Publications

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Stochastic Modeling of the Rainfall Runoff-Process for Nonpoint Source Pollutant Load Estimation

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- Full Text

A stochastic simulation methodology was developed for the rainfall-runoff process to assist in the assessment of nonpoint source pollutant loads, particularly for ungauged watersheds where there is a scarcity or complete lack of historical data. The methodology was developed based on simulating individual rainfall-runoff events. A simulation model employed a rainfall simulator to stochastically generate rainfall event characteristics for input into basin hydrologic transformation functions which then predicted the corresponding runoff hydrography characteristics.

Also addressed was the impact of limited data availability on the ability to model the rainfall-runoff process. An evaluation was conducted to the degree to which committing valuable resources to expand the data base would provide measurable improvement in model results. Specifically, the probability of achieving certain levels of accuracy with the simulation model was statistically assessed as a function of the number of observed rainfall-runoff events used for model development. The probability of monitoring various numbers of rainfall-runoff events in specified time intervals was also established as an aid for planning field monitoring studies.

The simulation methodology was applied to a study watershed in the Lake Ray Hubbard reservoir drainage basin near Dallas, Texas. Regional rainfall characteristics were established using historical hourly data from the Federal Aviation Administration rain gage at Love Field Airport in Dallas, Texas. Hourly rainfall data were resolved into individual rainfall events and probability density functions were identified for event volume, time between events, and event duration. Linear hydrologic transformation functions were derived and incorporated into the simulation model by applying a unique stepwise least squares optimization procedure using observed data from the study watershed. Both total direct runoff and peak runoff rate were shown to be functions of rainfall event volume and a white noise component. Verification of the model was achieved by statistically demonstrating that long-term simulation results and observed field data were drawn from the same underlying population.

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