Supporting Information for

Stochastic Generation of Multisite Streamflow for Future Water Resources Vulnerability Assessments: Application over South Korea

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Introduction

This supporting information offers additional figures, tables, and descriptions to support results and conclusions of "**Stochastic Generation of Multisite Streamflow for Future Water Resources Vulnerability Assessments: Application over South Korea**".

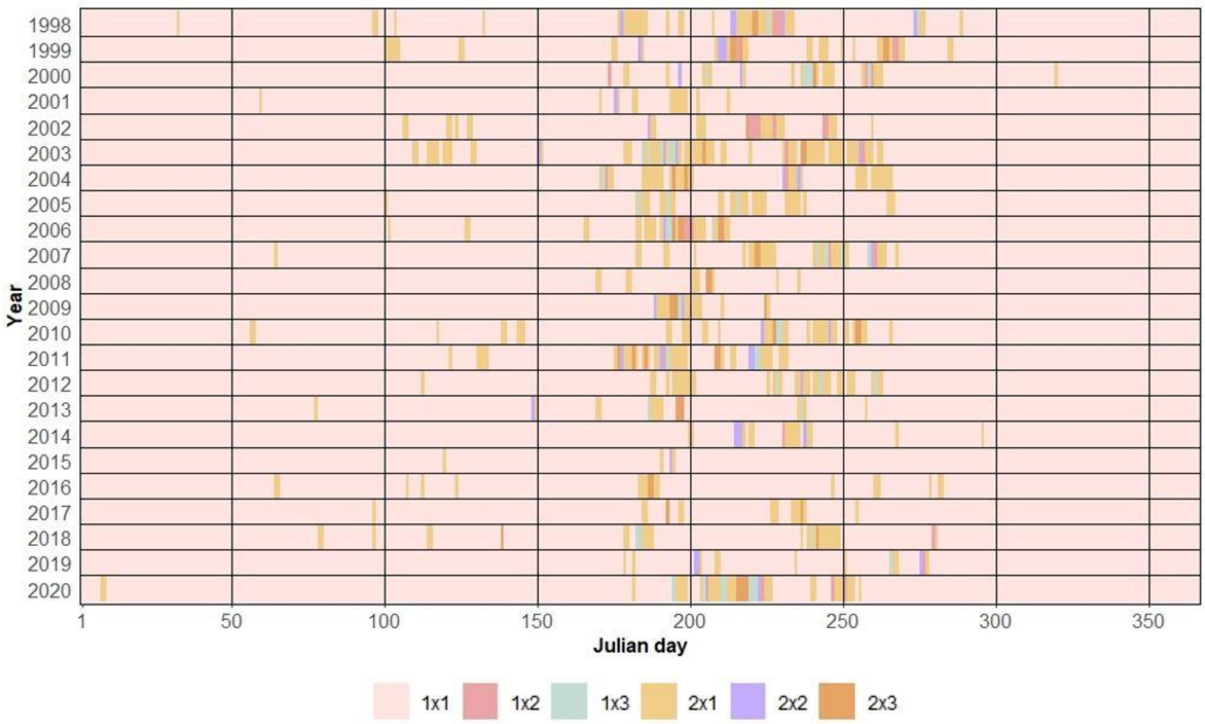

Figure S1. Time series of the assigned SOM nodes for a period of 23 years (1998 ~ 2020).

