



Explaining the differential response of glaciers across different mountain ranges in the north-western Himalaya, India

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ABSTRACT

The study investigated a group of 65 glaciers, selected from different mountain ranges in the north-western Himalaya, India to understand and explain their status and response to the changing climate, surface topography and glacier morphology. Two-date Landsat satellite images (1990 and 2014), ICESat altimetry data, HMA DEM and SRTM DEM were used to estimate the changes in glacier area, snout position, Equilibrium Line Altitude (ELA), glacier thickness and volume. The total area of the glaciers under consideration across the five ranges shrunk from $1106 \pm 33.6 \text{ km}^2$ in 1990 to $1073 \pm 24.6 \text{ km}^2$ in 2014 with the consequent reduction in the glacier volume from $219 \pm 6.66 \text{ km}^3$ in 1990 to $211 \pm 4.85 \text{ km}^3$ in 2014, a loss of $5.9 \pm 0.09 \text{ Gt}$ during 24-year observation period. Upward shift in ELA, ranging from $18 \pm 17 \text{ m}$ to $64 \pm 17 \text{ m}$, was observed during the observation period. The glaciers across the study area are losing thickness in the range of -0.59 ± 0.22 – $1.18 \pm 0.40 \text{ m a}^{-1}$. The study revealed that the glaciers situated at altitudes $<4500 \text{ m}$ have witnessed higher glacier area loss ($8.25 \pm 1.3\%$) compared to those situated at altitudes $>6000 \text{ m}$ ($2.72 \pm 0.92\%$). The influence of size on glacier loss is indicated by the higher shrinkage observed for the glaciers $<3 \text{ km}^2$ in size ($6.75 \pm 1.63\%$) compared to the lower shrinkage of $2.17 \pm 1.12\%$ observed for the large-size glaciers ($>30 \text{ km}^2$). Significant differences in the glacier response were observed across the five ranges due to the unique topographic and climatic setting endemic to a particular mountain range.