Multi-scale mapping of supra-glacial lakes and their associated glaciers for assessment of lake outburst flood hazards under changing climate in Hunza Karakoram-Pakistan using remote sensing and GIS tools

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Abstract

The glaciers of Hunza River Basin in the Karakoram Range of Pakistan have been declared as rapidly retreating at significant rates during the recent decade under changing climatic conditions. Particularly high ablation rates for the snout of Batura Glacier in upper Hunza are recorded as annual ablation on bare ice of 1841 mm per year during an ablation season of 315 days. As a global consensus, it has been declared that glaciers from all over the world are dramatically retreating and are expected to continue as the globe is getting warm drastically over the coming years. While the significant changes in glacier dynamics and the rapid formation of pro-glacial lakes under changing climate is challenging in high mountain regions around the world. In combination, rapid growth and development of glacial lakes and retreating glaciers are provoking serious hazards in the high mountain cryospheric environment.Global warming and extreme weather events may initiate potential mass movements in terms of landslides, debris-flows, rock/ice avalanches or mudflows which can act as potential triggering factors for the lake outburst floods.

The present study is based on three research levels in order to study the Glacial Lake Outburst Flood (GLOF) Hazards in detail and to develop a correlation between Lake Outburst Floods with changing climatic conditions in Hunza River Basin. Level-1 includes mapping of spatio-temporal variations in supra-glacial lakes over selected Hispar and Batura glaciers, which are located in Hunza River Basin, Karakoram Range of Pakistan and are losing their ice mass rapidly under conflicting climate peculiarities in this topographically complex region. Glacial lakes were mapped using satellite images of LANDSAT-7 (ETM+) and LANDSAT-8 based on spectral classification of digital images in ArcGIS.Critical lakes were identified and modelled for GLOF hazard assessment based on their peak flow discharge and geomorphological conditions. Level-2 of this research is the evaluation of rate of drifting of Hispar glacier and it's Accumulation Area Ratio (AAR) in terms of glacier mass balance. Level-3 includes mapping of maximum snow extent of Hunza Basin and assessment of snow-cover dynamics during the last decade (2001-2011) in a GIS-based environment to observe the snowline shift under different climate scenarios and the resulting fluctuations in discharge of Hunza River.