



Climate warming at headwater of Ürümqi River, Xinjiang in past 44 years and its impact on glacier shrinking

G. Y. Wang (1), Y.P. Shen (2) and W. Y. Mao (3)

(1) State Key Laboratory of Cryospheric Science, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou 730000, China, (2) Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou 730000, China, (3) Institute of Desert Meteorology, China Meteorological Administration, Ürümqi 830002, China (guoya@lzb.ac.cn / Phone: +86-931-4967128)

Abstract: The headwater of Ürümqi River located on the north slope of Mt.Tianger II (altitude 4476m) of the middle of Tianshan Mountain, with a continental climate. Tianshan Glacier No. 1(for short Glacier No.1) occupied at the headwater of Ürümqi River. In the context of global warming and water cycle enhanced, the climate changed obviously in northwest China, especially in Xinjiang from 1987. Precipitation, glacial melt water and river runoff and air temperature increased continuously during the last decades, as did also the water level of inland lakes and the frequency of flood disasters. The annual mean temperatures are rising obviously. The extent of air temperature rise in piedmont region is much greater than the mountain.

Meteorological data have been collected since 1958 at the Daxigou meteorological station, located at 3540m asl, about 2 km downstream of Glaciers No.1. The mean annual temperature and precipitation are -5.18°C and 450 mm respectively. Based on the daily data observed of Daxigou Meteorological Station from 1961 to 2004, the characteristics of climate warming at headwater of Ürümqi River have been analyzed from the aspects of maximum temperature, minimum temperature, daily temperature range and the climate accumulated temperature. It is found that maximum temperature, minimum temperature, mean annual temperature, and extreme minimum tem-

perature in winter are rising. The linear trends are $0.21^{\circ}\text{C}\cdot(10\text{a})^{-1}$, $0.18^{\circ}\text{C}(10\text{a})^{-1}$, $0.26^{\circ}\text{C}\cdot(10\text{a})^{-1}$ and $0.20^{\circ}\text{C}\cdot(10\text{a})^{-1}$ respectively. The asymmetry of minimum temperature increase more than maximum is detectable. The decrease of daily temperature range is obvious. The cause of the hours of sunlight decrease but the air temperature rise may be greenhouse effect of water vapor. That indicated water vapor greenhouse effect played an important role in climate warming. At headwater of Ürümqi River, most cloud come forth in afternoon and evening, so the cause of night warming is self-evident. The trend of the duration is consistent with climate accumulated temperature of $T \geq 0^{\circ}\text{C}$ especially from the middle of 1980s. The duration and climate accumulated temperature is gradually increasing at the same time. It indicated that climate warming made the duration delay and winter shorten.

Ürümqi Glacier No. 1 is located in the headwaters of the Ürümqi River (438050 N, 868490 E), Tianshan, about 120 km southeast of Ürümqi, China. It has the longest monitoring record in China, covering the period 1958–2005. It is a small valley glacier with two branches, east and west. Due to glacier retreat, these two branches separated into two small independent glaciers in 1993. The length and area of the glacier have respectively decreased from 2.40 and 1.95km^2 in 1962 to 2.20 and 1.72km^2 in 2003, with an elevation of 3740–4486masl. The trend of climate warming in summer is lower at headwater of Ürümqi River, but glacier is more sensitive to climate change in summer just because of winter warming. The mass balance of Ürümqi Glacier No.1 has been negative since the late of 1950s. The trend of negative accelerated after 1985. The correlation analysis shows that the correlation of mass balance of Glacier No.1 with the climate accumulated temperature of $T \geq 0^{\circ}\text{C}$ is the best, and the correlation coefficient is -0.6142. The result shows the accumulated temperature rise by 1°C , the mass balance will decrease by -3.36mm. That is to say the annual mean temperature rise by 1°C , the mass balance will decrease by 230mm. what extent the temperature rise at headwater Ürümqi River is due to the greenhouse effect of water vapor and how to affect the glacier need to strengthen the observation and study of water vapor.

Key words: climate warming; climate accumulated temperature; glacier responding; sensibility; headwater of Ürümqi River