

Glaciological investigations on the Grosser Aletschgletscher

Andreas Bauder¹, Matthias Huss^{1,2}

¹ Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie (VAW), ETH Zürich, Zürich, Switzerland

² Department of Geosciences, University of Fribourg, Fribourg, Switzerland

bauder@vaw.baug.ethz.ch

Part of this programme: Glacier Monitoring in Switzerland (GLAMOS)

Keywords: Glacier measurements; mass balance, snow and firn accumulation; ice melt; ice volume change

1. Project description

Long-term glacier observations have been carried out in the frame of Glacier Monitoring in Switzerland (GLAMOS) in order to document glacier variations of Grosser Aletschgletscher and include annual length change measurements since 1880, accumulation and mass balance measurements starting in 1918, and repeated map or aerial photograph surveys, respectively. In an ongoing project the length, area, volume, and mass changes are continuously observed applying modern remote sensing techniques, as well as direct field measurements. The research activities are focused on long-term trends and seasonal fluctuations.

Net ice volume changes of the entire glacier are calculated by comparison of digital elevation models representing the surface topography. A modeling approach allows ice volume changes over multi-annual periods to be downscaled to annual time scales. Swisstopo has recently updated their digital elevation model swissALTI3D based on aerial photographs acquired in fall 2017. This allowed the evaluation of the ice volume change of the entire glacier since the last detailed survey of the glaciers in the Aletsch area in 2009 (see Figure 1). A further significant volume loss of about 1 km³ of ice has occurred over the last period. This corresponds to a mean annual surface lowering of 1.5 m/a distributed evenly over the entire surface. At the glacier snout values were about one order of magnitude higher (8-13 m/a). Thus, the strong negative trend of the previous period continued. The period was again characterized by an uninterrupted series of negative mass balances and not a single positive or nearly balanced year was present. As a result of the ongoing mass loss, the glacier front further retreated substantially.

Mass balance components with firn accumulation and ablation are measured in detail at Jungfraufirn. Seasonal observations at the end of winter and end of summer are performed. During winter snow accumulation is the dominating process while ablation of snow and ice occurs in the summer period. Thus, results from seasonal mass balance measurements allow to separate the processes of accumulation and ablation. First measurements at this site were started one century ago in 1918. Whereas in the first

three periods, the observations suffered from losses of the measurement stake, an uninterrupted time series has been collected since then (see Figure 2).

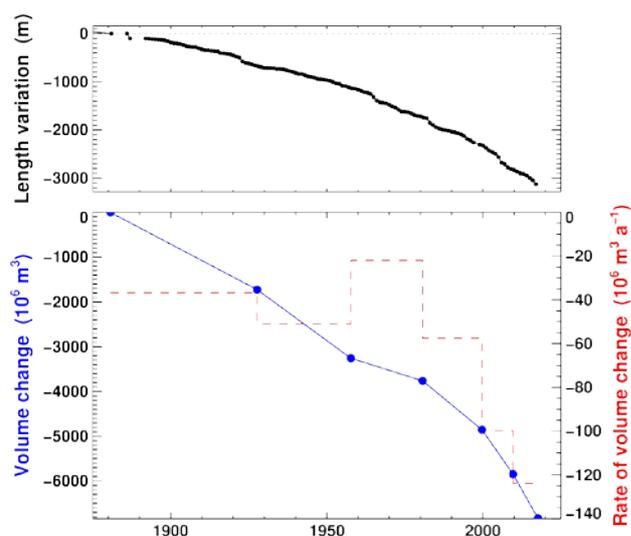


Figure 1. Evolution of glacier length variation (top) and ice volume change (bottom) of Grosser Aletschgletscher since 1880.

On Jungfraufirn, the last observation period (2017/18) was characterized by average amounts of snow accumulation at the end of the winter period and the most extensive melt during the summer season on record. The melt season started early at beginning of May with warm and continuous melting conditions and was never interrupted by a significant summer snow fall. The result of the past period is again the combination of average accumulation and very intensive melt. Both the summer as well as the annual balance is most negative at the site since the beginning of the measurements (Figure 2).

