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Spatial variability of glacier elevation changes in the Alps obtained from the SRTM DEM

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According to the direct measurements on 10 Alpine glaciers, the last 25 years were characterized by nearly continuous negative mass balances with an increasing trend and record values reaching 10 times the long-term mean loss. The question, however, remains open as to what degree the small number of directly measured mass balances can be representative for the entire Alps. This question has been a funadmentally important aspect in systematic climate-related glacier monitoring. The comparison of recently obtained digital terrain information over wide areas now enables a closer analysis of corresponding causes and effects. The SRTM3 DEM has been acquired in Februar 2000 and is available for free at 90 m (3') spatial resolution. It offers the unique opportunity to assess glacier elevation changes over the entire Alps by subtracting it from an earlier DEM. Such a DEM is available with 25 m grid cells for the entire Swiss Alps and parts of Austria from the years around 1985. This study presents glacier-specific elevation changes for more than 1000 glaciers $>$0.1 km2 in the Swiss Alps using digital glacier outlines and GIS-based automated data processing. Extreme thickness losses (exceeding 100 m) result for many flat and/or low lying glacier tongues and strong thinning is documented over large parts of most other tongues. While the loss does not primarily seem to depend on geographic location, there is a certain dependence on elevation and a correlation (r=0.5) with glacier size and potential global radiation in summer. An earlier reported bias of the SRTM3 DEM is also visible in the present study at elevations $>$2800 m but there is some evidence that this is not an artefact. Although the calculated mean mass change for five mass balance glaciers is much more negative than measured, our cumulative overall mass loss is 5 m we less negative. As a consequence, measured mass balances of individual glaciers or their mean value need corresponding correction factors.