Estimation of Future Water Deficit under Changing Climate Based on Joint Drought Management Index

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(a) Purpose of study or research hypothesis

The study aims that (1) identifying the changes of drought characteristics induced by climate change using the future simulated data of 26 Global Climate Models (GCMs), (2) evaluating the future drought risk compared with the present condition, and (3) quantifying the drought risk by estimating drought duration and water deficit.

(b) Key issue(s) or problem(s) addressed

There is a consensus that the climate and atmospheric-oceanic environment have been changed over the past decades and the change will be accelerated in the future. It is assumed for the traditional hydrological analysis that the key statistics such as mean and variance do not vary over time, which called the stationary condition. Under the changing climate condition, however, the nonstationary probabilistic models have been suggested to identify time–dependent characteristics underlying hydrological processes. Indeed, water engineers have difficulties to manage practical problems induced by nonstationary features of future extreme events when they design a hydrologic system.

(c) Methodology or approach used

Generalized Additive Models in Location, Scale, and Shape (GAMLSS) provides the modeling techniques that each parameter is assumed to be linear, nonlinear, or nonparametric smoothing functions of the explanatory variables. The explained variable might include time, climatic and anthropogenic factors. In this study, the new multi?dimensional drought index, named joint drought management index (JDMI), is proposed to assess the potential water deficit under changing climate.

(d) Results or conclusions derived from the project

The JDMI classifies the drought conditions based on the joint occurrence probabilities of reliability and vulnerability. In order to consider the time?dependent features of drought events, the GAMLSS is used for defining each marginal distribution of reliability and vulnerability, and their joint distribution. The JDMI is designed to increase when reliability and vulnerability increase, in other words, the larger the JDMI, the higher the risk. Drought risk can be quantified using the JDMI by estimating (1) the minimum and maximum values of reliability and vulnerability that triggered each drought state and (2) the minimum and maximum values of potential drought duration and water deficit of each drought state.

(e) Implications of the project relevant to congress themes

The key process of drought risk mitigation is to identify and quantify the risk, and then it is possible to discuss how to reduce the risk. JDMI could be the useful tool for drought risk preparedness/resilience since it is possible to define the drought and estimate the potential damage under changing climate.

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