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Development of saturation dynamics factor and geomorphometric scaling methods for catchment classification

N.R. Pradhan (1), F. Ogden (1), Y. Tachikawa (2), K. Takara (2)

(1) University of Wyoming, Laramie, WY, 82071, U.S.A (npradhan@uwyo.edu), (2) Kyoto University, Uji, Kyoto, 611-0011, Japan

Development of a generally-applicable rainfall-runoff model and identification of associated model parameters requires understanding of connections between physical processes at disparate scales and hydrological similarities between catchments. In this study, we test the hypothesis that geomorphometric scaling relations can be used to transfer model parameters between catchments where saturation-excess runoff is dominant. Scaling relations on contributing area, slope, and contour length were successfully used to scale the topographic index distribution in watersheds located in vastly different regions of the world; Japan, Nepal, Panama, and the United States. Model parameters identified through calibration of TOPMODEL were transferred to vastly different regions, where saturation-excess runoff is dominant, of the world; Japan, Nepal, Panama, and the United States. Results show how a-priori estimates of the effective model parameters sets can be transferred and used to make predictions in poorly gauged or ungauged basins with some degree of confidence. This result hints at the potential universality of the topographic index distribution scaling relations in catchments where runoff is dominated by subsurface flow.

This research has further developed a factor named as saturation dynamics factor that corresponds to the dynamics of the saturation area for a catchment. The saturation dynamics factor is found to be relatively constant for a catchment for the entire rainfall runoff simulation time steps. The value of saturation dynamics factor can differ from one catchment to another. Identifying the value of the saturation dynamics factor

can be an approach to define hydrologic similarity and to catchment classification. We are further testing the hypothesis that the catchments having relatively similar value of the saturation dynamics factor falls into hydrologically similar catchments. The hydrologically similar catchments should use a relatively similar set of effective parametric values in producing runoff. Testing the hypothesis could help to develop an approach in transferable rainfall runoff model and to predict ungauged basins.