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Glacier trends in the Eastern Himalayas (Nepal and Sikkim) derived from remote sensing and field observations: a contribution to the GLIMS project

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The paucity of field-based glacier measurements in the high Himalayas limits our understanding of the temporal and spatial patterns of glacier dynamics and the sensitivity of glaciers to climate variability. While there is some information on decadal changes in glacier extents in the Himalayas, there still remains a gap in glacier parameters such as hypsometry, size distribution and termini elevations. Moreover, the influence of the South Asian monsoon on the response of glaciers to climatic changes is not well understood.

Here we compare and contrast present day glacier characteristics in two glacierized areas of the Himalayas: (1) Khumbu (∼27.78°N, E 86.54ºE) in the Nepal Himalaya and 2) Sikkim (27.33ºN and 88.62ºE) in the Indian Himalaya. These regions were selected to capture a wide variability of glacier topography and debris cover, as well as the pronounced influence of the Asian monsoon. Glacier mapping techniques include: semi-automated algorithms using ASTER and Landsat ETM imagery combined with SRTM data; a decision tree for debris-cover delineation based on visible, near infrared and thermal data combined with morphology; field-based observations (ground-based photography using a GPS-enabled camera); GPS data and meteorological records. We focus on: frequency distribution of glacier area; changes in termini elevations; hypsometry changes over time; glacier topography (slope, aspect, length/width ratio); debris cover characteristics and decadal precipitation and temperature trends. The goal is to apply the results of this new inventory towards assessing the contribution of glaciers to stream-flow runoff using area-distributed processes and degree-day methods that we developed for the Nepalese Himalaya.