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Glacier surface elevation change by field surveys 1996-2008 in Langtang Himal, Nepal Himalaya

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Larger parts of glacier surface in the Himalayas are covered with debris. Changes in elevation are essential for monitoring fluctuations in debris-covered glaciers because the supraglacial debris mantle makes it difficult to detect changes in area. Therefore, an approach using remotely sensed (RS) digital elevation models (DEMs) is feasible solutions to evaluate how fast Himalayan glaciers are changing in volume. Because the RS-DEMs generally include various errors, validation and calibration using field measurements data are necessary for accurate estimation of elevation. However, few ground-based observational studies have been available because of remoteness and high altitude in the regions.
We calculate changes in elevation of the glacier surface using field geodetically measurement (theodolite with laser distance finder) in 1996, 1999, and differential GPS (DGPS) measurements in 2008 at Lirung Glacier in Langtang Himal, Nepal Himalaya. Individual surveys were co-registered by referring to benchmarks installed on bedrock around the glacier in 1996. Those points data were converted to 30-m-grid DEMs for calculating changes in elevation. We also calculated changes in elevation of the glacier surface using multi-temporal RS-DEMs calibrated with DGPS data in 2008. The calibration is co-registration of each RS-DEM against DGPS derived DEM in 2008 by minimizing the root mean square error over glacier-free terrain, where no elevation change is expected. RS-DEMs used in this study are topographical map derived DEM in 1992, SRTM DEM in 2000, and ASTER DEMs between 2001 and 2004. Temporal changes in elevation is calculated by generating a weighted least square linear regression model. We will show the result in presentation.