Frequency analysis of nonidentically distributed large-scale hydrometeorological extremes for South Korea

Taesam Lee*, Changsam Jeong**, Taewoong Park***

Abstract

In recent decades, the independence and identical distribution (iid) assumption for extreme events has been shown to be invalid in many cases because long-term climate variability resulting from phenomena such as the Pacific decadal variability and El Nino-Southern Oscillation may induce varying meteorological systems such as persistent wet years and dry years. Therefore, in the current study we propose a new parameter estimation method for probability distribution models to more accurately predict the magnitude of future extreme events when the iid assumption of probability distributions for large-scale climate variability is not adequate. The proposed parameter estimation is based on a metaheuristic approach and is derived from the objective function of the rth power probability-weighted sum of observations in increasing order. The combination of two distributions, gamma and generalized extreme value (GEV), was fitted to the GEV distribution in a simulation study. In addition, a case study examining the annual hourly maximum precipitation of all stations in South Korea was performed to evaluate the performance of the proposed approach. The results of the simulation study and case study indicate that the proposed metaheuristic parameter estimation method is an effective alternative for accurately selecting the rth power when the iid assumption of extreme hydrometeorological events is not valid for large-scale climate variability. The maximum likelihood estimate is more accurate with a low mixing probability, and the probability-weighted moment method is a moderately effective option.

Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the South Korea government (MEST) (2015R1A1A1A05001007).

Key words : Frequency analysis, Generalized extreme value, Independence and identical distribution, Large-scale climate variability

* 정회원 · 경상대학교 토목공학과 조교수 · E-mail : tae3lee@gnu.ac.kr
** 정회원 · 인덕대학교 토목환경설계공학과 조교수 · E-mail : csjeong@induk.ac.kr
*** 정회원 · 경상대학교 토목공학과 석사과정 · E-mail : taewooong@gnu.ac.kr