

Regional difference of annual precipitation and discharge variation over West China with high mountains during the last 50 years

DING Yongjian, YE Baisheng, HAN Tianding, SHEN Yongping & LIU
Shiyin

the States Key Laboratory of Cryospheric Sciences, Cold & Arid Regions Environmental and
Engineering Research Institute
Chinese Academy of Sciences, Lanzhou 730000, China

West China is a vast and arid region in which water resources are dominated by discharges from surrounding mountains. Water resources are a key factor for local social and economic development in West China. Hence, the discharge variations in this region are of great concern for local and/or general decision makers. One objective of this study is to address the temporal and spatial characteristics of discharge variations across West China, so that the relevant results could be a useful reference for decision makers. Besides, discharge variations are also an important content of global change research.

Annual discharge data were used from 77 gauge stations in west China during 1951-2000 in this research. These river gauge stations are mostly set at the upstream of rivers and close to mountains, and have less or without human activities. Also, annual precipitation data has been used at more than 700 meteorological stations over China during 1951-2000. In order to further investigate the impact of climatic factors on the regional differences in the discharge and precipitation variations, four summer climatic indices were used to compare with discharge. Four indices are the western North Pacific summer monsoon index (WNPSM) and Indian summer monsoon (ISM) index, the summer West wind (SWW) index and Tibet Plateau summer monsoon (TPSM) index. we analyzes the regional differences over West China in terms of climate and discharge variations, and investigated the relationship between the regional characteristics and the activities of South and East Asian summer monsoon.

Results revealed that the precipitation and discharge in the upper reaches of the Yellow River (Central West China) have a negative correlation with those in Xinjiang (Northwest China) and the Yarlung Zangbo River (the upper reaches of the Brahmaputra Rive, Southwest China) regions. The geographical patterns of precipitation and discharge variations are different over West China, i.e. the regional climate displays the alteration of dry-wet-dry or wet-dry-wet from north to south in West China, as 'sandwich pattern'. The negative correlation of annual discharges between Xinjiang and the upper reaches of the Yellow River is found statistically significant in the decadal scale, and that between the Yarlung Zangbo River and the upper reaches of the Yellow River is found active in the inter-annual scale.

There is a good relationship between annual discharge of the upper Yellow River and WNPSM index. With respect to interannual variation, they have a significant positive correlation ($R=0.42$, $\alpha>99\%$) and with respect to the cumulative anomalies curves, they have even more consistent variation processes ($R=0.84$). However, the annual discharge at upper Yellow River has weak positive correlation with TPSM index ($R=0.12$), though the correlation

coefficient of their cumulated anomalies curves is statistically significant ($R=0.5$, $\alpha>99.9\%$), but still smaller than that with WNPSM index. This implies that although the upper Yellow River is located in the Qinghai-Tibet Plateau, its discharge variation is mainly affected by East Asian summer monsoon.

The total annual discharge of rivers in Xinjiang region shows high correlations with both the WNPSM (negative relation) and SWW (positive correlation) indices. This indicates that the interaction between the East Asian summer monsoon and west wind in Xinjiang and the interaction influences on precipitation and discharge. The annual discharge at the Cuntan in the upper Yangtze River shows good correlation with both WNPSM and ISM during 1951-2000 but not with TPSM. The discharge generated in large region ($86.6\times 10^4\text{km}^2$) and is affected by TPSM, WNPSM and ISM.

The regional characteristics indicate that the discharge/precipitation variations in the upper reaches of the Yellow River are dominated by the East Asian summer monsoon while their variations in Xinjiang are affected by both the west wind and East Asian summer monsoon.

Corresponding Author:

Name: Yongjian Ding

Organization: the States Key Laboratory of Cryospheric Sciences, Cold & Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou 730000, China

Address: 320 Donggang West Road
Lanzhou , 730000,
China

Email Address: dyj@lzb.ac.cn