Abstract

The generation of rainfall data needs a range of models depending on time and on spatial scales involved. Cox and Isham (1994) presented three types of rainfall models, namely, empirical statistical models, models of dynamic meteorology and intermediate stochastic models, a classification based on the amount of physical realism incorporated into the model structure. This study is based on the empirical statistical model type, where empirical stochastic models are fitted to the daily rainfall data range from 1951 to 1993 of 28 stations. The models for generating a long sequence of daily rainfall series are required increasingly, not only for the hydrological purposes but also to provide inputs for models for crops growth, landfills, tailing dams, land disposal of liquid waste and environmentally sensitive projects. It also provides the means of extending the simulation of rainfall to unobserved locations.

The present study develops models for simulating daily rainfall series i.e. occurrence processes and rainfall amounts on wet days using the spatially distributed predictors such as latitude, longitude, altitude, exposition effect etc.

Two-state first-order Markov chain is used to model wet-dry and wet-wet occurrence processes; transition probability between dry or wet and wet days are calculated. The Weibull distribution function is used to model the daily rainfall amounts on a wet day. The seasonal variation in rainfall is an important factor and several approaches have dealt with the seasonality; in this study, we assume that parameters vary either as a step function for each month and use a double normal function to describe the seasonal variation of parameters. The idea behind the double normal function is based on the assumption of two different rainy seasons during a year, each one with a peak similar to that of a normal function. If there is only one rainy season, we expected that this could also be represented by near zero values for one of the two normal distribution. Parameters of double normal function are estimated by a minimization of errors. Stepwise regression analysis is then used to approximate parameters of the double normal function from spatially distributed predictors. As the outcome of the regression analysis, 5 % significance level is chosen to decide the inclusion or the exclusion of a predictor. Approximated parameters of the double normal function are used to write the equations of the models allowing the generation of daily rainfall series (occurrence processes and daily rainfall amounts) by the following procedures:

- chose an arbitrary location P in Cameroon where you want to simulate daily rainfall series

- determine the necessary information on $P's$ position and relief surrounding for input in equations for estimating wet/dry and wet/wet occurrence processes and the user will get a time series of daily precipitation occurrence at P.

- determine the necessary information on $P's$ position and relief surrounding for input in equations for estimating the Weibull parameters g, b and simulate daily rain amounts by generating random numbers R from pseudo-random number generator. Each random number then inserted in equation gives daily rain amount r time series at P using the Monte Carlo method.

Regrettably, we were not able to use the observation data that are independent from the ones we used for calibration, i.e. estimating all the parameters. The main results are as follows: The models reproduced well the seasonal variation of dry-wet and wet-wet transition probabilities at all the stations tested in spite of the gap existing between the observed and the estimated probabilities. It is also noted that there is a discrepancy between the month where the maximum (peak) and the minimum of estimated probabilities occurred against the observed ones. The generator seems to be able to generate rain series (number of wet days) for inland stations with statistics resembling the observations whereas the coastal area (Douala and Ngambe) shows the contrary. The simulated series present the same configuration as the observed series with the maximum of wet days occurring in the rainy season. In Douala, Ngambe and Ngaoundere, the maximum number of wet days occurs in August for the observed series whereas it occurs in September for the estimated series. The test of the frequency distribution of generated and observed rain amount series shows that the generator produces good estimate of daily rainfall amounts in the northern area (Kaele) and in the southern plateau (Sangmelima). Weak rainfall amounts are generated at the stations situated on highlands (Koundja) and in the coastal area (Douala and Ngambe). The test of the mean rainfall indicates that the significance value is above .05 in Kaele, Koundja, Ngambe, Sangmelima for all the 12 months suggesting that there is no difference between the mean of observed and simulated rainfall series. In Douala, the significance is less than .05 in August; in Ngaoundere the significance is also less than .05 in December. Both cases suggest a difference between the mean of

observed and simulated data in these months. The situation is the same when testing the monthly variance; the value under .05 indicates that there is a difference between the variance of observed and simulated series in August, October, and November in Douala.