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Flood Modeling in Watersheds Using Statistical Analysis and Morphometric Characteristics
A Case Study of Watersheds in Kurdistan Province

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1-Introduction

Morphometric analysis of drainage basins and canal network plays a vital role in understanding the atmospheric and hydrogeological behavior of drainage basins. It expresses the prevailing climate, geology, geomorphology, and basin structure (Hajam et al, 2013). Physiographical characteristics in each basin are almost constant, and their importance is because there is a relationship between them and runoff in the basin. Therefore, for basins with no discharge meter stations or insufficient harvest period of data for investigation, these relationships can be used to estimate the amount of runoff or flood intensity and establish a relationship between discharge with return periods and morphometry of basins (Ghanavati, 2004). The study of morphometry and its effect on discharge in different periods is influentialin reducing or increasing discharge in different periods. So far in hydrological studies, no attention has been paid to the period of return, morphometric studies, and discharge, so this issue must be investigated. So, in this regard and considering the importance of this issue, it is necessary to investigate the performance of watersheds in Kurdistan province as well as the relationship between morphometric characteristics of basins and discharge in specific return periods, to manage water resources and control better and prevent flood hazards in this province.

2-Methodology

In this study, to model floods, selected basins were first determined using topographic maps and ARC GIS 10.5 software, and the morphometric indices related to floods were extracted and calculated for all studied basins. In the next step, the return periods were determined using probability distribution functions and the normality test of the data was

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performed. In the third step, the normality test of the data was investigated. The Kolmogorov-Smirnov single sample test was used to distribute the normality of the data. In the fourth step, the correlation between variables and floods with different return periods was calculated. In the fifth step, multivariate regression methods were used to achieve a suitable flood prediction model.

3- Results and Discussion

Since the data in this study are quantitative variables, the Pearson correlation coefficient was used to investigate the correlation between variables. Investigating the correlation coefficient between variables shows that flood has a positive and significant correlation with most morphometric variables. In floods with a higher return period this correlation coefficient is higher. It is noteworthy that the correlation coefficient and significant level of variables increase to a certain extent with increasing return periods, but at some point again with increasing the return period, the correlation coefficient decreases. As a result, the correlation of variables showed that the indices of basin area, surface flow length, and basin length had the highest correlation with the flood variable in return periods of 25 years to 500 years. Therefore, the linear regression between these variables and floods was analyzed. More than 70% of the dependent variable changes can be predicted using these three variables, i.e., flood. Regression analysis and modeling of the mentioned variables for more extended return periods have more correlation coefficients so that for flood with a 25-year return period equal to 0.689, a 50-year return period is 0.741 and a 100-year return period is 0.754 and for a 200-year return period is 0.766. These changes show that in the presented model based on linear regression analysis, the higher the flood return period, it will be the more accurate.

4- Conclusions

Statistical analysis in this study showed that although not all morphometric properties have the same effects on flood discharge, using variables that are more correlated with flood discharge, a significant relationship can be established between those variables and flood discharge and provide a statistical model proportional to each basin. In this study, it was found that there is the highest correlation between flood discharge and basin area, basin length, and surface flow length. So that using this relationship, can provide models for the desired return periods. Also, the studies showed that the presented models in higher return periods provide better results. Analysis of the variance of variables confirmed this and showed that the presented models for return periods of 25 to 500 years have a significantly higher level. Based on the results obtained in the present study and some other research (Alam et al., 2021, Hamedan, 2020, Utlu and Ozdemir, 2018), morphometric variables play an essential role in flood occurrence in watersheds.

Researchers (Alam et al. (2021), and Nayeri et al. (2016)) also believe that analysis of morphometric characteristics helps to study the flood condition in basins and takes necessary measures in managing basins and planning to prevent flood damages.

Keywords: Flood discharge, Return period, Multivariate regression, Morphometric variables, Kurdistan province, West of Iran

5-References

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