Developing a Non-stationary Drought Index Using a Generalized Additive Model for Drought Risk Assessment

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(a) Purpose of study or research hypothesis
Drought is a multifaceted natural phenomenon with diverse spatial and temporal characteristics, affecting environment, society and economy significantly. The objective of this study is to model drought characteristics (duration and severity) under non-stationary environmental conditions, which is essential for early warning and effective management of drought.

(b) Key issue(s) or problem(s) addressed
The conventional drought indices based on the assumption of stationarity has become questionable due to rapid changing environment. Therefore, a nonstationary standardized precipitation index (SPI-NS) is proposed in this study in order to reassess the meteorological drought.

(c) Methodology or approach used
The precipitation observations from eight rain gauge stations for the period 1961-2013 in South Korea are fitted to non-stationary gamma distribution by using Generalized Additive Models in Location, Scale and Shape (GAMLSS) algorithm. Two major drought characteristics (duration and severity) derived from the SPI-NS are fitted to various probability distribution and best distribution is selected based on Akaike Information Criterion (AIC). The copula theory is employed for bivariate drought frequency analysis for drought risk assessment.

(d) Results or conclusions derived from the project
The result shows that average drought characteristics (duration, severity and frequency) obtained from SPI-NS are more severe than conventional standardized precipitation index (SPI-C). The average inter arrival time is 41.46 months and 39.86 months for SPI-C and SPI-NS, respectively, at Seoul station. The results of bivariate analysis show that return period (TD and S) of drought having duration 5 months and severity 6 is 13.86 and 8.28 years for SPI-C and SPI-NS respectively at Seoul station.

(e) Implications of the project relevant to congress themes
The findings of this study will be very helpful for drought management, preparedness, resilience, and risk assessment under changing environment because effective management requires necessary prior knowledge of event happening. The early warning and effective management of meteorological drought will reduce risk of agricultural drought and hydrological drought.

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Keywords : Non-Stationary Standardized index; Drought; Copula; Bivariate Return Period