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Proglacial Lakes Elevate Glacier Surface Velocities in the Himalayan Region

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Meltwater from Himalayan glaciers sustains the flow of rivers such as the Ganges and Brahmaputra on which over half a billion people depend for day-to-day needs. Upstream areas are likely to be affected substantially by climate change, and changes in the magnitude and timing of meltwater supply are likely to occur in coming decades. About 10 % of the Himalayan glacier population terminates into pro-glacial lakes and such lake-terminating glaciers are known to be capable of accelerating total mass losses. However, relatively little is known about the mechanisms driving exacerbated ice loss from lake-terminating glaciers in the Himalaya. Here we examine a 2017-2019 glacier surface velocity dataset, derived from Sentinel 2 imagery, covering most of the Central and Eastern Himalayan glaciers larger than 3 km². We find that centre flow line velocities of lake-terminating glaciers are more than double those of land-terminating glaciers (18.8 vs 8.24 m yr⁻¹) and show substantially more heterogeneity around glacier termini. We attribute this large heterogeneity to the varying influence of lakes on glacier dynamics, resulting in differential rates of dynamic thinning, which effects about half of the clean-ice lake-terminating glacier population. Also, numerical ice-flow model experiments suggest that changes at the frontal boundary condition can play a key role in accelerating the glacier flow at the front. With continued warming new lake development is likely to happen and will further accelerate future ice mass losses, a scenario not currently considered in regional projections.