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Quantifying changes and trends in glacier area and volume of a study area in the Oetztal Alps

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In this study we apply a simple, reliable, and time-efficient method to derive recent changes in glacier area and volume. The used data contains two existing glacier inventories based on analogue and digital photogrammetry (1969 and 1997) complemented by high-resolution airborne laser scanning DEMs (Digital elevation models) from 2006. Thus, we are able to quantify area and volume changes over the past almost 40 years between three dates for 84 glaciers in the Ötztal Alps (116 km^2 of area in 2006). This area represents almost one third of Austria's total glacier extent and approx. 85% of the ice-covered area in this mountain group. Since 1969, glacier area and volume decreased considerably with significant differences between the individual size classes. Between 1997 and 2006 an overall area loss of 10.5 km^2 or 8.2% occurred, while volume decreased by 1.0 km^3. Assessing the altitudinal distribution of area losses for both periods, we observe a stronger acceleration of area loss in low altitudes than in high altitudes. This is due to the higher sensitivity at low elevations to changes in the main factors governing the energy balance (e.g. temperature, fraction of solid precipitation). The three available inventories allow a comprehensive analysis of glacier changes over all size classes but lack a high temporal resolution. We therefore used all available glacier length as well as mass balance measurements within the study area to obtain qualitative information of the temporal resolution of glacier area and volume changes. Extracting the duration of periods of area and volume loss from this additional data allows a rough estimate of mean annual area, volume and mean thickness changes. By comparing these values between the different retreating periods we are able to assess acceleration trends roughly. The analysis reveals that the mean annual absolute area changes have decelerated slightly in the period between 1997 and 2006 compared to the period 1969 – 1997. This is attributed to an already reduced absolute glacier area value for the latter period. In contrast, relative area changes have accelerated slightly, whereas volume as well as mean thickness changes have accelerated significantly.