Hydrol. Earth Syst. Sci. Discuss., 8, C435–C438, 2011
www.hydrol-earth-syst-sci-discuss.net/8/C435/2011/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Modelling the statistical dependence of rainfall event variables by a trivariate copula function" *by* M. Balistrocchi and B. Bacchi

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Received and published: 14 March 2011

The manuscript presents an interesting analysis of rainfall event variables dependence using copula functions. Within the background of urban drainage applications, the paper questions the usual hypothesis of considering event rainfall variables such as depth, storm duration and interevent time, independent. Authors study the dependence structure in three Italian locations, identifying a strong dependence between event depth and duration. A joint probability model is finally proposed and fitted, assuming Weibull functions for the marginal distributions.

My overall impression on the paper is very positive, since the results deal with an issue

sometimes neglected or assumed as a conservative hypothesis. I think the paper is very well written and organised.

Since I have been recently working on similar topics, I cannot avoid establishing some parallelisms resulting in the following comments which aim at enrich the previous discussion to the final publication of the paper in HESS, which I obviously recommend.

I)Individual events identification I completely agree that identification of individual storms strongly affects the subsequent statistical analysis. Relate this procedure to physical characteristics of the derived runoff process could be useful; nevertheless, I point out two ideas that could be also discussed in the final paper, related to the choice between meteorological or hydrological events. a) P433, L24-26. "So, the IETD should be estimated, depending on the hydrologic hydraulic system that is analysed, as the minimum time necessary to avoid the overlapping of the hydrographs generated by two subsequent storms". I agree that this choice simplifies the hydrologic and hydraulic modelling, as it avoids considering probable overlapping events. Nevertheless, overlapping events is an important factor to be taken into account in storm tank management, as, for instance, it could reduce significantly its efficiency. b) P433, L26-27. "Furthermore, the volume threshold can be reasonably identified with the initial abstraction (IA) of the catchment hydrological losses (see for example Chow et al., 1988); thus, only the runoff producing rainfalls are taken into account". If only the runoff producing rainfalls are considered in the analysis, the global catchment management point of view is lost. Rainfalls that not produce runoff are directly managed by infiltration processes in the catchment, and if the purpose is to evaluate the overall system efficiency, I think this minor rainfall events should not be neglected. In my opinion, if the purpose is to identify statistical independent storms, an analysis focusing on the rainfall time series itself is more appropriate and not incompatible with other hydrological aspects (hydrographs overlapping or not runoff producing rainfalls). In "I. Andres-Domenech, A. Montanari, and J. B. Marco, Stochastic rainfall analysis for storm tank performance evaluation. Hydrol. Earth Syst. Sci., 14, 1221–1232, 2010, doi:10.5194/hess-14-1221-

2010" the rainfall characterisation is performed in this way, and, for instance, a more detailed runoff production model is used in order to take into account more precisely producing and non-producing runoff events.

II)Dependence structure between variables Section 3 of the paper aims at studying association degrees which relate paired variables. Results highlight that interevent periods are independent from both event depth and duration variables. This result is in fact inherent with the statistical features of the interevent time variable. Shape parameter for the interevent time marginal distribution is found to be fairly close to unity (section 5.1 and 5.2), showing that an exponential behaviour is not unlikely at all. This connects with the idea that if interevent periods could be exponentially distributed, they correspond to independent events. If a reasonable bounded exponential model can be fitted for this variable, support to the assumption that rainfall events occur according to a Poisson process, and thus, are independent, will be provided. A wide discussion on this topic can be also read in "I. Andres-Domenech, A. Montanari, and J. B. Marco, Stochastic rainfall analysis for storm tank performance evaluation. Hydrol. Earth Syst. Sci., 14, 1221–1232, 2010, doi:10.5194/hess-14-1221-2010"

III)What consequences could we expect? The results achieved in the paper could be applied to analytical urban runoff modelling to obtain, for example, efficiencies of a storm tank detention system. An immediate question that arises to me when reading the paper is about the differences that could exist on the results if the dependent variables model is used instead of the independent one. For instance, how results in figures 4, 5 and 6 in "Balistrocchi, M., Grossi, G., and Bacchi, B.: An analytical probabilistic model of the quality efficiency of a sewer tank, Water Resour. Res., 45, W12420, 2009" or those related in figure 1 in "I. Andres-Domenech, A. Montanari and J. B. Marco, Efficiency of storm detention tanks for urban drainage systems under climate variability, Journal of Water Resources Planning and Management. Submitted 2011; doi:10.1061/(ASCE)WR.1943-5452.0000144" could be modified if a trivariate joint distribution is used? Maybe authors could consider adding some preliminary observation

on the improvements that could be achieved with this more accurate way to describe rainfall event variables.

IV)Minor points P480, L25. Please replace "have to fitted according to" with "have to be fitted according to". P457, L13. Please replace "is related to the a considerable" with "is related to a considerable"

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 429, 2011.