Summary statement for the project "Overtures"

Glaciers as sensitive indicators of climate change: enhanced water yield from Vernagtferner, Ötztal Alps, Austria

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The Vernagtferner has been observed carefully since the year 1600, as it had shown numerous rapid advances into the Rofen valley, causing the formation of an ice-dammed lake which often drained catastrophically. The first detailed map of Vernagtferner was drawn in 1889 by S. Finsterwalder, with an accuracy comparable to modern maps, and since then glacier volume changes have been calculated, describing quantitatively the general retreat of this glacier since 1850 due to global warming. These results demonstrate the long history of scientific investigations of glacier behaviour and its relationship to climate conditions in the Ötztal Alps, Austria.

Annual glacier mass balances of the Vernagtferner have been determined by the Commission for Glaciology since 1964 using the direct glaciological method. Precipitation and other climatological variables, as well as discharge have been measured since 1974 at the gauging station "Pegelstation Vernagtbach". This high alpine basin has an area of 11.4 km², extends from 2640 m to a maximum elevation of 3630 m, and the glacier area decreased from about 10 km² (88 %) in 1964 to 8 km² (70 %) in 2006.

Annual precipitation amounts to about 1500 mm, expressed as water column averaged over the whole basin. Mean discharge amounts to 1800 mm, a value that can only be maintained by a mean negative glacier mass balance of about -300 mm with respect to the total basin area over the 32 years of records considered here. While the Vernagtferner winter balances have remained more or less stable at a value of 1000 mm over the past 40 years, the summer balances show an obvious trend from values of -1000 mm in balanced years when measurements began, towards strongly negative values of -2000 mm in the last 2 decades, culminating in the year 2002/03 with a record summer balance of -3100 mm, and basin runoff amounting to 3400 mm.

The drastic changes in runoff conditions demonstrate the impact of global change in this high alpine environment, and the monitoring efforts should be continued so that we have the footprint of this global experiment in progress also in the future. It also shows that we are presently living in a period of excess water yield from these high mountain regions, which will eventually fade away if the glaciers should disappear. Most alpine rivers then will run dry during hot summers with scarce precipitation – a situation that we are experiencing already today in the Po River basin, just to name one example.

