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A Study of Rainfall-Runoff Process considering two uncertainties in Basin with multiple dams

Ojiro Furuoka[1] and Tomohito Yamada[2]
[1]Hokkaido university, School of Engineering, Civil Engineering, Sapporo, Japan (furuoka.ojiro.e0@elms.hokudai.ac.jp)
[2]Hokkaido university, Faculty of Engineering, Civil Engineering, Sapporo, Japan (tomohito@eng.hokudai.ac.jp)

Forecasting of natural phenomena is generally based on observation data, but it is impossible to measure everything perfectly, and there are uncertainties in the limits of observation and human perception. In runoff forecasting, there is also uncertainty in the rainfall information that uses as input data, and it is important for flood control to estimate the effect of this uncertainty on the output data, the runoff data.

Currently, rainfall in Japan is monitored by ground rain gauges and meteorological radar. Ground rain gauges measure rainfall on the ground, but they are installed at intervals of 10 to 20 km, and not all locations are measured seamlessly. Ground-based rain gauges have spatial uncertainties because they may miss cumulonimbus clouds with a horizontal scale of about 10 km that bring heavy rainfall, and because rainfall in mountainous areas is considered to be highly spatially variable due to the topography. On the other hand, radar observations use radio waves to measure the shape of raindrops in the sky and estimate rainfall on a 250 m mesh or 1 km mesh. There are limitations in accuracy, such as indirect rainfall estimation and rainfall attenuation behind strong rainfall areas. There are discrepancies in comparison with ground rain gauges at the same location, and radar must also accept uncertainties due to observation limitations.

Uncertainty in rainfall data is not limited to observational uncertainty.Uncertainty also exists in the process of rainfall retention by soil until it flows into the river. In particular, while the degree of soil wetness prior to a rainfall event is considered to have a significant impact on the process of water retention, it is impossible to observe the wetness of the entire watershed, and there is inherent uncertainty as to how much rainfall will contribute to direct runoff. Against this background, it is necessary to convert the conventional deterministic model, which uniquely provides rainfall data and uniquely determines the runoff height, to a stochastic model that accounts for uncertainty.

For studies that consider uncertainty, a rainfall-runoff model that takes into account uncertainties due to observation limitations was proposed by Yamada et al. and a rainfall-runoff model that takes into account uncertainties due to observation limitations and initial soil moisture uncertainty was proposed by Intan and Yamada.

In this study, the theoretical development is described and a rainfall-runoff model with two uncertainties is applied to Kinugawa river basin to quantify the inflow.