Temporal Analysis of Potentially Dangerous Glacial Lakes (PDGLs) in Nepal: Assessing the Seasonal Glacial Melt Inflow into the Thulagi Glacier Lake (Dona Lake)

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SUMMARY

Climate change has triggered an era of global boiling, with projections indicating a trajectory exceeding 2°C during the next two decades. This rise in temperature has accelerated the alteration of Earth's cryosphere, including the glaciers in Nepal, which are retreating at varying rates. The rapid expansion and formation of glacial lakes due to glacial retreat are potentially hazardous for their associated risk from Glacial Lake Outburst Floods (GLOFs). Therefore this study investigates decadal variations in the extent of 21 Potentially Dangerous Glacial Lakes (PDGLs) of Nepal using remote sensing data from Landsat satellites. The findings displayed an overall rising trend in 14 of the 21 glacial lakes, with an average decadal increase of 0.6% - 48.78% in the lake area. Lakes like Imja, Lower Barun, Thulagi, Tsho Rolpa, Chamlang, and Lumding Tsho are expanding more rapidly than others. Lakes GL087596E27705N, GL082673E29802N, and GL086977E27711N have increased substantially as well. Lake GL087945E27781N however, shows a substantial reduction. The remaining seven lakes have maintained a virtually stable area since the 1980s. Among the PDGLs, only the Dona lake lies within the western region of Nepal, where limited studies have been conducted compared to the Khumbu region in the central region. We utilized the MODSNOW tool to assess the glacial melt patterns of Dona Lake. The MODSNOW-modeled glacier melt shows growing discharge rates throughout the monsoon season, followed by post-monsoon and pre-monsoon periods, indicating variations in melt dynamics within the Marsyangdi river basin due to characteristics of the source glacier, and climatic variations responsible for changes in the Indian Monsoon and Westerlies. The findings stress the need for a deeper understanding of glacier dynamics in the Nepalese Himalayas, emphasizing the importance of adaptive methods for mitigating risks and ensuring the resilience of vulnerable communities and ecosystems.
