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Eastern Alpine summit mass balances as complementary indicators of local climate change

Andrea Fischer[1], Pascal Bohleber[1,2], and Martin Stocker-Waldhuber[1]
[1]Austrian Academy of Sciences, Institute for Interdisciplinary Mountain Research, Innsbruck, Austria
[2]Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University of Venice, Italy

Eastern Alpine Mountain Glaciers are threatened by current climate change, for which they are visible and prominent indicators. This makes them an important part of climate communication pushing our commitment for mitigation efforts. At the same time, this requires the scientific community to thoroughly understand and communicate the ongoing processes.

From a scientific viewpoint, the link between classical in-situ mass balance data and the climate and environmental records potentially preserved in the so-called cold “miniature ice caps” sparks novel research perspectives. Summit stake measurements and ice core drillings are both rare, although the comparison of today’s stake mass balance records with the variance of annual accumulation preserved in ice cores offers an intriguing hub to unravelling past processes.

We implemented summit stake mass balance measurements on two summits in the Austrian Alps, Weißseespitze (3500 m) in Ötztal Alps and Großvenediger (3600 m) in Hohe Tauern National Park. At Weißseespitze summit ice cap, two ice cores were drilled recently to bedrock and subsequently micro-radiocarbon dated. A stake network is complemented by a continuous monitoring of point thickness changes and a time lapse cam to monitor patterns of snow cover distribution. An energy balance station offers information on wind, air and ice temperatures and radiation.

The results from the first two years of monitoring at Weißseespitze indicate that the remaining ice cap of about 10 m thickness will be gone within two decades even under current conditions. In view of present melt rates of about 0.6 m/year, a dated ice core record could eventually shed light on the question if similar conditions as today have occurred earlier in the past 6000 years of glacier cover at the summit. Learning more about (sub)seasonal patterns of accumulation is extremely import for the interpretation of these ice cores, as main accumulation takes place during early and late accumulation season, whereas the accumulation during colder periods is lost by wind erosion. The so far rarely studied miniature ice caps therefore open windows to complementary climate information, different from summer temperatures and winter precipitation which are widely accepted to be represented in total glacier mass balances.