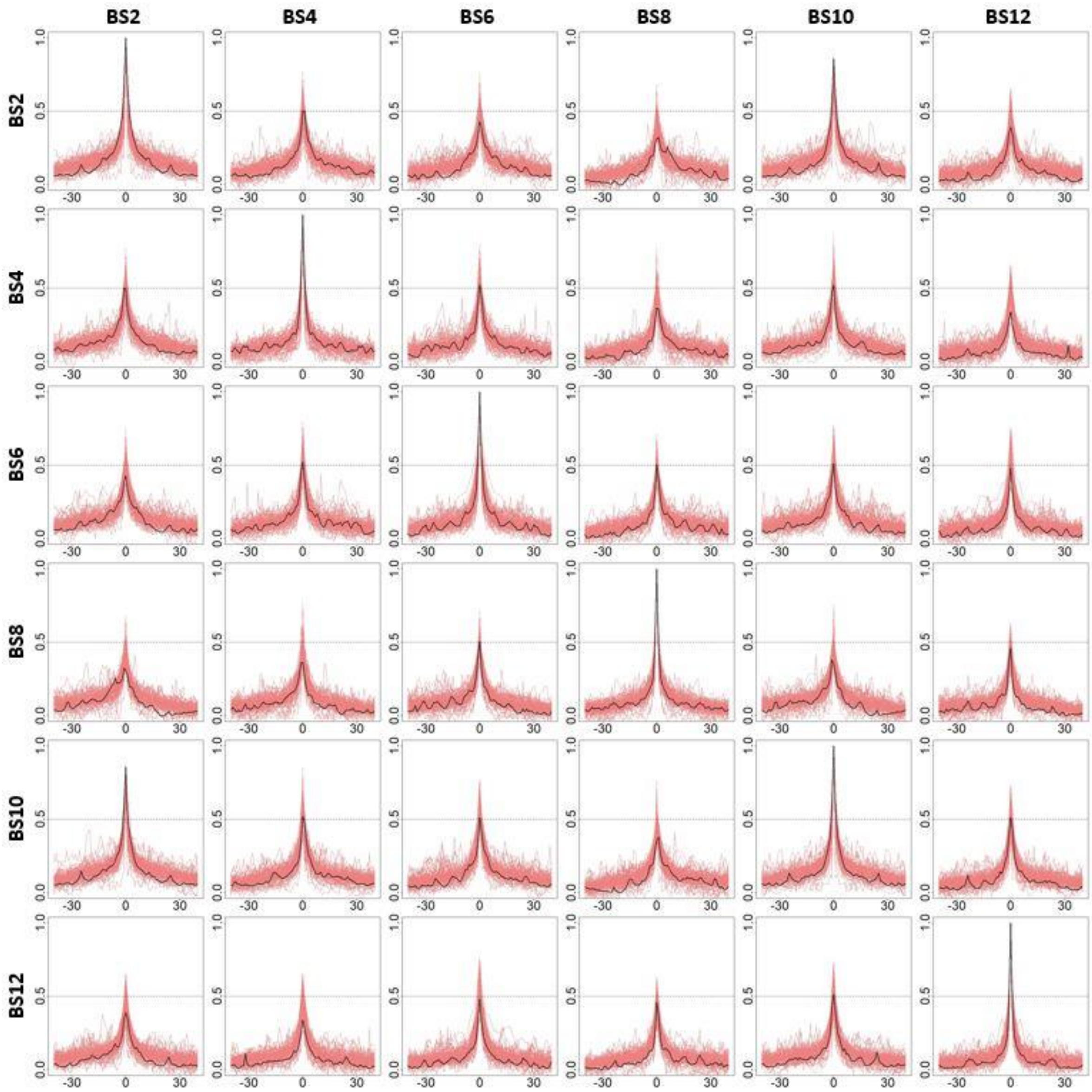

Figure S2. Comparison of observed (black) and simulated (red) cross-correlation functions of the daily streamflow for pairs of stations among the six basins in the study area.

