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Hydrology and Earth System Sciences Discussions

Interactive comment on "Copula-based statistical refinement of precipitation in RCM simulations over complex terrain" *by* P. Laux et al.

Anonymous Referee #1

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1 Introduction

The manuscript under review uses copulas in order to describe the dependence between modelled and observed precipitations, conditionally on the prevailing large-scale whether situations.

The main goal of the manuscript is to show that, knowing the link (the copula) between observed and modelled precipitations, one could reduce the discrepancies between simulated and observed rainfalls.

The manuscript presents a novel procedure with some interesting applications. How-

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Interactive Discussion

Discussion Paper

ever, in order to provide a more substantial contribution, I would invite the authors to revise the manuscript and to devote more attention to a number of aspects that I am going to illustrate.

2 General comments

2.1 ARMA-GARCH time series models

As illustrated in section 4.1, the original time series exhibit serial dependence. In order to describe it, an ARMA-GARCH model is adopted. Now, the graphs of figure 3 do not completely support such a choice. I wonder whether a simple ARMA (or GARCH) model could be useful as well. In order to convince the reader about this choice, I would suggest to discuss:

- why simple models (like AR or MA) fail;
- what are the orders and the parameters of the ARMA-GARCH model fitted to each time series;
- what are the results of Ljung-Box Q-test (page 14, line 16).

2.2 Estimation of the copula models

As said, the univariate time-series M_t and O_t related to modelled and observed rainfalls are serially correlated. As such, they have been transformed into other time-series X_t and Y_t (the residuals of M_t and O_t, respectively) that are a random sample from a given distribution. Now, it is not clear from the manuscript whether Table 2 considers the copula of (M_t, O_t) or the copula of (X_t, Y_t).

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Choosing between these two sets of paired observations makes a big difference! In order to get a full picture of this problem, one should refer to the paper
V. Grégoire, C. Genest & M. Gendron (2008). Using copulas to model price dependence in energy markets. Energy Risk, 5 (5), 58-64.

Following Table 2, I do not see strong motivations in favor of Gumbel copula. I think that other families of copulas should be considered as well, with particular emphasis on copulas that exhibit some upper tail dependence (for instance, survival Clayton copulas, Student copulas, extreme-value copulas, etc.).

2.3 Conditional stochastic simulations

The procedure of stochastic simulations should be described in detail in section 4.5. Moreover, I do not see any strong evidence of the fact that copula-based simulations lead to significant improvements. A detailed and serious simulation study should be conducted in several cases and, moreover, a clear performance measure should be adopted in order to convince the reader about the goodness of the proposed methodology.

3 Small comments

Here a list of small comments and/or typos.

- Page 4, line 27: “studied” instead of “studies”.
- Page 7, line 2: “independent” instead of “independend”
- Page 8, eq. (1): I think that past observations of Y also should be taken into

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account. Thus, eq. (1) could be written in the form

$$Y_t = f(Y_1, \ldots, Y_{t-1}, X) + \varepsilon_t.$$

- Page 9, line 3: wrong reference to eq.(5). Please, check.
- Page 10, line 9: “continuous functions” instead of “steady functions”
- Page 10, line 10: what are “correlated iid variables”? Copulas describe the dependence among random variables $X_1, \ldots, X_d$ that are not necessarily iid.
- Page 10, line 12: “Nelsen” instead of “Nelson”
- Page 11, eq. (8): I would use the symbol $\mathbf{1}$ for the indicator function.
- Page 11: title of section 3.2.2 should be changed, since the subsection deals with GOF methods, not with estimation.
- Page 11, line 19: please, chech a missing reference.
- Page 15, lines 12-13: “opposite diagonal of the unit square” instead of “minor diagonal”.
- Page 16, lines 4–5: It is said that “no clear functional dependence between the altitude of the stations and the copula parameter θ exists”. How has this fact been proved?
- Page 17, line 22: “assuming” instead of “asssuming”.
- Page 18, lines 24-25: I do not understand why ARMA-GARCH models “are generally useful to generate iid random variables”.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 3001, 2011.