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Distributed hydrological modelling using spatiotemporally varying velocities

Konstantina Risva, Dionysios Nikolopoulos, and Andreas Efstratiadis
National Technical University of Athens, Department of Water Resources and Environmental Engineering, Greece
(conrisva@gmail.com)

We present a distributed hydrological model with minimal calibration requirements, which represents the rainfall-runoff transformation and the flow routing processes. The generation of surface runoff is based on a modified NRCS-CN scheme. Key novelty is the use of representative CN values, which are initially assigned to model cells on the basis of slope, land cover and permeability maps, and adjusted to antecedent soil moisture conditions. For the propagation of runoff to the basin outlet two flow types are considered, i.e. overland flow across the terrain and channel flow along the river network. These are synthesized by employing a novel velocity-based approach, where the assignment of velocities along the river network is based on macroscopic hydraulic information. It also uses the concept of varying time of concentration, which is considered function of the average runoff intensity across the catchment. This configuration is suitable for event-based flood simulation and requires the specification of only two lumped inputs, which are either manually estimated or inferred through calibration. The model can also run in continuous mode, by employing a soil moisture accounting scheme that produces both the surface (overland) runoff and the interflow through the unsaturated zone. The two model configurations are demonstrated in the representation of observed flows across Nedontas river basin at South Peloponnese, Greece.