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Assessing the contribution of climate variability and human activity to runoff variation in Jinghe basin

Yimin Wang and Jie wei
xi'an University of Technology,China (wangyimin@xaut.edu.cn)

Hydrological processes in river systems have been changing under the impacts of both climate variability and human activities. Assessing the respective impacts on decadal streamflow variation is important for water resources management. By using an elasticity-based method, a calibrated TOPMODEL and VIC model, we have quantitatively isolated the relative contributions that human activities and climate change made to decadal streamflow changes in Jinhe basin located in northwest of China. This is an important watershed of Shaanxi Province that supplies drinking water for population over 6 million. The results from the three methods show that both human activities and climatic differences can have major effects on catchment streamflow, and the estimates of climate change impacts from the hydrological models are similar to those from the elasticity-based method. Compared with the baseline period of 1960-1970, streamflow greatly decreased during 2001–2010. The change impacts of ΔQ_H and ΔQ_C in 2001–2010 were about 83.5% and 16.5% of the total reduction, and the contribution ratios of ΔQ_H and ΔQ_C during 1971-2010 are 78.3% and 21.7% respectively when averaged over the three methods. The maximum contribution value of human activities was appeared in 1981-1990 due to the effects of soil and water conservation measures and irrigation water withdrawal, which was 95%, 112.5% and 92.4% from TOPMODEL, VIC model and elasticity-based method respectively. The maximum value of the moisture index (E0/ P) was 1.91 appeared in 1991-2000. Compared with 1960–1970 baseline period, climate change made the greatest contributions reduction in 1991–2000, which was 47.4%, 43.9% and 29.9% from TOPMODEL, VIC model and elasticity-based method respectively. We analyzed the source of errors and uncertainties which may occur in the different approaches.