



## Glacier volume changes at Mt. Everest/Qomolangma 1962 - 2007

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The larger glaciers at Mt. Everest are heavily covered with supra-glacial debris like many other glaciers in the Himalaya. Most glacier change studies concentrate on area change only. However, the melting of debris-covered glaciers is most recognisable through downwasting. Hence, multi-temporal DEM analysis is needed to study the reaction of these glaciers to climate change in detail. We generated a time series of DEMs based on stereo corona (years 1962 and 1972) aerial images (1984), ASTER (2001) and Cartosat-1 data (2007) for the southern side of Mt. Everest (investigated glaciers: Khumbu, Nuptse, Lhotse, Lhotse Nup, Lhotse Shar and Imja) and two DEMs for the northern side (Rongbuk Glacier) based on a topographic map (1974) and ASTER data (2003). IceSat GLAS data, topographic maps and field GPS measurements are used for validation. The Cartosat-1 DEM was chosen to be the master DEM due to the highest accuracy and the other DEMs were co-registered to it.

The characteristics of the downwasting are similar for all investigated glaciers: The downwasting is pronounced in the upper part with thin debris-cover and less pronounced but still recognisable in the lower parts with thick debris-cover. The highest surface lowering at the southern side is found at the possible transition zone between the active and stagnant glacier parts. The average downwasting for the investigated Eastern Rongbuk Glacier seems to be little higher ( $0.81 \pm 0.53$  m/a) than the value for Khumbu Glacier ( $0.42 \pm 0.21$  m/a). Both the accumulation and ablation area of Khumbu Glacier showed a surface lowering. Volume loss is detected for all glaciers and investigated time periods.