the monthly time series of temperature, evaporation, precipitation and discharge in the catchment).

11) Page 5693, line 25: How much runoff is generated in mm/yr? Is this the pan evaporation measured at the dam or the evapotranspiration of the catchment?

The mean annual runoff generated is 420 mm/year. It is the pan evaporation measured at the dam reservoir.

12) Page 5694, line 1: When did the precipitation records start?

For some stations (but located downstream of the catchment) the precipitation records starts in the 70s. A good coverage of the catchment is only available after 1980, prior to the dam construction. We have included the time series of temperature, evaporation, precipitation and discharge in the revised version of the manuscript.

13) Page 5694, line 3: Did the temperature records stop in 1996? Which observed temperatures did you then use between 1996 and 2010?

Yes the temperature data is only available until 1996 (page 5694, line 3). We did not use observed temperatures between 1996 and 2010. It is explained page 5699, lines 10 to 26. We first compared different computation methods for potential evapotranspiration (PE) to be included in the hydrological model (during the period when all the data is concomitant). The results showed no sensitivity of the hydrological model to the different PE formulations, i.e. considering daily PE, monthly PE or interannual mean monthly PE. This is why we choose the third option, a very common practice in hydrology, in catchments when the runoff processes are driven by precipitation more than PE. The monthly mean temperatures from 1984 to 1996 have been used to compute the interannual mean monthly PE.

14) Page 5694, lines 7-10: For temperature this is in contradiction to IPCC 2007, fig. 3.10. For precipitation there is no trend, but a tendency towards extremes (see figure 2). Please show the graphs of the records to show there is no trend. Please show this not only for the study period but for the full record lengths.

We added in the new figure 2 the time series of monthly temperatures. Indeed there is a significant trend in annual mean temperature (at the 5% level identified by the Mann-Kendall test) but only for the 1975-1982 period. For the period 1983-1996, the monthly and annual temperatures show no trend. In addition, as shown on figure 2, there is no trend or major changes in the evaporation cycle measured at the dam during the whole observation period. In the opposite case, if there was a change in the temperature or evaporation cycles during the modeling period we would not have adopted an interannual mean monthly PE for the hydrological model.

It must be noted that a trend can be identified at the global or regional scale, but may be different at the local scale, such as in the case of one catchment or one station. This is particularly true in developing countries where the large scale assessments of trends are usually performed with a (very) low number of stations due to the limited data availability. Also the question of homogeneity must be raised, since stations may have been relocated.

In addition, the figure 2 does not show the time series of annual precipitation amounts, but the annual precipitation amounts sorted from minimum values to maximums values. Therefore it is impossible to detect a trend from this figure.

15) Page 5694, Line 1: Did you apply the model yourself for this study or did you use the data from the model runs?

The ALADIN-Climate model development, set-up and runs have been performed at Météo-France/CNRM by Samuel Somot (third author of the manuscript and co-coordinator of the Med-CORDEX initiative with Paolo Ruti from ENEA) and his team and are now freely available on the Med-CORDEX website. Up to now, this is the only model with complete runs (driven by ERA interim and a GCM for "hist", "rcp 4.5" and "rcp 8.5") available from Med-CORDEX. A more generic paper describing the Med-CORDEX initiative is under review for BAMS:

Ruti P., S. Somot, C. Dubois, S. Calmanti, B. Ahrens, A. Alias, R. Aznar, J. Bartholy, S. Bastin, K. Béranger, J. Brauch, J.-C. Calvet, A. Carillo, B. Decharme, A. Dell'Aquila, V. Djurdjevic, P. Drobinski, A. Elizalde-Arellano, M. Gaertner, P. Galán, C. Gallardo, F. Giorgi, S. Gualdi, A. Harzallah, M. Herrmann, D. Jacob, S. Khodayar, S. Krichak, C. Lebeaupin, B. L'Heveder, L. Li, G. Liguro, P. Lionello, B. Onol, B. Rajkovic, G. Sannino, F. Sevault. (2011) MED-CORDEX initiative for Mediterranean Climate studies (submitted to BAMS, October 2011)

16) Page 5695, lines 14-18: These lines can be deleted, since they are of no interest for this study.

We removed the sentences accordingly.

