* P and L denote Page and Line, respectively.

Reviewer #2:

General comment:

The authors present three copula-based methods for bias correction of daily air temperature data, obtained from the European Centre for Medium-range Weather Forecasts (ECMWF). The aim is to predict conditional copula quantiles at "unvisited locations". The three new methods are compared with standard methods for bias correction, using data from five weather stations within an agricultural area in the Qazvin Plain, Iran.

Overall, the description of the methodology has to be improved significantly and the innovation of the new methods must be better elaborated. The results section must be improved as well, most of the overall conclusions are not convincingly derived from the results. The study is lacking of a demonstration about how robust the results are, which is crucial to show since the sample size is small. I also think that the title (as well as the whole paper) should contain the term "interpolation" rather than "bias correction". This would better reflect the contents of the manuscript. Since the manuscript contains some interesting parts, but needs very significant improvement, I recommend **"(very) major revisions"**.

1- Regarding "the description of the methodology", P3-P11, we have revised this section completely.
2- Regarding "the innovation of the new methods", P3, L1-11, it has been revised as follow: In this study, we aim for:
   - estimating different conditional quantiles at all unvisited locations accounting for the temporal variability of the dependence structure.
   - evaluating the ability of these methods to predict the spatial variability of the bias-corrected daily air temperature at unvisited locations.
   - comparing the proposed methods with available bias correction methods, which are quantile mapping, expectation predictor and single quantile predictor.
   - providing a review and application of these methods for bias correction of the daily air temperature data when a relatively low number of observations are available.
3- Regarding "the results section", P12-P15, this section is completely revised.
4- Regarding "how robust the results are, which is crucial to show since the sample size is small",
- P10, L15-16, it is mentioned that: The observations from weather stations are used for cross-validation to quantify the robustness of the each method (Lafon et al. 2013). The reference is added to this line.
5- Regarding "the term "interpolation" rather than "bias correction"", the reason for the title "bias correction" is based on the definition of bias and literature review in the Introduction section:
   - P2, L3-4, it is mentioned that: Bias is defined as the systematic underestimation or overestimation of a global weather forecast system with respect to local measurements from weather stations (Persson 2013; Mao et al. 2015).
   - P2, L9-16, it is mentioned that: Various bias correction methods have been proposed in the literature….

Comments:

• Abstract: Please explain the three different new approaches. What are the differences between them?

- P1, L10-14, it is added that: The new methods are bivariate copula quantile mapping (BCQM-I and BCQM-II), and a quantile search (QS). In the BCQM methods, quantile mapping is performed between two bivariate copulas. The difference between BCQM-I and BCQM-II is the choice for a particular covariate. The QS method allows one to generate a random variable and to re-estimate the bivariate copula minimizing the error between the true marginal quantile and the marginal quantile estimated by the BCQM methods.

• P1, L28: "...result in system uncertainties of the obtained weather data ...": what do you mean by this statement? Please explain.

- P1, L26-28, it is revised as: The coarse resolution of models, mutual dependence of weather parameters, and variability of these parameters in space and time are main sources of uncertainties in a weather forecast system (Dee et al. 2011; Durai and Bhradwaj 2014).

• P2, L11: This is obviously wrong. The QM, since correcting the whole distribution, is able to correct also the higher order statistics.

- P2, L10-12, it is revised as: Although quantile mapping methods are able to correct for bias in the mean and standard deviation, none of them could robustly correct other moments of a probability distribution (Lafon et al. 2013).

• P2, L28: I would not label this as bias correction, the Vogl et al. (2012) paper is about assimilation of different data products in order to derive improved precipitation fields.

- P2, L28, in the Vogl et al. (2012) paper , they mentioned several times especially in the title of the paper that their work is about copula-based assimilation of radar and gauge information to derive bias-corrected precipitation fields.

• P3, L28 (and also later in the manuscript): These are not all copula "families", please correct.

- P3, L28, in the literature they are called as “families” and references are added to this line as: (Nelsen 2003; Joe 1993).

• Equation 3: I suggest to include the time t and the location s in the formula.

- P4, L4, it is done as : $z_2^{t,s}$: $z_1^{t,s} = z_2^{t,s} + Bias^{t,s}$.

• P4, L9: t and s already defined before

- P4, L9, this line is removed.
- P4, L2, this line is revised as: The bias at a single moment t in time and location s in space is defined….

• P4: L25: Certainly one of the most critical aspects: What about the robustness of the MLE? It is suggested to apply also other apporaches, e.g. method of moments to cross-check. It is recommended to demonstrate that your results are robust for both, the marginals and the Copula functions, which I severely doubt (due to the very small sample size).

