Simulation of the water storage capacity of Siling Co Lake on the Tibetan Plateau and its hydrological response to climate change

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Abstract

Due to their special geographical locations and environments, plateau lakes play a key role in maintaining regional water balance, but lake water storage changes are upsetting this balance. Based on data from lakes on the Tibetan Plateau (TP), this study used the Spatial Processes in Hydrology (SPHY) model to simulate the runoff process in the Siling Co basin from 2000-2016 and estimated the changes in water storage of Siling Co and the contribution of each component of runoff into the lake. The results showed that the water storage capacity of Siling Co has increased by 1.157 billion m ^{3}/yr, declines in precipitation have significantly reduced baseflow(BF), rainfall runoff(RR), and Snow runoff(SR), while temperature increases have raised glacier runoff(GR). The simulated average runoff showed that BF, GF, RR, and SR contribute 24%, 22%, 16%, and 38%, respectively, of the flow into Siling Co. Based on hypothetical climate change scenarios and two Shared Socioeconomic Pathways (SSP1-2.6 and SSP3-7.0) from the MRI-ESM2-0 GCMs, this study estimated that a 10% increase in precipitation could lead to a 28.45% increase in total runoff, while a 1 °C increase in temperature could lead to a 9.49% decrease in runoff. The average runoff depth of the basin is expected to increase by 29.77-39.13 mm, since the temperature and precipitation may increase significantly from 2020-2050. The intensification of glacial melting caused by the increase in temperature continues, posing a greater challenge to many water resources management problems caused by the expansion of lakes.

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