



## **Austrian glaciers in historical documents of the last 400 years: implications for historical hydrology**

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First documentations of Austrian glaciers date from as early as 1601. Early documentations were triggered by glacier advances that created glacier-dammed lakes that caused floods whenever the dam collapsed. Since then, Austrian glaciers have been documented in drawings, descriptions and later on in maps and photography. These data are stored in historical archives but today only partly exploited for historical glaciology. They are of special interest for historical hydrology in glacier-covered basins, as the extent of the snow, firn and ice cover and its elevation affect the hydrological response of the basin to precipitation events in several ways:

- Firn cover: the more area is covered by firn, the higher is the capacity for retention or even refreezing of liquid precipitation and melt water.
- Ice cover: the area covered by glaciers can be affected by melt and contributes to a peak discharge on summer afternoons.
- Surface elevation and temperatures: in case of precipitation events, the lower surface temperatures and higher surface elevation of the glaciers compared to ice-free ground have some impact on the capacity to store precipitation.
- Glacier floods: for the LIA maximum around 1850, a number of advancing glaciers dammed lakes which emptied during floods.

These parameters show different variability with time: glacier area varies only by about 60% to 70% between the LIA maximum and today. The variability of the maximum meltwater peak changes much more than the area. Even during the LIA maximum, several years were extremely warm, so that more than twice the size of today's glacier area was subject to glacier melt. The minimum elevations of large glaciers were several hundred meters lower than today, so that in terms of today's summer mean temperatures, the melt water production from ice ablation would have been much higher than today.

A comparison of historical glacier images and description with today's makes it clear that the extent of the snow cover and thus the albedo of the glacier surface has been highly variable. This has significant impact on the meltwater production.

These historical glacier data complement the first available runoff data from the early 20th century taken close to the glacier tongues.