Characteristics Analysis of Runoff and its Components Variation in the Yangtze River Source and Future Trend Estimation based on CMIP6

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July 30, 2023

Abstract

Under global climate change, the temperature and precipitation on the Tibet Plateau have significantly changed, and the melting of glacier and snow has been also affected, subsequently causing changes in runoff. The assessment of runoff and its components on the Tibetan Plateau under climate change is important for water resources management and ecology conservation in alpine regions. Therefore, the Spatial Processes in Hydrology model (SPHY model), a distributed cold-zone hydrological model which contains a glacial ablation module and performs well in alpine region, was used to simulate runoff in the Yangtze River source located in the middle of the Tibetan Plateau during 2000-2020. The input data included the measured runoff from the Zhimenda hydrological station, meteorological data from 16 meteorological stations, digital elevation model (DEM) data, land use data and glacier data. And the coupled model intercomparison project 6 (CMIP6) climate model was used to predict the runoff process for the future 30 years (2020-2050). The results showed that Nash-Sutcliffe efficiency coefficient (NSE), Relative Error (RE) and coefficient of determination (R^2) in Zhimenda hydrological station for the calibration period, reached 0.900, 0.036 and 0.956, respectively, and NSE, RE and R^2 reached 0.828, 0.120 and 0.924, respectively, for the validation period, which shows that the model performed well in most years. In 2000-2020, rainfall runoff contributed most to the total runoff (60.87%), followed by baseflow (22.96%), snowmelt runoff (11.59%) and glacier runoff (4.58%) in the Yangtze River source. The runoff amount of the three source river, Dangqu River, Tuotuo River and Chumar River accounted for about 53% of the total runoff in the Yangtze River Source basin, with rainfall runoff (52.04%) contributing the most and glacier runoff (5.92%) contributing the least. Compared to the contribution of glacial runoff in the Dangqu River (8.87%) and Tuotuo River (6.59%), the proportion of glacial runoff in the Chumar River was very small (0.89%). Under the CMIP6 climate model, the mean runoff depth was predicted to increase approximately 13.5 mm from 2020-2050 compared to 2000-2020.

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