Regressions Relating Watershed Physical Characteristics to Instantaneous Unit Hydrograph Parameters for Rainfall-Runoff Modeling in Central Texas

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ABSTRACT

This poster presents the results of on-going study to evaluate regionalized unit hydrograph methods for Texas watersheds in the 200-acre to 10 square mile range. The research was conducted as part of a four-institution team (Texas Tech University, Lamar University, University of Houston, and the U.S. Geological Survey) to develop regionalized methods for use in watersheds with limited stream gage data for use by the Texas Department of Transportation for drainage areas in the specified size range. Currently the department uses the NRCS unit hydrograph as implemented in HEC-HMS.

Our research explored an alternate method where instantaneous unit hydrographs are synthesized from a two-parameter Rayleigh distribution, and excess precipitation is synthesized from an initial-abstraction, constant proportion (runoff coefficient) model. These two components are combined to simulate runoff hydrographs from a precipitation event.

The study has four fundamental steps:

1. Determine the underlying Rayleigh unit hydrograph for several events at each watershed.
2. Determine a median unit hydrograph for each watershed
3. Develop regional regression equations for the unit hydrograph and excess rainfall model in terms of watershed physical characteristics.
4. Evaluate the performance of this approach.
5. Compare the results to current NRCS methodology.

In this research a database for 90 watersheds was constructed containing paired rainfall-runoff events for 1600 storms. Each member of the research team then subjected these data to various analyses.

The University of Houston team created psuedo 1-minute data for instantaneous unit hydrograph development then performed a simple baseflow separation procedure. Next storm-optimum unit hydrographs were developed by pattern search for timing parameters, shape parameters, initial abstraction depths, and runoff coefficients. This step was accomplished using a purpose-built psuedo-parallel computer. Once the storm-optimum results were obtained, the storms were screened using an acceptance algorithm to automatically remove pathologically poor data (e.g. runoff arrives before precipitation begins, etc.). The remaining data are then correlated to selected watershed parameters (area, basin length, slope along main channel, etc.) to develop regression equations to predict unit hydrograph parameters given these simple measures. Lastly, the regression equations are applied to a handful stations that were omitted from the original analysis as a test of method performance.