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Monte Carlo Simulation for Calculating Drought Characteristics

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Abstract Drought characteristics (risk, magnitude and duration) are usually necessary for the planning, design and operation of water-supply reservoir system. For instance, the storage capacity of the reservoir system is often planned and designed based mainly on the water shortage risk that is chosen to be tolerated. The operation performance of the system is generally assessed according to the greatest water deficit and the longest drought duration. In general, the water shortage properties at seasonal – says, tri-monthly, quarterly or monthly – level are considered to be adequate. They are reliably determined using Monte Carlo simulation study of interested water-resource system against many samples of generated flow records and synthetic climate – rainfall and evaporation – data. The computation technique involves the set-up of a simulation model for the studied system based upon computer programs available. It also includes the developments of stochastic models for the flow and climate phenomena, and the integration of all referred models together. However, the stochastic simulation technique may be simplified in practical applications through considering only the generated seasonal-flow records, and replacing the synthetic rainfall and evaporation data at the corresponding level by their historic average values. This paper investigates the feasibility of using the assumptions of neglecting generated seasonal climate – rainfall and evaporation – data for calculating drought characteristics. The examined simulation model was constructed using HEC-3 program as a based model and combining it with a decomposed MAR(1) of seasonal flows. It was then applied to a medium-scale (100 MCM $<$ storage capacity $<$ 1, 000 MCM) and a large-size (storage capacity $>$ 1, 000 MCM) water-resource systems for computing their water deficit statistics. Obtained results were compared with those of an actual simulation model, where the stochastic rainfall and evaporation models developed by the CRC for Catchment Hydrology (Australia) were added to the investigated one. The comparisons have shown that the simplified simulation model is feasible for the medium system since it gives the drought characteristics that agree well with the actual simulation one does. However, for the large system, the use of the hypotheses of ignoring the synthetic climate data is unacceptable. These generated climate records are necessary for capturing the maximum of the drought statistics. Keywords: Monte Carlo simulation, drought characteristics, generated flow data, generated climate (rainfall and evaporation) data.