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The implications of modern long term glaciological monitoring for paleoglaciological modelling

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The fluctuations of specific glaciers are not only a result of the climate, but also of the specific topographic configuration governing mass and energy balance as well as glacier dynamics.
More than 50 years of mass balance data of Hintereisferner, Ötztal Alps, were analyzed to separate the influence of climate change from the effect of glacier changes, the mass balance at three sub areas were compared to the total mass balance and to summer temperatures and winter precipitation measured at the nearby climate station in Vent. The mass balance depends on the size of glacier: at high elevations, mass balance is dominated by winter precipitation, at low elevations by summer temperatures. Geometric changes of the glacier are superimposed on the climate signal: between 1953 and 2003, the surface of the glacier tongue lowered by 160 m. This corresponds to a temperature increase of about 1°C at the surface 2003 compared to the surface 1953. In the same period, the potential incoming solar radiation during the summer is reduced by the surface lowering. Comparing the effect of these two factors, the impact of the topographic temperature change on mass balance is much higher than the impact of increased shading. At higher elevations, the effect of topographic changes is small compared to changes in the mean surface albedo.
The comparison of the measured basin precipitation with the measured glacier accumulation shows that the accumulation of snow is about twice the precipitation. This is the result of the redistribution of snow by wind drift and avalanches.
The sensitivity of the mass balance of Hintereisferner to climate change varies within these 50 years as a result of the changing glacier geometry and the specific glacier topography. The sensitivity of the length change to climate change is not only governed by the climate sensitivity of mass balance, but also by the configuration of the tributary glaciers contributing mass to a glacier tongue.