17) Page 5696, line 13: Citation for ERA-Interim (e.g. Dee et al., 2011)

Citation added.

18) Page 5697, line 21: It does not make sense to "interpolate" a 2500 km2 grid cell to a 1800 km2 catchment, so please describe more specifically what you did.

Changed to =

"For the different simulations, the different grid meshes covering the catchment area have been averaged according to the fraction of catchment coverage, to be consistent with the Thiessen interpolation method used for observed precipitation."

19) Page 5698, section 3.1: Please provide the equations and/or a graphical description of the model. Is irrigation included?

The GR4j model has been extensively used and the standard version of the model is considered here. Due to the length of the paper, we chose to not include its detailed description since the focus here is not on the hydrological model structure. The full equations and graphical descriptions are provided in many studies including Perrin et al. (2003) or Ru elland et al. (2012) (already in the reference list). Irrigation is not included in the model since it does not play a significant role in the catchment of the dam, the main irrigation area is located downstream the dam, in the Loukkos plain.

20) Page 5699, lines 10-20: Temperature data is only available until 1996. It does not become clear here how with this temperature data the potential evapotranspiration is calculated from 1984-2010.

Please see the response to comment 13/

21) Page 5699, line 22: Please give the formula used for the calculation of PE and show the graphs.

As for the GR4J hydrological model, the Oudin formula is widely used in hydrological studies and the full equation is given in Oudin et al. 2005 (already in the reference list). The cycle of measured evaporation at the dam can be seen in the new figure 2 added in the revised version of the manuscript.

22) Page 5699, ligne 24: see above, contradiction to IPCC 2007.

Please see the response to comment 14/

23) Page 5700, line 1: This section is about bias correction, not about downscaling methods.

This section is not about bias correction, since the quantile perturbation method is not a bias-correction method. In section 3.2.1 we described the bias-correction method that we used (CDFt), and in section 3.2.2 the quantile perturbation method, that both can be seen as downscaling methods.

24) Page 5700, section 3.2.1: This method assumes that the quantile distribution does not change under climate changed conditions. Further this method might enhance uncertainty about climate projection, namely if only one model is used. The method shall be evaluated for the catchment, e.g. verifying it on precipitation data from 1961-1990.

This is exactly what we have done. Page 5701, lines 18-25, we explained the methodology used to test this assumption of stationarity. Then in page 5706, we have a specific section of the results now entitled "4.3 Validation of the precipitation bias correction method". Our results indicate that for this catchment the stationarity hypothesis was not fulfilled at least when using past precipitation records. Therefore we did not produce future projections results based on this method. In addition, we cannot do a calibration/validation exercise with this method for the period 1961-1990 since there we do not have data for this time period. The data available is detailed in section 2.1.

25) Page 5702: This perturbation method assumes that the quantile distribution is independent of an increased temperature of 1.8_C. So this should be discussed. Further the method should be verified for 1961-1990 for the Med-HIST runs prior to applying them to projections.

The quantile perturbation method does not rely on such an assumption. See Chiew et al. 2009; Liu et al., 2011; Taye et al., 2011; Willems and Vrac 2011. As explained earlier, it belongs to family of 'delta change' method, applying to observed data a change factor obtained with climate simulations between a reference period and future projections periods. Therefore this method is just a construction that modifies the observed series according to a climate change signal, without considering the model bias with observed data.

As an example, to compute the change in the median quantile (p=0.5), the median of the climate model simulation during the reference period is compared to the median of the climate model simulation during a future period. For example, if the median quantile is expected to increase by +20% for the future period, then the median of the observed series is increased by +20% and the resulting modified series is used in the impact model. Therefore the bias between the reference period in the climate model and the observed series is not considered.

26) Page 5703: It should be discussed that the seasonal cycle is shifted in winter towards maximum precipitation in February in the simulations instead of December.

Added in the text, first paragraph of section 4.1.

Which effect does this have on the bias correction?

From our results it would be impossible to conclude on this, since we did not consider a bias-correction method to evaluate the projected changes.

Further the observed local mini-mum in March is not met by MED_HIST. Does MED_HIST show the same large scale circulation patterns from 1984-2010 as MED_EVAL?

