Evaluating the hydrological responses to climate change over a large basin with a hydrological–vegetation coupling model

XINGGUO MO, SUXIA LIU & ZHONGHUI LIN

Key Laboratory of Water Cycle & Related Land Surface Processes, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China
moxg@igsnrr.ac.cn

Abstract A physically-based distributed hydrological–vegetation coupling model, VIP, is developed to predict the responses, i.e. the relative changes, of hydrological processes to climate change in the Wuding River basin, one of the largest tributaries to the middle Yellow River, located in the Loess Plateau. It is found that the discharge is sensitive to climate change scenarios, and the response amplitudes are quite different at sub-basins. The response of discharge ranges from 11% to 25% under the scenarios of ±10% precipitation variations and 1°C temperature increment, showing that precipitation amplifies stream runoff change, but the warming mitigates the responses of runoff. Regressive analysis shows that better correlation exists between the responses of runoff and the annual runoff (basin area), with the Pearson coefficient (r) being from 0.35 to 0.61, than the correlation between the response of runoff and annual precipitation with r being from 0.29 to 0.43. It is illustrated that considering precipitation processes other than just the annual precipitation, and running the ecohydrological model at as small as a daily scale and coupling with vegetation dynamics, are crucial in exploring the responses of hydrological processes to climate change.

Key words distributed ecohydrological model; streamflow; evapotranspiration; climate change; Loess Plateau