Geophysical Research Abstracts
Vol. 18, EGU2016-12754, 2016
EGU General Assembly 2016

Interpretation of heavy rainfall spatial distribution in mountain watersheds by copula functions

Giovanna Grossi and Matteo Balistrocchi
Università degli studi di Brescia, DICATAM, Brescia, Italy (giovanna.grossi@ing.unibs.it)

The spatial distribution of heavy rainfalls can strongly influence flood dynamics in mountain watersheds, depending on their geomorphologic features, namely orography, slope, land covers and soil types. Unfortunately, the direct observation of rainfall fields by meteorological radar is very difficult in this situation, so that interpolation of rain gauge observations or downscaling of meteorological predictions must be adopted to derive spatial rainfall distributions. To do so, various stochastic and physically based approaches are already available, even though the first one is the most familiar in hydrology.
Indeed, Kriging interpolation procedures represent very popular techniques to face this problem by means of a stochastic approach. A certain number of restrictive assumptions and parameter uncertainties however affects Kriging. Many alternative formulations and additional procedures were therefore developed during the last decades. More recently, copula functions (Joe, 1997; Nelsen, 2006; Salvadori et al. 2007) were suggested to provide a more straightforward solution to carry out spatial interpolations of hydrologic variables (Bardossy & Pegram; 2009).
Main advantages lie in the possibility of i) assessing the dependence structure relating to rainfall variables independently of marginal distributions, ii) expressing the association degree through rank correlation coefficients, iii) implementing marginal distributions and copula functions belonging to different models to develop complex joint distribution functions, iv) verifying the model reliability by effective statistical tests (Genest et al., 2009).
A suitable case study to verify these potentialities is provided by the Taro River, a right-bank tributary of the Po River (northern Italy), whose contributing area amounts to about 2˙000 km2. The mountain catchment area is divided into two similar watersheds, so that spatial distribution is crucial in extreme flood event generation. A quite well diffused hydro-meteorological network, consisting of about 30 rain gauges and 10 hydrometers, monitors this medium-size watershed. A decade of rainfall-runoff event observations are available.
Severe rainfall events were identified with reference to a main raingauge station, by using an interevent time definition and a depth threshold. Rainfall depths were thus derived and the spatial variability of their association degree was represented by using the Kendall coefficient. A unique copula model based on Gumbel copula function was finally found to be suitable to represent the dependence structure relating to rainfall depths observed in distinct raingauges.

Bardossy A., Pegram G. (2009), Copula based multisite model for daily precipitation simulation, Hydrol. Earth Syst. Sci., 13, 2299–2314.
Genest C., Rémilland B., Beaudoin D. (2009), Goodness-of-fit tests for copulas: a review and a power study, Insur. Math. Econ., 44(2), 199-213.
Joe H. (1997), Multivariate models and dependence concepts, Chapman and Hall, London.
Nelsen R. B. (2006), An introduction to copulas, second ed., Springer, New York.
Salvadori G., De Michele C., Kottegoda N. T., Rosso R. (2007), Extremes in nature: an approach using copulas, Springer, Dordrecht, The Nederlands.