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Calibration of rainfall-runoff models: The effect of the temporal distribution of rainfall on uncertainties in model parameter estimation

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The temporal distribution of rainfall, which is used as input in rainfall-runoff simulations, determines (along with the model parameters) the form of the simulated hydrographs of the total runoff. Independent of the method used for the calibration of a rainfall-runoff model, the uncertainty in estimating the model parameters depends on the smoothness of the measured hydrographs. For instance, the estimation of those parameters that determine the recession limp of a hydrograph, which is relatively smooth, is less uncertain than the estimation of the parameters determining the peaks of a hydrograph. The smoothness of a runoff hydrograph mainly depends on the temporal distribution of rainfall, which enforces the runoff in the catchment.
In this study we investigate the uncertainty in model parameter estimation with respect to the temporal distribution of rainfall. To do so we use smoothed rainfall distributions to study the efficiency of adaptive methods when calibrating rainfall-runoff models. The investigations are performed using the ENNS rainfall-runoff model (Nachtnebel et al., 1993), as follows: (a) The equations used in ENNS are written in dimensionless form to reduce the number of model parameters. (b) Starting with smooth rainfall distributions over the wet period of the year (e.g. uniform, sinusoidal or other distributions) and proceeding with measured distributions smoothed to different degrees, we investigate the sensitivity of the total runoff and its particular components to different model parameters. In this way we assess the effects of the temporal distribution of rainfall on the uncertainty in model parameter estimation. (c) We produce synthetic time series of rainfall smoothed to different degrees and, then, we select a set of model parameters to simulate runoff hydrographs using ENNS. Finally, we apply the uniform random sampling procedure (see e.g. Duan et al., 1992) to identify the parameter set that best approximates the simulated runoff. Combining the results from steps (b) and (c), we draw conclusions regarding the conditions under which it is reasonable to apply adaptive procedures for calibration of rainfall-runoff models.
References
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