

## ***Interactive comment on “Three novel copula-based bias correction methods for daily ECMWF air temperature data” by Fakhreh Alidoost et al.***

**Anonymous Referee #2**

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### **General comments:**

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

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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”**.

### **Comments:**

- Abstract: Please explain the three different new approaches. What are the differences between them?
- P1, L123 ff: "...result in system uncertainties of the obtained weather data ...": what do you mean by this statement? Please explain.
- P1, L30 ff: This is obviously wrong. The QM, since correcting the whole distribution, is able to correct also the higher order statistics
- P2, L13ff: 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.
- P3, L7 (and also later in the manuscript): These are not all copula "families", please correct.
- Equation 3: I suggest to include the time  $t$  and the location  $s$  in the formula.
- P3, L17:  $t$  and  $s$  already defined before
- P4: L4: Certainly one of the most critical aspects: What about the robustness of the MLE? It is suggested to apply also other approaches, e.g. method of

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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).

- P4, L19ff: Indeed, various names exist already for the QM, thus I suggest not to introduced another name.
- P5, L26-30: "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.
- P6, L11-12: "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.
- P9, L28-29: not clear. How are the "outliers" identified?
- P10,L1-2: "Since bias correction was applied separately for each day, there was no need to remove the outliers." Please explain this sentence.
- P11,L32f: "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.
- P12, L12-15: The link to crop production is not well elaborated throughout the manuscript. Please improve significantly.
- P12, L16-17: Why is there nor need to remove autocorrelation and heteroskedasticity?
- P13,L11-14: I could not see how both conclusions can be derived from the manuscript.

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#### **Editorial Comments:**

- P2, L4: "For this reason, we turn to Copulas." I suggest to delete this sentence in the introduction section.
- P4, L20: The abbreviation of the method can be used.
- P5, L25: Please use "suitable solution" instead of "single realization".
- P11,L27-28: Please correct this sentence: "... to develop three new methods in the bias correction methods."

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