On Regional Estimation of Floods for Ungaged Sites

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Accurate estimation of flood flows from a watershed is essential for the design of many hydraulic structures (e.g., dams, culverts, bridges). However, flow records that are needed for this estimation are either limited or unavailable at the site of interest. In such cases, regional estimation methods, which use hydrological information from many sites, have been proved to be able to improve the accuracy and reliability of the flood estimates. However, the success of these procedures lies upon the appropriate identification of hydrologically similar basins (or homogeneous regions). While several methods of delineating homogeneous regions, such as index-flood procedure, cluster analysis, discriminant analysis, or region of influence approach, have been proposed in the literature, the criteria used in these procedures for determining regional homogeneity involve still a great deal of subjectivity and may not be suitable for the estimation of floods at ungaged locations. Therefore, the main objective of the present study is to propose an objective approach to delineation of homogeneous regions for improving the accuracy of flood estimation at locations with limited or without data. The proposed method is based on the scaling of statistical properties of floods with basin characteristics. More specifically, the analysis of the physiographic and hydrologic data for over 200 watersheds of different sizes (ranging from 100 km2 to 90, 000 km2) in Canada has indicated the scaling behaviour of the non-central moments of flood series with the basin areas. Based on this empirical evidence, a new definition of regional homogeneity of watersheds has been formulated. It was found that the grouping of homogeneous basins as proposed in this study formed well-defined geographical regions with distinct climatic characteristics. Further, it was recommended that the selection of regional probability distribution for the estimation of flood quantiles and the corresponding parameter estimation method should be made such that the scaling properties of the flood series were preserved. Finally, it has been demonstrated that, based on the proposed definition of regional homogeneity, the estimates of floods for ungaged sites could be more consistent and more accuracy than those provided by existing methods.