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A non-stationary Neyman-Scott model for rainfall

G. Evin and A.-C. Favre

Chaire en hydrologie statistique Hydro-Québec/CRSNG, Institut national de la recherche scientifique INRS - Eau Terre et Environnement (bureau 2434), Université du Québec 490, rue de la Couronne Québec (QC) Canada G1K 9A9 (guillaume.evin@ete.inrs.ca / Phone: +1(418) 654-2530 #4479)

Stochastic point processes for rainfall are known to be able to preserve the temporal variability of rainfall on several levels of aggregation (hourly, daily), especially thanks to the cluster approach. One major assumption in the applications seen up to now is the stationarity of the rainfall properties. However, if we accept to consider a climate change as support by most of scientific world and The Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC), this postulate must be reconsidered. Thus, it seems important to explore the possibilities of introducing a nonstationarity in this type of models. Here, we focus on Poisson-based models with clusters. Many applications proved the strengths of such models, but the need of obtaining expressions of the statistical properties for the fitting limits the complexity of the model structure. We propose new developments of point processes which consider a nonstationarity function on storm arrivals. The key is to imagine that storms will be more frequent in the future. This assumption is in accordance with the increase of the mean annual precipitation. Thus, the basic theory is reconsidered and the moments are derived up to the third order in the general case and with a simple function on storm arrivals. However, these developments raise deeper issues, that is how to link the theoretical moments with the observed ones. If we consider that the statistical properties vary temporally, the computation of the observed moments is not straightforward. In this work, an humble proposition of a calibration method is proposed and discussed. Observed moments are computed thanks to the moving window statistics and a regression method. Then, the generalized method of moments can be applied to fit the model. The numerous consequences implied by this nonstationary

rate function on storm arrivals are analyzed from simulated series of rainfall.