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Changes in Glacier Mass Balance in Watershed of Sary Jaz-Kumarik Rivers of Tianshan Mountains in 1957-2006 and Their Impact on Water Resources and Trend to End of the 21th Century in Tarim River Basin

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Tarim River system is mainly fed by glaciers and snow melt water. A number of rivers fed by snowmelt and glacier melt begin in the mountains and drain into the basin with average annual streamflow of about 35 billion m^3. Around the rivers may be found oases of small villages and agriculture. There are a total of 14285 glaciers, with an area of 23628.98 km^2, ice reserves 2669.435 km^3 in Tarim river system. Runoff from glacier melt water reach up 15 billion m^3, occupy 40% and more of total surface runoff of the basin, is one of the most important water resources in the basin. We employed a maximum entropy method to estimation of year-to-year mass balance change and glacier water resources for watershed glacier–covered based on meteorological and hydrological data, and reconstructed glacier mass balance series for Sary Jaz -Kumarik River Basin of Aksu River, a main sources river of the Tarim River basin.

The drainage area is 12816 km^2 above Shehel Hydrological Station Aksu River China in Sary Jaz -Kumarik River Basin in which glacier area occupies 25% with an area of 3195.41km^2. The glacier runoff is about 895mm, river runoff is 381.3 mm. Ice melt contributed about 58.65% of the total runoff in the Shehel hydrological Station, so the effects of changes in glacier meltwater on water resources is very vital. The mean annual runoff is $48.64\times10^8 m^3$ in the period of 1957-2006. The mean annual runoff is increasing dramatically since 1993. The mean annual runoff increased by $10.56\times10^8 m^3$, also is 23% in 1994-2006 than in 1957-1993. As a result of a large number of glacier ice melting which were accumulated in the past, by preliminary calculations, mass balance wastages supply additionally 309.47 $\times$ $10^8 m^3$, an increase of 6.19 $\times$ $10^8 m^3$, about 13% of annual runoff to the river due to climate warming in the past 50 years. The supply additionally of glacier melt is $5.3\times10^8 m^3$, and occupies 11% of the mean annual river runoff in 1957-1993, and is $8.8\times10^8 m^3$ and 18% in 1994-2006. With climate warming, although precipitation increasing, glaciers is more sensitive to temperature, the glacial meltwater will be increasing continually.

To presume a little change in glacier area in the future, the temperature rise 4°, precipitation increased by 25mm in 2071-2100, an average annual runoff will be 66.2 $\times$ $10^8 m^3$, which increases by 19.75 $\times$ $10^8 m^3$ and the rate of increase is 43% than 1960-1990, and increases by $11.75\times10^8 m^3$and 22% than 1991-2006.

Key words: glacier mass balance; meltwater; climate change; response of runoff; future trend; Aksu River, Tianshan, Central Asia

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