

Original Article

Comprehensive analysis of glacier recession (2000–2020) in the Nun-Kun Group of Glaciers, Northwestern Himalaya

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Abstract: Himalayan glaciers are shrinking rapidly, especially after 2000. Glacier shrinkage, however, shows a differential pattern in space and time, emphasizing the need to monitor and assess glacier changes at a larger scale. In this study, changes of 48 glaciers situated around the twin peaks of the Nun and Kun mountains in the northwestern Himalaya, hereafter referred to as Nun-Kun Group of Glaciers (NKG), were investigated using Landsat satellite data during 2000–2020. Changes in glacier area, snout position, Equilibrium Line Altitude (ELA), surface thickness and glacier velocity were assessed using remote sensing data supplemented by field observations. The study revealed that the NKG glaciers have experienced a recession of $4.5\pm3.4\%$ and their snouts have retreated at the rate of $6.4\pm1.6\text{ m}\cdot\text{a}^{-1}$. Additionally, there was a 41% increase observed in the debris cover area during the observation period. Using the geodetic approach, an average glacier elevation change of $-1.4\pm0.4\text{ m}\cdot\text{a}^{-1}$ was observed between 2000 and 2012. The observed mass loss of the NKG has resulted in the deceleration of glacier

velocity from $27.0\pm3.7\text{ m}\cdot\text{a}^{-1}$ in 2000 to $21.2\pm2.2\text{ m}\cdot\text{a}^{-1}$ in 2020. The ELA has shifted upwards by $83.0\pm22\text{ m}$ during the period. Glacier morphological and topographic factors showed a strong influence on glacier recession. Furthermore, a higher recession of $12.9\pm3.2\%$ was observed in small glaciers, compared to $2.7\pm3.1\%$ in larger glaciers. The debris-covered glaciers showed lower shrinkage ($2.8\pm1.1\%$) compared to the clean glaciers ($9.3\pm5\%$). The glacier depletion recorded in the NKG during the last two decades, if continued, would severely diminish glacial volume and capacity to store water, thus jeopardizing the sustainability of water resources in the basin.

Keywords: Nun–Kun range; Glacier recession; Glacier snout; Remote Sensing; Himalaya; Glacier velocity

1 Introduction

Outside the poles, mountain glaciers constitute an important component of the Earth's natural freshwater system (Barry and Gan 2011) with substantial

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