

Modeling Shigar Basin Glacier changes in relation to climate variability

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Glaciers in Hindu Kush Himalayan (HKH) are the world's largest glaciers outside the polar region. It represents 30% of the Earth's total glacial coverage and plays an important role in the lives of millions of people living downstream. The concern of melting glaciers at alarming rates in the HKH due to global warming has the dire consequences in terms of water scarcity in Pakistan. The specific objectives of the study were to (1) develop a computer model for automatic delineation of clean ice and debris covered glaciers (2) model glaciers mass balance in Shigar Basin and (3) study the relationship between glacier mass balance and climate variability. Landsat TM and ETM+ multispectral datasets were used for temporal mapping of glaciers in the Shigar Basin. The satellite imagery data was pre-processed in terms of gap filling using focal analysis technique in ERDAS IMAGINE software. The study was divided into two time periods based on accumulation & ablation (accumulation period from October to April & ablation period from May to September). For automatic delineation of clean ice and debris covered glaciers a model was developed based on different band rationing techniques and geomorphological characteristics. There was no uniform trend in mass balance for the entire Shigar basin, although some local trends were observed at individual glacier level. Overall there was a negative mass balance trend due to higher summer temperatures and increase in winter minimum temperature with decreased in winter precipitation. As with 0.47 °C rise of maximum temperature in summer and 0.6 °C rise of minimum temperature in winter, the mass balance decrease of Baltoro, Biafo and Chogo glaciers during the last decade was -7.52, -15.7 and -26.35 mwe, respectively where it was 2.49 mwe for Panmah glacier. In winter the volumetric decrease of Baltoro, Biafo, and Chogo glaciers during the last decade was -2.68 km³, -19 km³ and -22.52 km³, respectively but for Panmah glacier it was increase by 3.45 km³. The glaciers debris cover analysis showed that overall on average there was a 20 % increase in the glacier debris cover from 2000 to 2011. The study will be helpful for the better understanding of the behavior of Shigar basin glaciers in respect to the climate change/variability and for better management of downstream water resources.