Clustering of hydrological data: a review of methods for runoff predictions in ungauged basins

Nilay Dogulu (1) and Elcin Kentel (2)

(1) Middle East Technical University (METU), Civil Engineering Dept., Water Resources Laboratory, Ankara, Turkey (ndogulu@metu.edu.tr), (2) Middle East Technical University (METU), Civil Engineering Dept., Water Resources Laboratory, Ankara, Turkey (ekentel@metu.edu.tr)

There is a great body of research that has looked into the challenge of hydrological predictions in ungauged basins as driven by the Prediction in Ungauged Basins (PUB) initiative of the International Association of Hydrological Sciences (IAHS). Transfer of hydrological information (e.g. model parameters, flow signatures) from gauged to ungauged catchment, often referred as "regionalization", is the main objective and benefits from identification of hydrologically homogenous regions. Within this context, indirect representation of hydrologic similarity for ungauged catchments, which is not a straightforward task due to absence of streamflow measurements and insufficient knowledge of hydrologic behavior, has been explored in the literature. To this aim, clustering methods have been widely adopted. While most of the studies employ hard clustering techniques such as hierarchical (divisive or agglomerative) clustering, there have been more recent attempts taking advantage of fuzzy set theory (fuzzy clustering) and nonlinear methods (e.g. self-organizing maps). The relevant research findings from this fundamental task of hydrologic sciences have revealed the value of different clustering methods for improved understanding of catchment hydrology. However, despite advancements there still remains challenges and yet opportunities for research on clustering for regionalization purposes. The present work provides an overview of clustering techniques and their applications in hydrology with focus on regionalization for the PUB problem. Identifying their advantages and disadvantages, we discuss the potential of innovative clustering methods and reflect on future challenges in view of the research objectives of the PUB initiative.