

AN ABSTRACT OF A THESIS

CONTINUOUS HYDROLOGIC MODELING WITH HMS: PARAMETER ESTIMATION AND MODEL CALIBRATION AND VALIDATION

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This study investigated the application of the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) for continuous hydrologic simulation for the Dale Hollow watershed located within the Cumberland River basin. The U. S. Army Corps of Engineers, Nashville District, is interested in replacing their current continuous hydrologic model, HEC-1, modified to include a continuous form of the antecedent precipitation index (API), with HEC-HMS. First, parameterization methodologies were presented for extracting initial parameter estimates from digital spatial data using geographic information systems (GIS) and from historical stream flow records using recession analysis. These methodologies were validated along with the digital spatial databases, Land Use and Land Coverage (LULC) and State Soil Geographic (STATSGO), by comparing the values of the SMA parameters before and after model calibration. This comparison indicated that the five SMA parameters calibrated do not deviate more than 130 percent and have an average of 37 percent deviation from the estimated parameter values. Of the remaining seven, six were not adjusted and one was entirely calibrated due to the lack of measurements for initial estimation. Therefore, the parameterization methodologies and the accuracy of the databases were validated.

In the second part of this study, HMS model performance for the Dale Hollow watershed, in continuous simulation mode, was investigated. The study employed a split sample test with three years for model calibration and three years for model validation. The methodology introduced, which involved estimating parameter values, along with reducing the number of parameters calibrated and the setting of initial parameter conditions, was investigated to minimize parameter uncertainty. The study also examined the advantage of seasonal SMA parameter sets for reducing model errors associated with the nonlinear seasonal rainfall-runoff response by comparing simulation results among annual, bi-annual, and seasonal models. Graphical and statistical comparisons of simulated and observed hourly flows at two stream gages and simulated and observed reservoir water surface elevations over the validation period indicated that the continuous simulation mode of HMS with SMA performed reasonably well. The bi-annual and seasonal SMA models improved model performance considerably when compared to the annual model, but little improvement was observed between the seasonal and bi-annual models. Based on the study results, the HEC-HMS model with SMA was a viable option for continuous hydrologic simulation in the Cumberland River basin as part of the Nashville District, U.S. Army Corps of Engineers' Corps Water Management System (CWMS).