1- Regarding “the robustness of the MLE”, P4, L26, we added the reference as: we apply maximum likelihood estimation (Gräler 2014),….
2- Regarding “other approaches, e.g. method of moments”, if the reviewer gives a reference, it will be included as a suggestion in the paper. The implementation, however, is beyond the scope of this paper.
3- Regarding “your results are robust for both, the marginals and the Copula functions”: we were able to increase the number of stations to eight and use the historical data at each day to deal with low number of observations as:
    - P11, L29-31 and P12, L1-4, we added that: Eight weather stations (Table 2) were selected because they had a long range of air temperature measurements available and were well spread over the study area. Minimum and maximum distances between stations are 13 and 78 km, respectively (Figure 3). For all weather stations, the daily minimum and maximum air temperatures are available for the periods 1-30 June 2004 to 2014. The quality of measurements and number of missing values, however, differ at each stations (Table 2).
    - P4, L29-32 and P5, L1-2, goodness of fit test is done for copulas and p.values are listed in Table 4.
    - P10, L15-16, we mentioned that: The observations from weather stations are used for cross-validation to quantify the robustness of the each method (Lafon et al. 2013). The reference is added to this line.

• P5, L16: Indeed, various names exist already for the QM, thus I suggest not to introduced another name.

- P5, L23-24, these lines are removed and the “quantile mapping (QM)” is used instead of “MQM”.

• P7, L14-16: "The mean and the median of the simulations are equal to the mean and the median as derived from the conditional copulas using methods 2.3.2 and 2.3.3 when choosing large number of the samples in the simulation (Mao et al. 2015)." I am not sure what is meant by the authors.

- P7, L9-16, it is revised as: The number of samples in the simulations, however, influences the simulation of conditional quantiles. In the simulation procedure, to obtain a single value for air temperature, a choice for either the mean, or the median or the mode of a simulation provides a single value $\hat{z}_1$. In the literature, the mean value of the simulations is considered as a single realization (Laux et al. 2011; Vogl et al. 2012). When choosing large number of the samples in the simulation and one chooses either the mean or the median of the simulations as a single value, the mean or median are equal to the mean value as derived from the conditional copulas using expectation predictor explained in Sect. 2.3.2 and or the median value as derived using median predictor explained in Sect. 2.3.3 (Mao et al. 2015).

• P8, L2-3: "The variable R is treated as a random variable due to uncertainty in positioning and elevation." I think there is a misunderstanding about the term random variable.

- P8, L2-3, this sentence is removed.
- P7, L27-30, the variable R is replaced by the elevation.

• P12, L27-30: not clear. How are the "outliers" identified?

- Outlier were responsible for negative temperature in March. Based on our knowledge, negative temperature in March is a strange value in the study area. Aggarwal 2013 defined outlier as : “Outliers are also referred to as abnormalities, discordants, deviants, or anomalies in the data”.
- P12, L27-30, this paragraph, however, is removed due to removing data in March. We now limit the implementation to data in June.

• P13,L1-2: "Since bias correction was applied separately for each day, there was no need to remove the outliers." Please explain this sentence.

- P13, L1-2, this sentence is removed due to removing data in March. We now limit the implementation to data in June.

• P15,L32: "The estimation of marginal distributions and copulas, however, are affected by the low number of observations." This is not shown in your manuscript, not a reference is given.

- P15, L32, this sentence is removed as the number of observations is now increased.
- P4, L29-32 and P14, L18-19, goodness of fit test is done for copulas and p.values are listed in Table 4.

• P16, L12: The link to crop production is not well elaborated throughout the manuscript. Please improve significantly.

- P11, L23, it is added that: The crop calendar is listed in Table 2.
- P11, L25-29, it is added that: One of the objectives of this project is to produce daily air temperature map from point measurements to be used in crop growth simulations for assessing near-real time crop and irrigation water requirement. Considering the importance of June in the crop calendar of the study area which is the end of winter crops and beginning of summer crops especially maize, we applied the proposed methods to available dataset of this month.
- P16, L16, it is added that: Further studies are necessary to quantify the impact of temperature variability on crop production in the study area.

• P16, L17-19: Why is there nor need to remove autocorrelation and heteroskedassticity?

- P2, L22-L26, further explanations are added about removing autocorrelation in time series: A bias correction method proposed by Laux et al. (2011) employed bivariate conditional copulas to model dependence between the daily precipitation time series retrieved from a regional climate model and observations at three locations where data is available. In their method, however, a bivariate copula is fitted to daily time series at one location, ignoring the temporal variability of copula parameter as well as spatial dependency. In addition, the fitting is required to remove autocorrelation and heteroscedasticity which may exist in the time series (Laux et al. 2011).

• P17, L13-16: I could not see how both conclusions can be derived from the manuscript.

- P17, L11, it is revised as: From this study, based on the error measures in Table 5 and 7 and the correlation coefficients in Table 6, we conclude….

Editorial Comments:

• P2, L16: "For this reason, we turn to Copulas." I suggest to delete this sentence in the introduction section.

- P2, L16, it is done.

• P5, L25: The abbreviation of the method can be used.

- P5, L25, it is done.

• P7, L12: Please use "suitable solution" instead of "single realization".

- A single value from a random variable is called a realization (Cressie, N. 1993).
- P7, L12, the reference is mentioned and the simulation results are called “realizations” (Laux et al. 2011).
- P5, L8, section 2.3 is all about the realization of the air temperature variable at unvisited locations.

• P15, L27-28: Please correct this sentence: "... to develop three new methods in the bias correction methods."

- P15, L27-28, this sentence is removed.