We did not analyze the sea level pressure or geopotential height fields simulated by the model, this analysis would be required to answer this question. An interesting comparison, outside the scope of this paper, would be to compare the large scale circulation patterns in ERA Interim and the GCM (CNRM) with the large scale circulation patterns obtained with the RCM model driven by ERA interim or the GCM, at both 12km and 50km resolutions. Note that similar studies were done using the ERA40-driven runs (Sanchez-Gomez et al. 2008) and the GCM-driven runs (not published) using the ENSEMBLES multi-model RCM ensemble (including a former version of ALADIN-Climate). The main result is that all the RCMs follow well the large-scale pattern of the driving model on average, at the monthly time scale and at the interannual time scale. This is especially true for the Winter season. Day-to-day chronology of large-scale pattern is less similar between GCM and RCM. Even if this study has not been repeated yet for Med-CORDEX simulations, this means that the RCMs inheritated from the GCM large-scale error especially for Winter.

Sanchez-Gomez E., S. Somot, M. Déqué (2008) Ability of an ensemble of regional climate models to reproduce the weather regimes during the period 1961-2000. Clim. Dyn., 33(5):723-736, doi:10.1007/s00382-008-0502-7

Are 27 years enough to overcome the strong variability in the study area?

As indicated page 5707, lines 28-29, “Results indicate that for the present catchment 27 yr may not be sufficient to obtain a good time stability of the bias-correction”. Due to this limitation we did not employ a bias correction technique for precipitation. On the opposite, 27 years are enough for the robust calibration of the hydrological model in this catchment to evaluate monthly runoff (page 5710, line 20): “In our case study, using a model evaluated at the monthly time step during a long period (27 yr), the results of calibration and validation show high stability over time, even between two radically different sets of years”

27) Section 4.1: Please add Fig. 4 for the projections and discuss it.

On figure 7 this information is already available = the projections under the scenarios 4.5 and 8.5 for monthly precipitation and also temperature.

28) Page 5704, line11: But there is a strong cold bias (up to 5 K) in winter in the simulations.

Previous to this statement, we indicated 2 lines above (line 7-8) “For the temperature, the comparison with observed data is limited since only mean monthly temperatures at the Makhazine station are available”. This “bias” is certainly due to the fact that we don’t have spatial information about temperature in several locations in the catchment but only one station at the dam. Therefore the temperature in the headwater area is probably not correctly estimated even with the interpolation considering a −6.5 ^{0}C gradient per kilometer. Therefore it is difficult to conclude on whatever it is the ground reference or the RCM that is biased. It is worth mentioning however that one of the known flaw of ALADIN-Climate is a general cold bias around the Mediterranean basin in Winter whatever the resolution. Low vertical resolution is the atmosphere boundary layer and a snow cover too persistent over the mountainous areas seem to be the main causes. This bias do exist in the evaluation runs and is enhanced in the historical runs.

29) Page 5708, section 4.4: The method should be verified for 1961-1990 for MEDHIST.

Please read our preliminary comments and the answers to points 23), 24) and 26). Again, we don't have the data for the period 1961-1990.

30) Page 5709, section 4.4: Please add the figure 14 without bias correction and discuss it.

As stated in our preliminary remarks to the reviewer and our responses to points 1), 23), 24), 26), we believe there is a misunderstanding of the methods. No bias correction has been applied to the data of figure 14. Since the validation of the bias-correction method failed (see results section 4.3), the projected changed are only those obtained with the quantile perturbation approach (section 3.2.2). In addition, the possibility to run the hydrological model with raw inputs of precipitation simulated by the RCM has been tested (page 5705 line 24, the results of hydrological simulations with uncorrected RCM data are shown in figure 10). Our results indicate that the hydrological model driven by raw RCM data is unable to reproduce the discharge of the catchment. Therefore making future projections by simply using raw RCM data into the hydrological model would make no sense.

31) Considering the large variability, additional plots of the standard deviation on the monthly mean precipitation in fig. 3 and 4 would be useful.

We added the figure 2 of monthly temperature, evaporation, precipitation and discharge, during the full lengths of record available. The interannual variability of the precipitation and discharge (in particular) can clearly be seen on this new figure, in a better way than just by giving a parametric estimate (standard deviation).