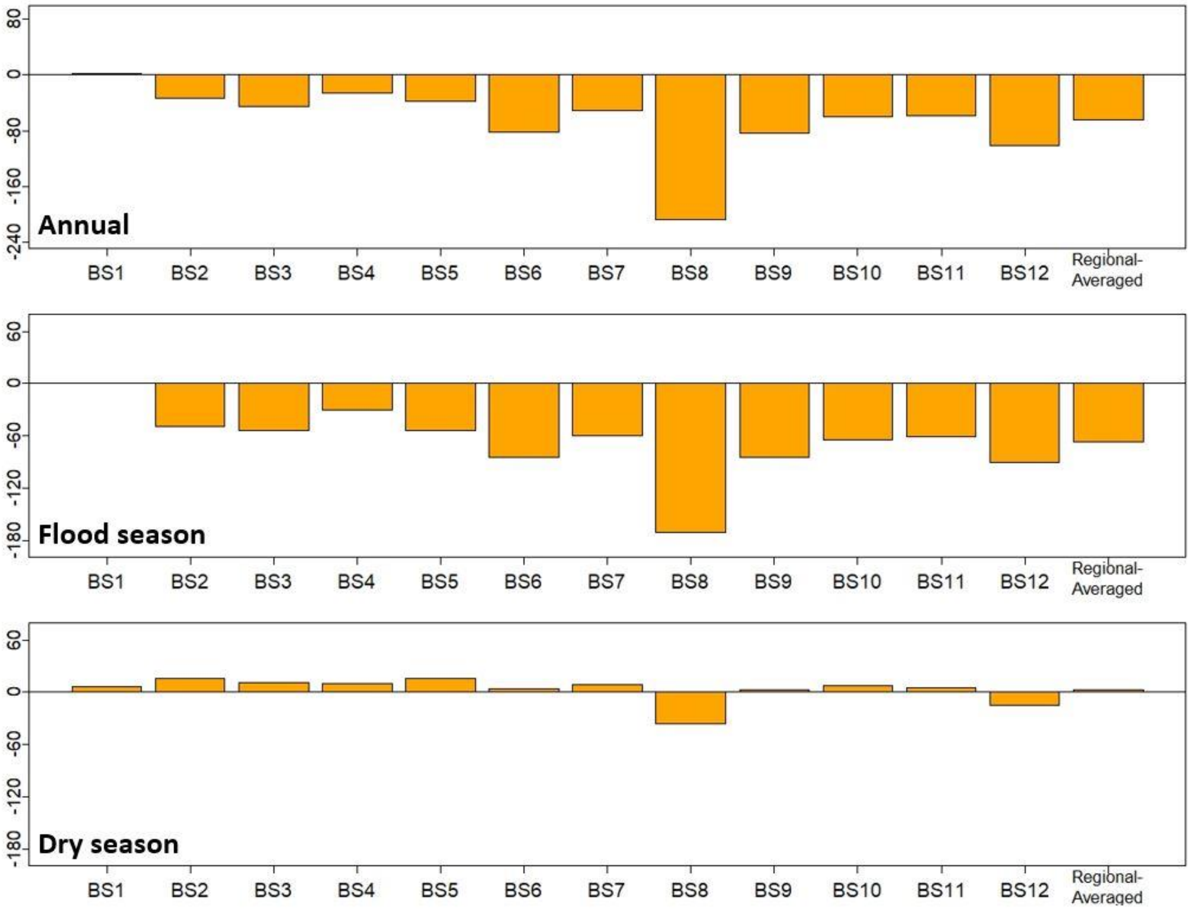

Figure S3. Differences between the observed and future projected median streamflows for (top) annual, (middle) flood season, and (bottom) dry season scales across the twelve study basins as well as the regional-averaged values. The simulated results are obtained by using 200 different ensemble members. The negative value demonstrates reduction in future projected streamflow.

Text S1. Mathematical formulation of water supply systems

The impact of the projected streamflow is additionally analyzed using four reservoir systems (Deacheong, Boryeong, Buan, and Hapcheon reservoirs) in South Korea. Those reservoirs (Deacheong, Boryeong, Buan, and Hapcheon reservoirs) with storage capacities of 1490 MCM, 116.9 MCM, 53.0 MCM, and 790.0 MCM (1 MCM is equal to 10^6 m^3) were constructed in 1981, 1998, 1997, and 1998 to serve four main purposes: (1) flood control, (2) water supply, (3) water quality, and (4) hydropower generation, and are operated by the Korean water resources corporation (K-water). In this study, the storage (ST) at time *t* for each reservoir system is formulated as follows:

