Comparison of urban basin application between GR4J (SNU-CAHL) and SWMM

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Abstract

Owing to the generation of high peak flow, the increase in impermeable areas due to urbanization is a critical problem. To manage this inevitable issue, forecasting and analyzing runoff is essential. This study aims to make a more accurate urban basin prediction using the Seoul National University-Climate Change Impact Assessment for Hydrology Library (SNU-CAHL), which obtains runoff results generated by the GR4J model. Prior to this, a comparison of runoff results between the Storm Water Management Model (SWMM), which is an urban rainfall-runoff model, and GR4J was conducted. Both models were simulated using daily rainfall scenarios and daily rainfall observations. Compared to time-series data, the two models exhibited similar patterns but different flow duration curves. To improve the ability prospects of urban basin runoff, it is expected that in further studies, GR4J will be fit into SWMM together with a parameter adding section.

Keywords: SNU-CAHL, GR4J, SWMM, urban basin, runoff.

Methods

GR4J and SWMM models were compared to make a more accurate urban basin prospects in SNU-CAHL.

The runoff results of the two models were obtained using the Representative Concentration Pathway (RCP) 4.5 Korea Meteorological Administration (KMA) precipitation scenarios for the basin, containing Bundang-gu in South Korea, from 2041 to 2070.

The rainfall observations from 2009 to 2015 for the same region were obtained by the Water Resources Management Information System (WAMIS) and were used to effectively evaluate the performance of the two models.

Results

Table 1: Simulated runoff from rainfall scenario (20a41~2070)

(mm)	SWMM	GR4J
Min	0	0.01
Max	327.11	383.54
Average	1.35	1.30

The following time series curve exhibits a similar pattern between the two models. Figure 2 shows a flow duration curve with relative frequency on the horizontal axis and flow rate on the vertical axis, in order of magnitude, for analyzing the discharge. A slight difference between the two models is evident.

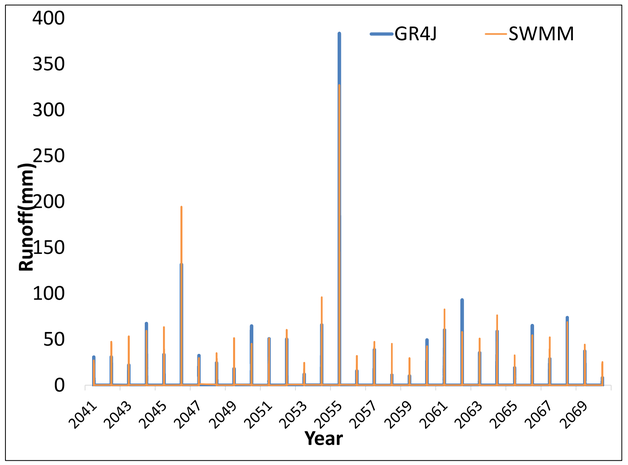

Figure 1: The time series curve for SWMM and GR4J from 2041 to 2070

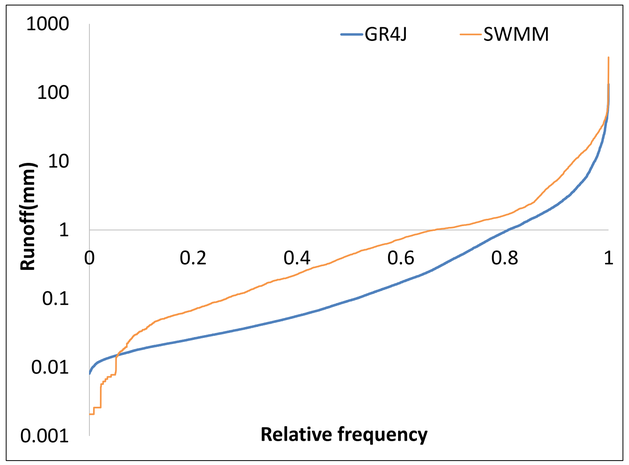

Figure 2: The flow duration curve simulated for 2041 to 2070

When comparing the observed flow rate and the simulated flow rate values of the two models, it can be seen that the SWMM has a value closer to the observed value.

Table 2: Observed runoff and simulated runoff from monitoring data (2009~2015)

(mm)	Obs.	SWMM	GR4J
Min	0.98	0	0.01
Max	175.29	260.13	76.22
Average	4.42	3.85	1.01

Conclusions

By comparing the runoff of the two models simulated from the observed rainfall to the field evidence, it can be seen that of the differences between the two models simulated through future scenarios, SWMM is more suitable.

Considering the increase in impermeable area, which is the main effect of urbanization(Kim, 2019), the percent impervious area among the sub-catchment features of SWMM should be added as a parameter of GR4J.

Applying the calibrated GR4J model to SNU-CAHL is expected to be beneficial in representing the outflow of the urban watershed.

Bibliography

Kim, B.S, Lee S.J, Lim, S.H. (2019). Analysis of runoff by LID application in Busan eco delta city using SWMM. Journal of Civil Engineering, 237-239.