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Formulation of parameters in the storage-discharge relation for floods in three mountainous basins in Japan

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While the storage-discharge relation of the type $S=aQ^b$ have been widely used as the basic equation in many flood runoff models, the optimum parameters, the coefficient a and exponent b, are different in each flood event, and their features are still not fully understood. Reducing the uncertainty of parameters in the storage-discharge relation can contribute to the accurate quantitative estimation of runoff. Here we present a formulation of the optimum parameters, a and b, by performing calibrations, which are carried out for 10,000 simulations of each flood event while changing the values of the parameters using a double-loop algorithm. The study basins are three mountainous basins located in different regions of Japan with different topographical, geological, and climatological conditions. The basin areas are from 233km^2 to 472km^2 and a total of 61 flood events are selected from hourly data over 15 years for the three basins. The hydrological model used in this study is a combination of the storage-discharge function and the Diskin–Nazimov rainfall infiltration model.

The results show that the optimum combination of parameters, a and b, in the storage-discharge relation for floods in each study basin are approximated by a power-law function and form a non-linear curve in a log-log graph; the values of the coefficient of determination of the power-law function of the three study basins are 0.42, 0.74 and 0.84, respectively.