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Editorial

Climate Changes and Hydrological Processes

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Due to the influences of climate changes and human activities, extreme climate events have made obvious changes to the hydrological process and the temporal-spatial distribution of water resources over the past several decades. These unexpected changes are affecting many aspects of human society, such as water supply, power generation, flood control, environmental protection, and economic development. In some countries, the growing rainfall has sharply increased the flood risk and many people must move from their hometown to safe areas during the flood seasons; in some regions, the risks of water resource shortage and drought are becoming more and more serious, and a great deal of manpower and material are required to guarantee the daily necessities such as food and water. In this context, many scientists and engineers are assessing the impact of climate change and human activities on the watershed hydrological process for a better understanding of the possible hydrological response and making reasonable scheduling schemes and policies under the rapidly changing environment.

This Special Issue aims to provide an opportunity for scholars to share their latest research findings related to climatic change, hydrological processes, and other related topics. As a collection of relevant research achievements, this Special Issue consists of six articles that cover a wide range of topics, including data-driven forecasting technologies, physically based hydrological models, copula-based multivariate approaches, implications of climate models, etc. These studies can help us to understand the relationship between climate changes and hydrological processes. The specific work and related findings of each article are briefly introduced as follows.

Wang et al. [1] investigated the accuracy of several forecasting technologies based on Wavelet Packet Decomposition (WPD) in monthly rainfall forecasting. In the study, three data-based models, namely the backpropagation neural network (BPNN) model, group method of data handing (GMDH) model, and autoregressive integrated moving average (ARIMA) model, were considered. Meanwhile, six conjunction models (BPNN, WPD-BPNN, GMDH, WPD-GMDH, ARIMA, and WPD-ARIMA) were tested by four quantitative indexes. The results showed that WPD can efficiently improve the forecasting accuracy, while the proposed WPD-BPNN model can achieve better prediction results. It can be concluded that the hybrid forecast model is an efficient tool for improving the mid- and long-term rainfall forecasting accuracy.

Wu et al. [2] used the Spatial Processes in Hydrology (SPHY) model to simulate the changes of hydrologic processes in the Upper Shule River (USR) based on hydrometeorological and glacier inventory data. Using the simulations and observations, the variations of runoff and runoff components were quantitatively analyzed. The changes and potential trends in rainfall, runoff, glacier area, glacier runoff (GR), and baseflow were also quantitatively obtained. The annual contribution of glacier and snow runoff to the total runoff showed decreasing trends with the decreasing glacier area and increasing temperature, whereas any increase of total runoff in the future would depend on the increasing rainfalls.

Kalugin [3] aimed to obtain new results on the physically based future hydrological consequences of climate change in the Amur, Lena, and Selenga River basins by using

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data from an ensemble of global climate (general circulation) models (GCMs) as boundary conditions in spatially distributed, process-based runoff formation models. The approach provided a basis for comparing the sensitivity of hydrological systems of neighboring large river basins in Eastern Siberia and the Far East. The study reported high summer–autumn and winter runoff changes for the Amur River under RCP 6.0 in the future case, as well as a significant increase in anomalies of the spring and winter runoff of the Lena under RCP 6.0 by the end of the 21st century.

Medina et al. [4] analyzed the importance of the hydrological processes of the HBV model at different temporal scales and for different hydrological regimes. A total of 88 watersheds located in south-central Chile were analyzed using time-varying sensitivity analysis at five different temporal scales (1 month, 3 months, 6 months, 1 year, and 5 years). The results showed that in watersheds with a pluvial regime, the greater the temporal scale, the greater the importance of soil water accumulation processes, the lower the importance of surface runoff processes. However, in watersheds with a naval regime, groundwater accumulation and release processes had greater importance at greater temporal scales, while soil water release processes were less important.

Ma et al. [5] used a multivariate approach to analyze the statistical characterization of hydrological droughts in Shaying River Basin with data from 1959 to 2008. The standard runoff index (SRI) and the run theory were employed to defined hydrological drought character variables (duration, severity, and intensity peak). Then, a multivariate joint probability analysis with four symmetric and corresponding asymmetric Archimedean Copulas was presented; then, the multivariate frequency analysis with the joint return periods (Tand and Tor) were estimated. It can be concluded that multivariate copulas can provide a reliable method for constructing a comprehensive drought index and evaluating multivariate drought characteristics. The results and findings provided useful indications for multi-dimensional drought risk assessment in Shaying River Basin.

Tang et al. [6] used the Spatial Processes in Hydrology (SPHY) model to simulate the runoff process in the Siling Co basin and estimated the changes in water storage based on data from lakes on the Tibetan Plateau (TP). The results showed increases in water storage capacity and lake area but reductions in baseflow (BF), rainfall runoff (RR), and snow runoff (SR) due to declines in precipitation. Meanwhile, temperature increases have raised glacier runoff (GR). The study also investigated the potential changes and trends of future runoff based on hypothetical climate change scenarios and two Shared Socioeconomic Pathways (SSP1-2.6 and SSP3-7.0) from the MRI-ESM2-0 GCMs. It was concluded that the intensification of glacial melting caused by the increase in temperature would continue, posing great challenges to the water resources management in the expanding lake cases.

The above-mentioned studies in this Special Issue contain theoretical analyses, numerical model simulations and field observations, and investigate various aspects of interactions between climate changes and hydrological processes with respect to river basins from dry and wet, plain and plateau regions. All papers published in this Special Issue have gone through the normal review processes. Hence, the Guest Editors believe that this Special Issue will greatly arouse and stimulate readers' interest in researching climate changes and hydrological processes.

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