On the Use of Classifications for Channel Network Structure for Determining Synthetic Unit Hydrographs for Ungauged Basins

Almoatasem M. Maamon, Sediqa Hassani, and Jeffrey D. Niemann
Department of Civil and Environmental Engineering, Colorado State University

Abstract. For ungauged basins, semi-distributed models often represent the accumulation of storm flow in sub-basin elements using synthetic unit hydrographs (UHs). Various methods are available to derive synthetic UHs from the physical characteristics of the sub-basin, but those methods usually do not consider the branching structure of the channel network. The structure of a channel network can vary depending on the conditions under which it developed and is often classified into categories such as dendritic, parallel, pinnate, rectangular, and trellis. The objectives of this study are: (1) to develop a synthetic UH method that incorporates knowledge of the channel network classification and (2) to determine how much consideration of the network classification benefits the estimation of the synthetic UH. To accomplish this objective, a synthetic UH approach is implemented using kinematic wave theory. This approach allows isolation of the effects of the channel network structure and representation of the structure with varying levels of detail in the synthetic UH. To assess the importance of the network classification, three cases are compared. In the first case, the travel times to the sub-basin outlet are derived from the actual flow paths within the sub-basin. In the second case, the flow paths are represented using the typical configuration the sub-basin's network classification. In the third case, the flow paths are represented using a typical configuration that neglects the network classification. The results show that consideration of the network classification is beneficial and that the benefits depend on the type of network that is considered.