Error analysis of radar rainfall estimate for rainfall runoff simulation

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Abstract

Radars have been widely employed to detect precipitation and to predict rainfall. However, the radar-based estimate of rainfall is affected by uncertainties or errors such as mis-calibration, beam blockage, anomalous propagation, and ground cutter. Even though these uncertainties of radar rainfall estimate (RRE) have been studied, their effects on a runoff simulation especially to the peak discharge and peak time has not been much focused. Therefore, the objective of current study is to analyze the effects of the RRE uncertainties or errors based on synthetic simulation of RRE and its effect on peak discharge. First of all, mean of modeled radar rainfall is fixed (e.g., 100mm) and its error variance was set as 10mm, 20mm, 40mm, and 50mm independent to each grid cell. This independent simulation is based on white-noise process. The second simulation included a spatial-correlation between grid cells in simulating the error variance. The relationship between the distances of rain gauges and the corresponding correlations was modeled with the power law function. The parameters of the function were estimated through meta-heuristic method (specifically harmony search). Moreover, in order to find the correlation of observed data, the whole data from 27 rain gauges in the basin and the corresponding RRE from the dual polarization radar on Mt. Bisl in Korea were employed. The results of the former simulation (independent errors to each grid cell) show that the bias of the peak discharge is increased along with the variance increased, which is caused by influence of zero values. In the latter simulation (spatially correlated errors between grid cells), the results show that the peak discharge variance from the latter presents much larger than that of the former. Furthermore, the spatial distribution pattern of the modeled radar rainfall exhibited very similar to that of the real rainfall. Finally, we concluded that the error variance of RRE on runoff simulation leading bias and high uncertainty.

Keywords: error influence, radar rainfall estimate, rainfall runoff simulation, spatial-correlation, white-noise

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