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A comparative assessment of HEC-HMS and VIC hydrological models for simulating hydrological processes in Cauvery River Basin, India

Gowri Reghunath[1,2] and Pradeep Mujumdar[1,3]
[1]Department of Civil Engineering, Indian Institute of Science, Bangalore, India (gowri3041993@gmail.com)
[2]Divecha Centre for Climate Change, Indian Institute of Science, Bangalore, India
[3]Interdisciplinary Centre for Water Research, Indian Institute of Science, Bangalore, India

The hydrological cycle is governed by a number of complex processes which occur at different spatial and temporal scales. Hydrological modelling plays an integral role in enhancing the understanding of hydrological behaviour and process complexities at a range of scales. Different hydrological models have various strengths in the representation of hydrological processes. The performance and applicability of each hydrological model can differ between catchments due to several catchment characteristics and dominant hydrological processes. With a wide variety of model structures, it is important to evaluate how different hydrological models capture the process dynamics in various catchments. This study aims at a comprehensive evaluation of the performance of two widely used hydrological models, namely, the HEC-Hydrologic Modeling System (HEC-HMS) and the Variable Infiltration Capacity (VIC) model, in simulating various water balance components in the sub-catchments of the Cauvery River Basin which is a major river basin in Peninsular India. The basin is characterized by extensive regional variability in land use patterns, water availability, and water demands. The chosen models differ in their model structure complexities, methods adopted for simulation of water balance components, and the representation of geographical information, meteorological and physiographical inputs. The models are calibrated with respect to the observed streamflow at various gauge locations, and the simulated water balance components such as evapotranspiration and baseflow are assessed at annual and seasonal time scales. Also, the impact of the representation of the spatial distribution of input variables and model parameters (lumped versus distributed) are evaluated among the models. This work provides valuable insights into the applicability of various hydrological models in simulating hydrological processes in catchments with high regional complexities. Also, this work aids in the identification of effective models and model parameters which can be useful for hydrological data transfers between catchments as well as predictions in ungauged basins.