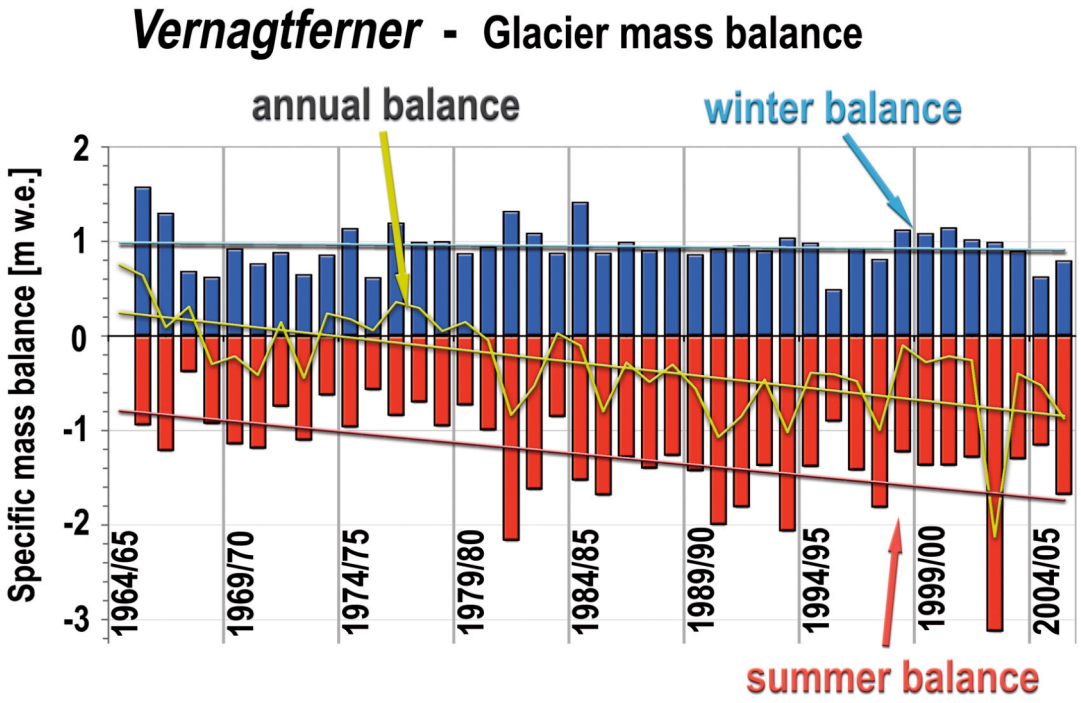

Fig. 1: The hot and dry summers are responsible for the strong mass losses of the alpine glaciers as shown here for Vernagtferner. The mass gain during winter has remained almost constant over the past 40 years, while the mass losses in summer have doubled in the last decades.

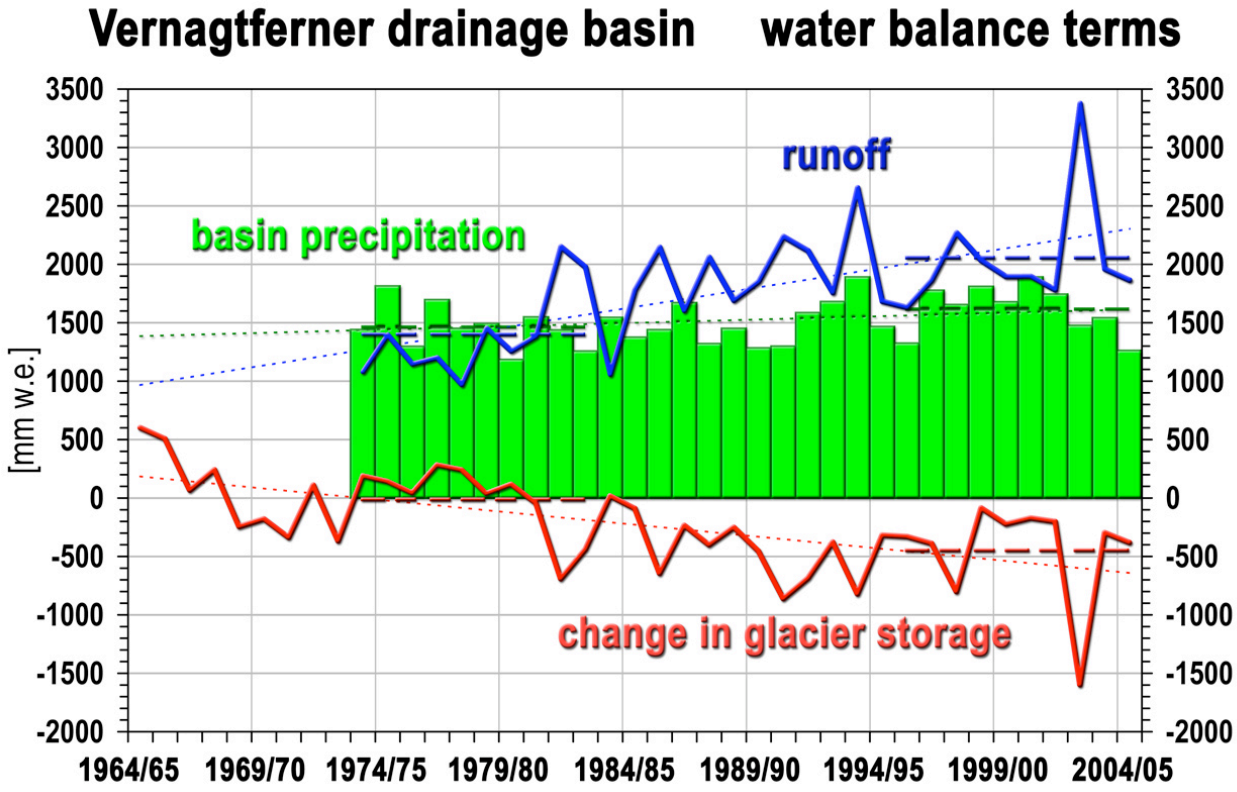

Fig. 2: Annual water yield from the Vernagt basin has almost doubled from the time measurements began in the 1970s, characterized by cool and wet summers. In 2003 runoff from glacier melt was even more than was contributed by precipitation (rain and snow). If the glacier should melt away completely, runoff from the Alps will be governed by precipitation alone, and hot and dry summers will experience much less river runoff as compared to today.

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