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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Design water demand of irrigation for a large region using a high-dimensional Gaussian copula" *by* Xinjun Tu et al.

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Anonymous Referee #2 Received and published: 3 July 2018 General comment In this paper, authors used the multivariate Gaussian copula and the general normal distribution to develop an eight-dimensional joint distribution of sub-regional precipitations. Using three design methods, i.e. equalized frequency, typical year and most-likely weight function, design combinations of sub-regional precipitation for a given cumulative frequency of entire regional precipitation were proposed and applied to analyze water demand of irrigation in a large region and its sub-regions. In a large region, design combinations of sub-regional water demand of irrigation were produced by the

linkage between the regional CDF of precipitation and the joint CDF of sub-regional precipitation, which is impressive and innovative. The technical methods are overall sound, and the recommended design approach is useful for the water re-source managers in long-term planning. I would recommend accepting this manuscript after the following concerns have been fully addressed. Specific comments 1. [P6: 2.4.1], the Gaussian copula may not work for all cases, did authors consider other available copula functions at higher dimensions? For instance, t-copula is conceptually similar to Gaussian copula and also available at higher dimensions. Response: We greatly thank the reviewer for the comment. In our previous investigation, the Gaussian-copula and t-copula functions were also used. the goodness-of-fit test of joint distribution showed that the RMSE and AIC values of two copulas were almost undifferentiated (see the table as follows). Goodness-of-fit test of joint distribution of sub-regional precipitation Type P-values RMSE AIC Gaussian copula 0.262 0.0173 -401.36 t-copula 0.250 0.0173 -401.37 The manuscript paid more concerns to design procedures for water demand of irrigation. Considering the limited length of the paper, only the Gaussian copula was addressed and further applied in modelling the joint distribution of sub-regional precipitation in our manuscript. 2. [P9: Lines 8-11], why is the entire region divided into eight sub-regions? Are there any references that authors can provide to support agricultural division in the study region? Response: We greatly thank the reviewer for the comments and revised the statement (see Page 9, Lines 14-16 in the revised manuscript). Eight sub-region in terms of agriculture is based on the report of Irrigation Quota of Guangdong Province. 3. [P10: Lines 1-5], the explanation of the box plot should be addressed in the title of Figure 4. Response: We greatly thank the reviewer for the comment. The description of the box plot was moved in the title of Figure 3 in the revised manuscript. (see Page 10, Lines 8-9 and Page 20, Lines 2-5 in the revised manuscript) 4. [P11: Lines 10-14], the confidence interval (CI) was mentioned many times after here, why use it and how to calculate it, should be addressed in Methodology. Response: We greatly thank the reviewer for the comment. A confidence interval (CI) was defined by the distance which deviated

from the diagonal (Serinaldi 2013; Volpi and Fiori, 2014) and transformed herein by the normal distribution. In design sub-regional CDFs of precipitation, The CI may not be necessarily, but it is used to further illustrate the relationship of the Kendall (joint) CDF of sub-regional precipitation and the CDF of precipitation of the entire region for the samples and design values (see Figures 8 and 9 in the revised manuscript) Considering the manuscript paid more concerns to design procedures for water demand of irrigation, we gave a simple but clear definition of CI in Methodology (see Page 9, Lines 3-6 in the revised manuscript). More details of the CI can be referred in previous studies, for example by Serinaldi (2013),Volpi and Fiori (2014), etc.. 5. [P20: Figures 3 and 4], the implication of Figures 3 and 4 is similar. Figure 3 may be deleted. Response: We greatly thank the reviewer for the comment and deleted Figure 3. Figures 4-14 in the original manuscript were revised to Figures 3-13 in the revised manuscript, respectively. 6. [P21: Figure 5], the label of X-axis is unconventional. Kindly suggest using general axis for the X-axis or giving an explanation about it. Response: We greatly thank the reviewer for the comment and gave a description of the X-axis (see Page 20, Lines 8-9 in the revised manuscript). 7. [P22: Figure 7], how to calculate multivariate empirical CDF? Response: We greatly thank the reviewer for the comment. The description of multivariate empirical CDF was addressed in Methodology (see Page 7, Lines 17-18 in the revised manuscript). 8. [P22: Figure 8], the illustrations of two subfigures are undifferentiated except the ticks of X-axis. Delete one of them. Response: We greatly thank the reviewer for the comment and would maintain two subfigures. The left figures generally used in most studies clearly presented the relationship and change between the Kendall CDF and conventional joint CDF. The right figure illustrated in this paper demonstrated that both of them transformed by the standard normal distribution showed a good linear relationship. (see Page 10, Lines 30-32 and Page 11, Lines 1-2 in the revised manuscript).

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-213/hess-2018-213-AC2-

supplement.pdf

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