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Remote sensing and GIS techniques for assessing decadal glacier changes in the Sikkim and Nepal Himalayas

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There is urgency in developing and testing remote sensing tools for developing extensive glacier datasets in high altitude areas of the Himalayas. Detailed information about glacier parameters is missing in many areas of the Himalayas, limiting our understanding of glacier fluctuations in this area. One of the biggest challenges in glacier mapping from spaceborne imagery is the delineation of debris-covered glacial tongues. The high Himalayas provide interesting challenges and unique opportunities for testing glacier mapping algorithms including debris cover. This research exploits the potential of visible, infrared and thermal ASTER data combined with SRTM elevation datasets for mapping glacier parameters (glacier area, elevations and snow lines) in the Himalayas. Multi-spectral classification techniques (ASTER ¾ band ratios and normalized differences NDSI and NDVI), single band thresholds, topographic characteristics (elevation and slope) and thermal information were combined in a decision tree to map clean ice and debris-covered ice. Snow lines were mapped from ASTER imagery acquired at the end of the ablation season, with instrument gains suitable for snow and ice. Ground control points (GCPs) collected in the field were used to assess the accuracy of the remote sensing-derived elevations. Changes in glacier parameters were derived by comparison with glacier datasets from older topographic maps and were linked with changes in climate parameters (precipitation and temperature).