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Influence of event characteristics on the dynamics and on the identifiability of parameters in an overland flow model

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Traditionally, event-based hydrologic models are considered calibrated when their outputs match a set of experimental observations from one or more events that are considered representative of the system to be simulated. Many of the calibrated parameters are subsequently considered constant through time and unchangeable as they are regarded as values describing properties of the basin, which are independent from the inputs. When simulating larger watersheds and long rainfall-runoff events, the variability of parameters in time is smoothed out by this calibrated constant value that intends to fit best the changing conditions of those longer events, trading off accuracy for parameters stability. In small semiarid basins, such as the one used to carry out the research, the hydrologic mechanisms act very fast and very sensitive to variability hence, using averaged parameter values to simulate events at different seasons of the year and with different characteristics will cause large predictive errors.

Furthermore, usually the experimental data available for calibration are reduced to discharge time-series at the basin's outlet. Most of the event based, hortonian, distributed physically based models are basically composed of one or several loss functions (interception, infiltration, depression storage and/or evaporation), and a routing function to propagate the rainfall excess downstream leaving numerous parameters to be adjusted from the information contained in the discharge time series. Providing only this information for calibration of low-yielding ephemeral streams basins, the parameters will show strong correlations rendering ill-posed the inversion process to identify the parameter values.

In this work we use a Marquardt-Levenberg algorithm implemented in PEST software coupled to a five adjustable parameters rainfall-runoff model to investigate the optimum set of parameters, their variability trough time and the evolution of the uncertainty associated with each parameter when calibrated only against discharge. The results show that the information contained in the output hydrograph is not enough to properly identify all the parameters in the model and only Manning's n can be calculated with a high degree of certainty. They also show the variability of the parameters and how part of this variability is not only influenced by the initial conditions of the basin but also by the characteristics of the event (mainly rainfall intensity). An analysis of sensitivity and the range of variability indicates that parameter dynamics cannot be ignored in hydrologic modeling if we intend to improve accuracy in the predictive capacities of, at least, hydrologic models simulating small semiarid basins.