ABSTRACT

A methodology for the development of a simulation model for the rainfall and runoff has been proposed and subsequently a stochastic rainfall-runoff generator was developed for a catchment in the Mahanadi Basin. Daily rainfall records at 7 stations in the catchment were analyzed. A nonparametric test based on the Mann-Kendall statistic showed no evidence of long-term trends in the rainfall occurrence and rainfall amount data. The spectrum of rainfall occurrences revealed that the process is only yearly periodic and within the monsoon season no cyclic behavior was detected. It was hypothesized that the rainfall occurrences governed by the monsoon climate are conditionally dependent and the hypothesis was specifically tested by the cumulative periodogram. The hypothesis of independent rainfall occurrences was rejected both at 1% and 5% significance level. The conditional dependence of rainfall occurrences was modeled by the discrete-parameter Markov chain. The order of the Markov chain was selected using the Akaike Information Criterion and an extension of the principle of maximum likelihood. The results show that a third-order model is required to depict the rainfall occurrence. The cumulative periodogram test on daily rainfall amount data showed that either the amounts are independent or are very weakly correlated. This independence of daily rainfall amounts led to the use of distribution functions to model the magnitude of rainfall on wet

days. Out of six probability distributions, the beta-P distribution was selected due to its better computational facility with the order statistic.

In order to study the internal structure of daily rainfall in more detail, the models for the number of storms per day, their amount and duration were developed. A Monte Carlo experiment to simulate the daily rainfall occurrences, daily rainfall amount, number of storms per day, storm amounts, and durations was carried out based on the developed models. The comparison between the observed and simulated data was quite satisfactory. A disaggregation procedure based on the double exponential function was developed to obtain the rainfall intensity patterns from the rainfall amount and duration. An infiltration approach was used to model the catchment runoff. For this, the average areal rainfall over the catchment was estimated by using the Kriging method. The average areal rainfall was disaggregated to obtain the rainfall intensity patterns. The Green and Ampt infiltration equation was, then, applied to the rainfall intensities to estimate the cumulative runoff from a rainfall event over the catchment. The estimated runoff and the observed runoff of the catchment were found to be in close agreement.

KEYWORDS:

Long-term trend *FFT* *Maximum likelihood*
Spectrum *Periodicity* *Simulation*
Periodogram *Markov chain* *Disaggregation*
Window *Information Criterion* *Kriging*
Infiltration *Green and Ampt*