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Evaluating hydrological signatures and catchment similarities to estimate model parameters 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

Catchments are complex self-organizing environmental systems for which the form, drainage network, channel geometries, soil and vegetation, are all an outcome of co-evolution and adaptation to the ecological, geomorphologic and land-forming processes. Quantification of hydrological signatures provides vital information about the complex system properties and the functional behaviour of catchments. This work aims at evaluating catchment similarity with respect to geomorphology and hydrological signatures such as runoff ratio, flow duration curves and peak flows for calibrating and upscaling model parameters. The study is carried out on the sub-catchments of Cauvery river basin which is a major river basin in Peninsular India. The basin is characterized by extensive regional variability in surface and groundwater availability and large-scale shift in land use patterns in recent decades. With a significant number of anthropogenic interventions such as check dams and reservoirs, the basin faces water management challenges at the local, regional and basin scales. Hydrological signatures derived from elevation, streamflow and meteorological data are used to evaluate geomorphologic and hydrological similarity between the sub-catchments. We employ the physically based macroscale Variable Infiltration Capacity (VIC) model coupled with a routing model to simulate the streamflow. Streamflow simulations are carried out for various sub-catchments delineated based on discharge gauging stations. Model parameters are estimated and hydrological signatures are assessed for effective model calibration. Impact of interventions on flow signatures at the catchment scale is also assessed. This work can significantly improve the scientific understanding of variability of hydrological processes at various scales and provide useful insights for development of scaling relationships. It can also aid in examining the model parameter transferability across scales.