Simple-Scaling of Flood Quantiles in a Small Hortonian Research Watershed: Higher-Order Moments and the Effect of Record Length

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Abstract. Many geomorphological characteristics have been shown to be highly correlated with contributing area. In fact, drainage area is one of the dominant factors in flood formation, particularly in Hortonian catchments. Several research studies have explored the relationship between flood peak magnitude and drainage area for both individual events and flood quantiles. At the time level of individual events, there are a host of reasons why one might not expect a strong relationship between flood magnitude and upstream contributing area over a wide range of scales. However, when the log-transform of these variables are plotted, interesting relationships appear. The hypothesis that the flood peaks or quantiles scale according to a ratio of drainage areas to an exponent is referred to as the "simple scaling" hypothesis, where the exponent is referred to as the simple-scaling exponent. Several intensive studies using data from a variety of different hydrologic settings have indicated that simple-scaling of flood quantiles is seen only at smaller scales in Hortonian watersheds, from below 1 km^2 in arid regions to below 20 km^2 in a humid regions. In this paper we present an extension of a prior analysis by Ogden and Dawdy of data from the USDA-ARS Goodwin Creek Experimental Watershed (GCEW), which is located in Northern Mississippi. We explore the effect of an increase in record length of 33%, and test the simple scaling hypothesis on flood quantiles using higher order moments. In the sense of scaling analysis using flood quantiles, the increase in record length changes the scaling exponent very little. Furthermore, the constant slope of higher order moments of the distribution indicates that indeed, simple scaling in flood quantiles is valid in the GCEW. This finding has important implications for hydrologic analysis and understanding in agricultural watersheds in humid and semi-humid regions.

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