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Hydrology and Earth System Sciences Discussions

Interactive comment on "Copula based multisite model for daily precipitation simulation" *by* A. Bárdossy and G. Pegram

Anonymous Referee #2

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General comments

In general this paper describes a novel method to generate multisite rainfall simulations using a copula-based approach. The Authors claimed that this approach is superior to classical approaches found in literature (e.g. the classical normal scores transform). The novelty of the proposed approach lies specifically in the application of a non-linear transform to a vector of Gaussian variates. The spatial dependency of rainfall time series occurring at various stations is governed by a multidimensional copula. Another novelty of the paper is the application of triples instead of pair-wise comparisons to establish the clustering capabilities of the rainfall model. The proposed technique was tested in a mountainous region in southern Germany for daily rainfall between 1958

to 2001. The subject covered by this paper is indeed a very relevant research topic in hydrometeorology, and, in my opinion suits to HESS's readers. The state-of-the-art in this subject is still far from satisfactory, thus, publications of relevant research in this subject should be encouraged. In the present paper, however, there are some shortcomings that have to be clarified before its publication.

Specific comments

1) The subscript i in the second part of the eq. (2) should be, in my opinion, a superscript, i.e. if $u^{(i)} =$ instead of if $u_i =$. Please define $u^{(i)}$ as a vector.

2) §2.1 Line 10, please use subscripts for $F(x1, \ldots, xn)$. It should be $F(x_1, \ldots, x_n)$. x_i is not defined so far. To be consistent with eq. (3), it should be $F(t_1, \ldots, t_n)$.

3) Eq.(3) should be $F(t_1, \ldots, t_n) = C(F_{t_1}(t_1), \ldots, F_{t_n}(t_n))$.

4) Left term of Eq.(4) should be $C(u^{(i)})$. Please use a vector notation.

5) Could you elaborate on possible reasons due to which the parameter α has reached a value of $m = 3.5$ during months between December to June? Why did you limit it to 3.5? Could you provide some rules on how to guess the limits of all copula parameters?

6) Is the scale of the ordinate of fig. 5 appropriate? In my opinion, the area below these curves must be equal to one. Moreover, one of them appears to be greater than the other one (although it is impossible to distinguish which is which because no legend is provided).

7) Please indicate in the caption of fig. 12 that the stations are ordered in ascendent order with respect to its distance to station nr. 30.

8) In my opinion, 20 replicates of the historical time series constitute a quite small sample to infer conclusions on behavioral characteristics of the model. Why 20 and not 999? Please increase the number of replicates at least to 100. Using one of the presented statistics vs. the number of replicates one may be able to show that there is

convergence in the ensemble mean and find a suitable number of replicates as a rule of thumb for future applications.

9) At the moment there is no analysis of uncertainty of the parameters k, α, and m. It is crucial to know the empirical distribution functions of these parameters provided various rainfall samples (e.g. using bootstrapping techniques) since you mentioned the non-uniqueness of the copula (§3.3 line 14).

10) I assume that values shown in fig. 13 were obtained with a kind of moving average since mean daily values are not so smooth. Please clarify this issue in the caption.

11) The presented method is relatively complicated and has various steps that should be explained in more detail. Please consider to present an algorithm or a flow diagram in which all main steps are detailed. The text could also follow these schema. Derivation of equations and other auxiliary equations (e.g. 12 and 13) can be provided in an appendix, for example. These would ease the understanding of the method as well as helping potential readers to apply this sophisticated and interesting method on their own. At the moment, I consider it rather complicated.

12) Some figures perhaps can be excluded because they show basically the same results, e.g. fig. 14 and fig. 15, fig. 16 and fig. 17, fig. 18 and fig. 19. Since in the conclusions it is stated that this method is superior to the classical normal scores transform, it would be fundamental to provide a graph such as fig. 13, in which the claimed superiority of the proposed method is depicted.

13) The result section is quite short with respect to the number of figures provided. At the moment, it is on average one line per figure! Some discussions of the interesting results are encouraged.

Technical corrections

1) Citations must be written without parenthesis when they constitute the noun of a sentence, e.g. in para. 1.1, line 1, and onwards.

2) Fig. 5 should be improved. Provide a legend for Fig 5.

3) Define Φ after line 20, §3.1.

4) Define p_0 in the text.

5) In the caption of Fig. 5, use $F_g(s)$ instead of $Fg(s)$.

6) Fig. 14, 15, 16, 17 require a legend.

Editing Comments

1) §3.1 line 15. multi-site should be multisite for consistency with previous text.

2) Improve the sentence in §2.3 line 7-8.

3) In my opinion there is one method in this study. Hence singular should be used in §4.

4) Please use decimal point instead of commas in the ordinates of Fig. 5, 8, 11, 12, 21, 22, 23.

Final Remarks

Provided that the Authors implement the previous suggestions, I recommend publication of this manuscript in HESS.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 4485, 2009.