EVALUATION OF GLACIER RUNOFF IN TAILAN BASIN BY MONTHLY DEGREE-DAY MODEL

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1. INTRODUCTION

Glacier runoff is important part of water resources in west China, especially in arid northwest China. Glacier water resources over China have been evaluated for the first time during 1980s-1990s. Yang[1] contrasted the glacier runoff modules method, runoff-temperature method, and contrast experiment method, and extended the calculated result for runoff in representative regions with observed data to mountain ranges. She estimated the total glacier runoff over China to be about $604.65\times10^{8}m^{3}$, which is equal to 10.5% of the total river runoff of four provinces in western China. The climate-warming trend in western China has resulted in a notable increase in glacier runoff, and the increase in air temperature is the key factor affecting the increase in glacier runoff. How much glacier runoff has increased in the last 40 years and the sensitivity of glacier to climate change were estimated by applying a monthly degree-day model with GIS in the paper.

2. MEHHOD

Degree-day model have been applied in some regions in China, and the spatial distribution of glacier degree-day factor and snow degree-day factor has been deduced from the observation of single glacier or many glaciers. The glacier melt water in one watershed was calculated on different altitude zones. At first, the monthly average air temperature, precipitation, snow degree-day factor (DDF_S) and glacier degree-day factor (DDF_G) were interpolated by Inverse Distance Weight (IDW) method from observed ones in neighbor areas, monthly Positive Accumulated Degree(PAD) were calculated base on a function derived from the relationship between PAD and monthly average air temperature and standard deviation of observation. The monthly accumulation, ablation, mass balance in each zone in last 40 years was calculated applying the model, the mass balance of all zones and snow line altitude in the mass balance year were also calculated. Second, the yearly average zero mass balance altitude was compared with the observed snow line from China Glacier Inventory and other observed data in short-term field work, the yearly mass balance compared with that in other literature. Third, the melt series were re-calculated by using the updated precipitation gradient and DDF_G. At last, glacier runoff was calculated by combining the glacier melt with glacial area-altitude curve. As a case, the monthly glacier runoff series in last 40 years in Tailan basin were constructed and compared with the discharge of downstream. Both the calculation are based on a web-serviced platform which has GIS interface, and will introduced on other article.

3. RESULTS AND DISCUSSION

The calculated snow line altitude of Tailan basin is 4400m in 1972, which is nearly the same with 4264-4350m in China Glacier Inventory which get in 1972, and the altitude is 4700m in 2006, which has agreement with the observed. The calculated total mass balance between 1961 and 2000 is -9.51m, which is slightly less than that calculated by other method of Shen et al[2].

The snow line altitude has increased about 300 meters from 1970s to 2006. The mass balance is all below zero after 1982-1983, the Total mass balance is -16.07m during 1961-2007,equal to -342mm/a. The maximum yearly mass balance is 1119mm in 1972, and the minimum yearly mass balance is -991mm in 1997. The average discharge of glacier during 2001-2007 has increased 25% than that between 1961 to 1990, about 2% contributed from the increased of precipitation, and another 23% contributed from the lost of glacier mass balance. The 0.4 degree increase of summer air temperature has made -235.7mm yearly mass balance compensate with 18.3mm increase of annual precipitation, which equal to -635mm per degree mass balance without increase of precipitation. The results suggest the contribution of glacier runoff to Tailan hydrological station has remarkable increase after 1990, especially after 2000.

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Reference

[1] Yang Zhenniang. Glacier Water Resources in China , Lanzhou ,Gansu Science and Technology Press , 2005

[2] Shen Yongping , Liu Shiyin , Ding Yongjian , et al , "Glacier mass balance change in Tailanhe River watersheds on the south slope of t he Tianshan Mountains and it s impact on water resources", *Journal of Glaciology and Geocryology*, 25 (3) ,pp124 – 129, 2003