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Comparative analysis of Muskingum parameters estimated from hydrologic observations and basin characteristics

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Abstract: The usefulness of the Muskingum model for flow routing has been widely recognized and made the model one of the most commonly used hydrologic channel flood routing models. Despite its wide application in hydrologic flood routing, the model is unsuitable for ungauged channel reaches due to its need for data from hydrologic observations for the estimation of its parameters. This paper uses a different method based on basin characteristics suggested by Yoo et al. (2013) at Chungju Dam basin to compare its results with the current hydrologic observation based parameter estimation method.

The Chungju Dam basin was divided into subbasins and each subbasin's exit was further divided into either upstream or downstream section of the channel reach. Rainfall data from 2010 to 2020 was used and a total of 55 rainfall events were selected from the entire data. 12 channel reaches were formed based on 15 water level stations within the study basin. The amount of storage was calculated using the inflow and outflow hydrographs for every channel reach, and then the Muskingum parameters were estimated by the graphical method. The time of concentration T_c and storage coefficient K values were calculated by the difference between the times of concentration (T_{c1} and T_{c2}) and the storage coefficients (K_1 and K_2) formed by two subbasins created according to Yoo and others' method. The weighting factor x was calculated by using the range of the time interval Δt. The T_c and storage coefficient K values used in the parameter estimation process were calculated by empirical equations such as the ones proposed by Lee et al (2013) and Kraven II and Sabol. In order to obtain the ideal outflow hydrograph to be used in the graphical method, the lateral inflow was calculated using the effective rainfall obtained by the SCS-CN method and Clark unit hydrograph. The Muskingum parameters were estimated using the final outflow hydrograph derived after removing the upstream lateral inflow and base flow from the observed outflow hydrograph data at the downstream in graphical method. The Muskingum parameters estimated by Yoo and others' method, which is based on Lee's and Kraven II and Sabol empirical equations were compared with the estimations made by the graphical method. The results showed that the empirical equations proposed by Lee and others give values that are closer to the Muskingum parameters obtained by the graphical method. This suggests that the Lee's empirical equations derived using the basin characteristics of the Chungju Dam basin yield more appropriate results.

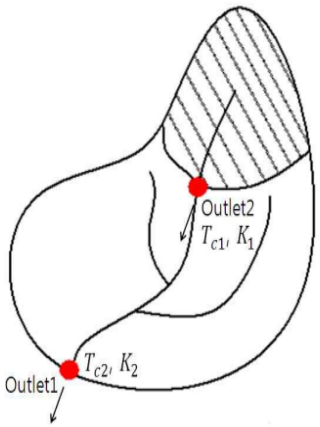

Figure 1. Subdivision of a basin and parameters T_c and K

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REFERENCES

Yoo, C.S., Kim, H.Y., Park, C.Y., 2012. Derivation of storage coefficient and concentration time for derivation of lateral inflow hydrograph. Journal of Korea Water Resources Association 45, 243–252.

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