Improving SARIMA model for reliable meteorological drought forecasting

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Abstract

Drought is a global phenomenon that affects almost all landscapes and causes major damages. Due to non-linear nature of contributing factors, drought occurrence and its severity is characterized as stochastic in nature. Early warning of impending drought can aid in the development of drought mitigation strategies and measures. Thus, drought forecasting is crucial in the planning and management of water resource systems. The primary objective of this study is to make improvement is existing drought forecasting techniques. Therefore, we proposed an improved version of Seasonal Autoregressive Integrated Moving Average (SARIMA) model (MD-SARIMA) for reliable drought forecasting with three years lead time. In this study, we selected four watersheds of Han River basin in South Korea to validate the performance of MD-SARIMA model. The meteorological data from 8 rain gauge stations were collected for the period 1973-2016 and converted into watershed scale using Thiessen's polygon method. The Standardized Precipitation Index (SPI) was employed to represent the meteorological drought at seasonal (3-month) time scale. The performance of MD-SARIMA model was compared with existing models such as Seasonal Naïve Bayes (SNB) model, Exponential Smoothing (ES) model, Trigonometric seasonality, Box-Cox transformation, ARMA errors, Trend and Seasonal components (TBATS) model, and SARIMA model. The results showed that all the models were able to forecast drought, but the performance of MD-SARIMA was robust then other statistical models with Wilmott Index (WI) = 0.86, Mean Absolute Error (MAE) = 0.66, and Root mean square error (RMSE) = 0.80 for 36 months lead time forecast. The outcomes of this study indicated that the MD-SARIMA model can be utilized for drought forecasting.

Keywords : Drought forecasting; Modified SARIMA; Standardized Precipitation Index (SPI)

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