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Contributions of glacier melt and precipitation to the 1971-2010 streamflow increase in a headwater basin of the Tarim River

Xiaogang Shi (1), Zehua Li (2), Qiuhong Tang (3), Yongqiang Zhang (4), Huilin Gao (5), Xicai Pan (6), and Stephen J. Déry (7)

(1) Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom (xiaogang.shi@lancaster.ac.uk), (2) Guangdong Hydropower Planning and Design Institute, Guangzhou, China, (3) Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China , (4) CSIRO Land and Water, Canberra, Australia, (5) Department of Civil Engineering, Texas A & M University, College Station, Texas, (6) Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China , (7) Environmental Science and Engineering Program, University of Northern British Columbia, Prince George, British Columbia, Canada

Glacier retreat and streamflow increase in the last few decades are the characterized conditions in the Kumalak River Basin, which is a headwater basin of the Tarim River with a catchment area of 12,800 km^2. To address the scientific question of whether, and to what extent, the observed streamflow increase can be attributed to enhanced glacier melt and/or increased precipitation, a simplified glacier evolution scheme and precipitation-runoff model are developed. Using the glacio-hydrological model, we find that both glacier cover area and glacier mass balance in the study area have decreased from 1971 to 2010, which is primarily due to the loss of glacier area at lower elevations in response to rising air temperatures. Furthermore, increases in both rainfall (accounting for 58%) and glacier melt (accounting for 30%) are the primary causes of increased streamflow in response to the warmer and wetter climate over the period 1971-2010. Moreover, the contribution from snow melt (accounting for 12%) has a minor influence on streamflow increase in comparison to rainfall and glacier melt.