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Evidence of glacial erosion as a control on mountain height and morphology

V. Pedersen, D. L. Engholm, and S. B. Nielsen
Department of Earth Sciences, Aarhus University, Denmark. (vivi.pedersen@geo.au.dk)

A number of previous studies have indicated that long term glacial erosion efficiently can limit mountain height and control the overall morphology of mountain ranges. This phenomenon has been termed the “glacial buzzsaw”. The effect of the glacial buzzsaw is to accumulate area in an elevation interval in the vicinity of the local glacial Equilibrium Line Altitude (ELA). This appears as a local maximum in the hypsometric distribution.

Through quantitative analysis of the entire SRTM3 data base (Shuttle Radar Topography Mission data with 3 arc-sec resolution), we have investigated the glacial buzzsaw mechanism on a global scale (between 60N and 56S).
The global distribution of the local maxima in the hypsometric distributions of the DEMs show a clear latitude dependency, which correlates closely with independent information on glacial ELA and snowline elevation worldwide. The close correlation of these independent data sets corroborate that climate, when expressed as glacial activity, serves as an overall control of mountain height and morphology. The correlation extends across tectonic ages and styles as well as lithologies, implying that glacial erosion has the capacity to keep pace with even the highest present-day tectonic rock uplift rates.

We use a fully coupled glacio-fluvial numerical model to show how the hypsometric signature of the glacial buzzsaw mechanism can be produced. The combined effects of glacial erosion of surface topography above the ELA and flexural isostatic uplift that affects the entire landscape, including unglaciated hill slopes below the ELA, produces the local maximum in the hypsometric distribution just below the ELA, in accordance with existing ideas regarding the glacial buzzsaw denudation mechanism.