Climatic Trends and Glacier Dynamics in the Himalayan Region: A Case Study of the Astor Basin

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Glaciers in the Himalayan region are very important for a variety of biological, environmental, cultural and scientific reasons. The Himalayan region, spanning approximately 2000 km and containing hundreds of glaciers, covers an area of around 40,000 km² and the area under investigation is located in Astore valley, the Nanga Parbat region in northern Pakistan. Due to the difficult terrain, high elevations, and lack of spatio-temporal field measurements, estimating snout variation location, statistical analysis of climatic trends, and the equilibrium line altitude (ELA) of the majority of the glaciers are difficult tasks. Moreover, calculating the net variation in glacier mass loss or gain over a given period produces ambiguous results in the absence of climate data and a differentiating contour between the accumulation and ablation zones of the glacier. To assess the climatic pattern in the Astore Basin, a quarterly trend analysis was conducted on climate data, including temperature, precipitation, and river discharge. Furthermore, this study calculates ELAs using the accumulation area ratio (AAR; 0.6 ±0.5; utilized for high-altitude mountain glaciers) and the accumulation area balance ratio (AABR; 2.24 ±0.9; interval: 0.05 and 0.01). The results indicate that the Bazhin glacier has receded by 2.1 km², while the Chhongpher and Chongra glaciers have receded by 1.1 and 1.2 km², respectively. The largest retreat of the Bazhin glacier's snout position was 1595 meters; the Chhongpher glacier was 3260 meters; the Chongra glacier was 960 meters. The accumulation area of the three largest glaciers in the study region decreases as the annual AAR ratio rises from 0.4 to 0.8. We conclude that considering the greatest AAR and AABR values recorded between 5000 and 5600 meters above the sea level (masl), the biggest glaciers (such as Bazhin, Chhongpher, and Chongra) that extend from lower to higher elevations are probably more susceptible. Understanding the consequences of global warming and the possible repercussions for downstream communities requires research into glacier dynamics, ice melt, and the influence of temperature changes.