

# Long-term variation of observed streamflow at the headwaters of the Urumqi River, eastern Tien Shan, at the multi-time scale

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May 5, 2020

## Abstract

Climate warming accelerates the melting of glaciers in the Tien Shan, which not only causes the increase of annual runoff of rivers, but also changes the law of variation of inner-annual runoff. In this paper, the source of Urumqi River in the Tien Shan is taken as a typical glacier region. Based on the observed hydrological and meteorological data for the period 1980-2016, the results of multi-time scale of runoff showed that the runoff of Urumqi Glacier No.1 and Zongkong catchment all exhibited upward trends and experienced a significant amplification after 1996 and 2008, respectively. The monthly mean discharge was observed to be highest in July followed by August. The daily flow of Glacier No.1 catchment increased before 2010 while the high flow had almost no growth and the low flow declined about 12% after 2010. For Zongkong catchment, the daily discharge showed an increment for both high-flow and low-flow (Except the reduction in high-flow in 2000s compared with the 1990s). The maximum discharge from the Glacier No.1 occurred in the afternoon, and the minimum discharge occurred in the morning. For the Zongkong catchment, the maximum discharge occurred in the evening or early morning of the next day, and the minimum discharge occurred in the afternoon. In the Glacier No.1 catchment, runoff variability was mainly due to the effect of temperature, while in the Zongkong catchment, the relation between annual runoff, temperature and precipitation variations was found to be complicated. Excluding the effect of the precipitation, the time delay between the daily discharge peaks from Glacier No.1 and the maximum temperature was 0-5 h.

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TABLE 1.doc available at <https://authorea.com/users/289709/articles/415978-long-term-variation-of-observed-streamflow-at-the-headwaters-of-the-urumqi-river-eastern-tien-shan-at-the-multi-time-scale>









