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Evaluation of SCS-CN method using a fully distributed physically based coupled surface-subsurface flow model

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The hydrological cycle contains a wide range of linked surface and subsurface flow processes. In spite of natural connections between surface water and groundwater, historically, these processes have been studied separately. The current trend in hydrological distributed physically based model development is to combine distributed surface water models with distributed subsurface flow models. This combination results in a better estimation of the temporal and spatial variability of the interaction between surface and subsurface flow. On the other hand, simple lumped models such as the Soil Conservation Service Curve Number (SCS-CN) are still quite common because of their simplicity. In spite of the popularity of the SCS-CN method, there have always been concerns about the ambiguity of the SCS-CN method in explaining physical mechanism of rainfall-runoff processes.
The aim of this study is to minimize these ambiguity by establishing a method to find an equivalence of the SCS-CN solution to the DrainFlow model, which is a fully distributed physically based coupled surface-subsurface flow model. In this paper, two hypothetical v-catchment tests are designed and the direct runoff from a storm event are calculated by both SCS-CN and DrainFlow models.
To find a comparable solution to runoff prediction through the SCS-CN and DrainFlow, the variance between runoff predictions by the two models are minimized by changing Curve Number (CN) and initial abstraction (Ia) values.
Results of this study have led to a set of lumped model parameters (CN and Ia) for each catchment that is comparable to a set of physically based parameters including hydraulic conductivity, Manning roughness coefficient, ground surface slope, and specific storage. Considering the lack of physical interpretation in CN and Ia is often argued as a weakness of SCS-CN method, the novel method in this paper gives a physical explanation to CN and Ia.