$$ST_t = ST_{t-1} + Q_t - SP_t - CR_t \qquad \text{Eq. (S1)}$$

where Q_t and CR_t are daily reservoir inflow and total controlled releases, respectively, and SP_t indicates any water that spills out from the reservoir. We define that SP_t occurs only when $S_t > S_{max}$. Also, total controlled releases for water supply at time *t* are defined as $CR_t = WS_t^{MI} + WS_t^{EN} + WS_t^{IR} + WS_t^{HP}$ with the principal municipal and industrial water supply (WS^{MI}), hydropower generation (WS^{HP}), environmental demand (WS^{EN}), and supply of seasonal irrigation demand (WS^{IR}).

The four reservoirs have been operated by their own operating rules. Figure S4 shows an example of the rule curve for the Boryeong reservoir. If the reservoir level drops below the mild storage level SC^*, the water allocation for WS^{EN} is terminated until the water level rises above SC^* again. Then, if the reservoir level falls below the severe level SC^{**}, three water demands (WS^{EN}, WS^{IR}, WS^{MI}) are restricted by 100%, 30%, and 10%, respectively. Here, additional water restriction of 10% is conducted for WS^{MI} if the reservoir level drops below the critical storage level SC^{***}. For assessing the reservoir performance, the critical level SC^{***} is employed as a criterion in this study.

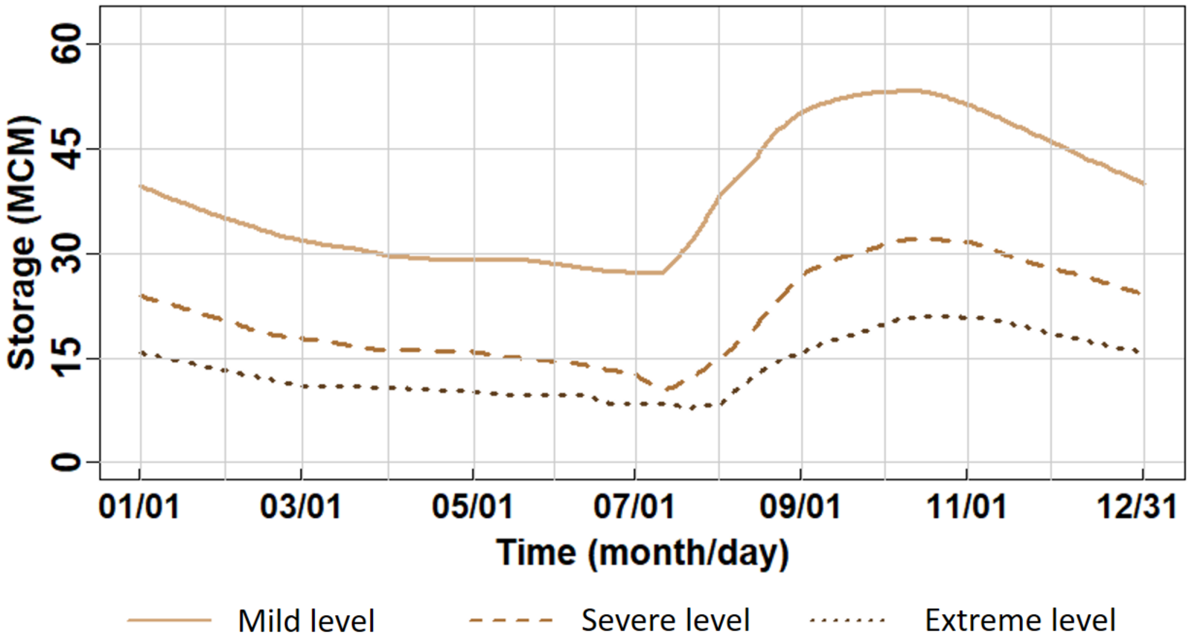

Figure S4 Standard operation rule curves adopted in the Boryeong reservoir.