Lakshman Nandagiri and V.S. Abha

Catchment classification by scaling of flood frequency curves.

Regionalization is the most popular approach to making hydrologic Predictions in Ungauged Basins (PUB). The crucial first step in this approach is classification of basins/catchments into homogeneous groups exhibiting similar hydrologic behavior (hydrologic delineation). A number of methods for delineation based on identification of similarity in a variety of hydrogeoclimatic characteristics using statistical methods have been developed and tested. Recently, it has proposed that catchments may be classified on the basis of similarity in the shapes of normalized flow duration curves (FDC). Such classification may prove to be useful in making predictions of flow quantiles at ungauged sites. It is contended in this paper that the flood frequency curve (FFC) is also another useful descriptor of runoff response (albeit extreme) of a catchment and shape similarities in normalized FFCs can also be used to classify catchments for the purposes of making flood quantile predictions at ungauged locations.

The present study proposes a novel approach to characterizing the shape of a normalized FFC (or FDC) through application of a scaling method that was originally developed for characterizing the spatial variability of soil water retention curves. This scaling method yields scaling factors (one for each site) which may be interpreted as a measure of the shape of individual normalized FDC/FFCs. Based on the magnitudes of the scaling factors, similar groups of catchments may be identified.

The applicability and efficacy of the proposed approach was tested using historical streamflow observations at 24 gauging stations located in the Krishna river basin (128,000 km2), India. The annual maximum series of daily flows was used to derive FFCs for each site using the Probability Weighted Moments based Extreme Value Type 1 probability distribution. Each FFC was normalized with the corresponding observed mean annual flood. The set of 24 normalized FFCs were subjected to the scaling procedure to yield a scaling factor for each catchment. The Krishna river basin was then delineated into 2 homogeneous regions based on the magnitudes of the scaling factors. Regional Flood Frequency Analysis (RFFA) was performed within each group using the Index Flood procedure. Accuracies of the established regional flood formulas within each region were evaluated using a leave-one-out jack-knife cross-validation procedure.

Overall results indicated that the proposed delineation procedure yielded better results than two other cases of delineation; one considering the entire basin as a single region and the other based on heuristic cluster analysis.