Entropy-Based Assessment of Two Hydrologic Models

Mariano Hernandez, David C. Goodrich, Leonard J. Lane

Abstract

The purpose of this paper is to evaluate the effects of watershed segmentation and rain gage network density on simulated watershed response using informational entropy concepts. Two hydrologic models are used to simulate runoff from a small watershed in the USDA-ARS Walnut Gulch Experimental Watershed while varying the number of rain gages in the network and the contributing source area to generate different drainage network configurations. The first model is an event-based, physically distributed parameter model and the second is a continuous simulation model based on the hydrologic Curve Number. Both models are calibrated using the maximum number of rain gages in the network and the highest resolution configuration of the drainage network. The efficiency of both models is evaluated at each optimal rain gage network density and drainage network configuration. In this research, it is argued that there is a relationship between the maximum efficiency of the hydrologic models and the amount of information conveyed by both the existing rain gage network and the topological representation of the watershed. Based on the optimization of the informational content, a maximum contributing source area is identified as a function of the optimal spatial distribution of rain gages that maximizes model performance. This result can represent a new approach in evaluating the informational content associated with hydrologic data and the hydrologic model performance in order to develop a watershed segmentation criterion that defines geometric model complexity.

Keywords: informational entropy, hydrologic uncertainty, watershed, complexity

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Hernandez, Goodrich, and Lane (retired) are with the USDA-ARS, Southwest Watershed Research Center
Tucson, AZ 85719. E-mail: mhernandez@tucson.ars.ag.gov.