

The changing climate and glaciers in the Himalayas and its impact on water resources

Cunde Xiao[†]; Guo Wanqin; Baisheng Ye; Xuejie Gao; Dongqi Zhang; Xiaoyin Guo

[†] Chinese Academy of Meteorological Science, China, People's Republic of

Leading author: cdxiao@cams.cma.gov.cn

The Himalayas, lies in the southern margin of Qinghai-Xizang (Tibet) Plateau, is approximately 2400 km in length and ~200 km in width. Over 18,000 glaciers distributed over it, equals water volume up to 3700 km³. Regional warming was identified in the whole Himalayas in the past ~50 years, with larger warming rate in the last decade. During the same period, precipitation decreased in the most areas of Himalayas. Warming-dry regime of climate resulted in widespread retreating of glaciers. Based on in-situ investigations and mapping of satellite images, we studied glacial changes between 1970's to 2008. It shows that in the north slope of Himalayas, retreating glaciers amount to 25.3% of overall glaciers in Ganges basin, 23.3% in Yarlung Zangbo basin, 29.2% in Indus and 25% in other areas. Glacier changes in the southern slope of the Himalayas have larger amplitudes, with averaged retreated distance roughly doubled, than that of the northern slope. Using degree-day model (DDM), we estimate glacier mass balance as well as contributions of glacier melt-water to river runoff over different drainage basins in north Himalayas. During 1961-2006, the total mass loses of glaciers amounts to 198 km³, equals to approximately 10 m thinning of glaciers. Among the mass lose, 40 km³ occurred in Ganges basin (10.8m ice thinning) which is 360.4±108 m³ water equivalent, and 168.4 km³ (11.4m ice thinning) occurred in Yarlung Zangbo basin which amounts to 1515.7±108 m³ water equivalent. While glaciers in Indus basin experienced a positive mass balance before 2000 and negative after 2000. The mass balance is averaged -220mm.a⁻¹ during 2000-2006. Glacier melt water increases in the last 5 decades, contributing to an increasing amount to total river runoff in the Indus, Ganges and Yarlung Zangbo Rivers. For instance, melt water averagely contribute about 11.8% to runoff of Yarlung Zangbo during 1961-2008, with the percentage a slightly increasing trend. Projections of future climate change by Regional Climate Model (ICTP RegCM3) shows continuously warming and drying trends in the most part of Himalayas before 2050, implying continuously retreating of glacier thus depletion of water storage over the Himalayas.