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## Linking glacial lake expansion with glacier dynamics: An assessment of the South Lhonak lake, Sikkim Himalaya

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The Himalayan Cryosphere is imperative to the people of south and central Asia owing to its water availability, hydropower generation, environmental services, eco-tourism, and influences on overall economic development of the region. Additionally, this influences the energy balance of the earth and contributes significantly to the sea level rise. Therefore Himalayan Cryosphere remains center of attraction for scientific community. Glacier dynamics, seasonal snow and glacial lakes are studied at various scales using a combination of remote sensing and field observations. The existing literature reveals heterogeneous behavior of Himalayan glaciers which is largely influenced by climate change, debris cover and presence of glacial lake at the terminus. There are very limited studies that attempt to comprehend glacier dynamics and lake expansion in the Eastern Himalayan region. Therefore the present study aims to demonstrate link between glacier dynamics and lake expansion of South Lhonak glacier which is situated in the northern Sikkim. Multitemporal remote sensing data (Landsat, 1979-2019) and climate data (1990-2017) observed at Gangtok meteorological station are used in the study. The results reveal that the lake has expanded with a rate of  $0.026 \text{ km}^2 \text{ yr}^{-1}$  during the last four decades. The preliminary results show strongly imbalanced state of glacier, as glacier has deglaciated (area and length), and surface flow velocity and ice thickness have reduced significantly. The statistical analysis (Mann Kendall and Sens slope) of climate data measured at Gangtok meteorological station shows an accelerated trend of mean maximum ( $0.031^\circ\text{C yr}^{-1}$ ) and mean minimum ( $0.043^\circ\text{C yr}^{-1}$ ) temperatures (95% confidence interval). Whereas, no significant trend in total annual precipitation was observed. Inference can be drawn from study that glacier slow down and retreat contribute significantly to the glacial lake expansion under the influence of climate change, such lake expansion pose anticipated risk of glacial lake outburst in the region.