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A multivariate regional test for trend detection in extreme rainfall: the case of extreme daily rainfall in the French Mediterranean area.

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The effect of human activity on the climate and on the earth global warming is now accepted by all the scientific community. In the context of a global warming one can ask for the consequences on the extreme events: in several regions their frequencies and/or their magnitude are expected to increase in the future. As the global warming starts in the beginning of the XXe century, can we already find some signal of any changes affecting the extreme events in the long series of observations? We try to bring some answer focusing on the extreme daily rainfalls in the French Mediterranean area. A set of 92 series of annual maxima daily rainfall has been sampled during at least 56 years. Those gauges have been gathered in seven homogeneous climatic regions with regard to extreme rainfall. A regional multivariate parametric test of trend detection has been developed, based on recent improvements in trend detection (Renard et al., 2008). The regional consistency is taken into account considering a common climatic trend for all the series of the same homogeneous region. The test consists of the following four steps:

i) The marginal distribution of each extreme rainfall series has been modelled with the generalized extreme value (GEV) distribution function and the spatial dependence between the time series of a given region has been modelled with copulas function.
ii) Two models have been defined: the stationary one (M0) and the non stationary one, where the GEV position parameters are supposed to be time dependant (M1).
iii) The maximization of the likelihood function with genetic algorithm has lead to the parameters estimation.
iv) The likelihood ratio test has been applied to select the “best” model between M0 and M1.

From a theoretical point of view, the present work underlines i) the necessity of taking into account the spatial dependence between the rainfall series of a given region and ii) the necessity of development in order to justify the copulas choice, as the test results are dependent of the copulas function.

Applied to the Mediterranean maximum annual daily rainfall, the results show a low significant trend in three out of the seven regions, concerning mainly the mountains area in the west part of the French Mediterranean region. The GEV position’s parameters present a low significant increasing trend, which lead in an increase of about 5% to 10% of the 99th annual maxima rainfall percentile in the last 56 years. This work is still going on in order to assess the extreme rainfall evolution in the future. This point needs to go beyond the descriptive work and must take into account the evolution in the next years of the main climate factors explaining the extreme rainfall.

Renard B, Lang M, Bois P, Dupeyrat A, Mestre O, Niel H, Sauquet E, Prudhomme C, Parey S, Paquet E, Neppel L, Gailhard J, 2008. Regional methods for trend detection: Assessing field significance and regional consistency. Water Resources Research, 44(8), W08419, doi:10.1029/2007WR006268.