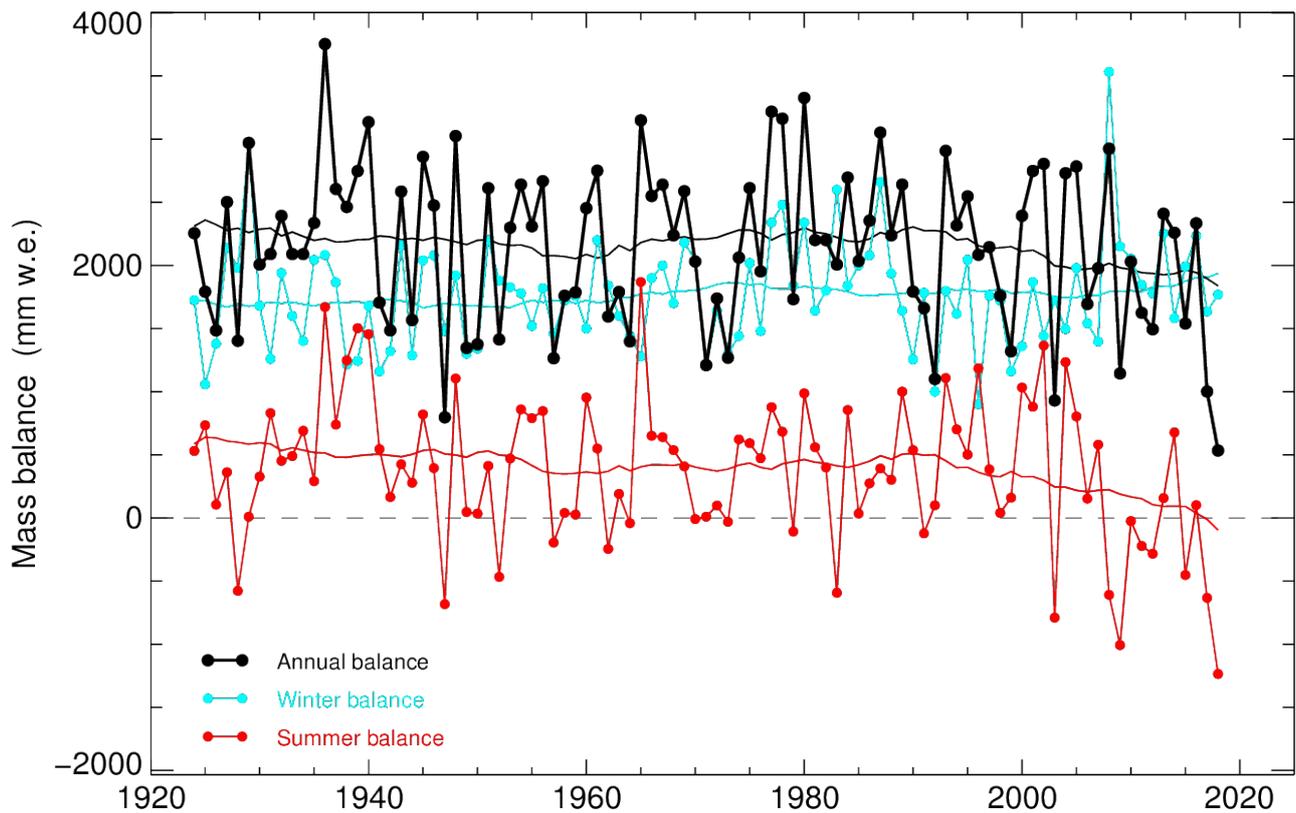


Figure 2. Winter, summer and annual mass balance (in millimetre water equivalent) at the site P3 on Jungfraufirn (3350 m asl).

Internet data bases

<http://www.glamos.ch>
<http://www.gliaciology.ethz.ch>

Collaborating partners / networks

Laudo Albrecht, Pro Natura Zentrum Aletsch, Villa Cassel, Riederalp
 Dr. A. Streilein, R. Artuso, swisstopo, Wabern

Scientific publications and public outreach 2018

Data books and reports

Bauder, A., eds., The Swiss Glaciers 2015/16 and 2016/17, Glaciological Report No. 137/138, Cryospheric Commission of the Swiss Academy of Sciences published by the Laboratory of Hydraulics, Hydrology and Glaciology (VAW), ETH Zürich, 132p., doi:10.18752/glrep_137-138, 2018.

Huss, M., A. Bauder, Ch. Marty, and J. Nötzli, Schnee, Gletscher und Permafrost 2016/17 - Neige, glace et pergélisol en 2016/17 - Neve, ghiaccio e permafrost 2016/17. Die Alpen - Les Alpes - Le Alpi (Zeitschrift des Schweizer Alpen-Club), 94 (7/2017), 40-45, 2018.

Radio and television

CCTV State TV of China (<http://tv.cctv.com>), August 22, 2018.
<http://tv.cctv.com/2018/08/22/VIDERf10E5UZovfOk76qCrP5180822.shtml>

“Massiver Eisverlust wegen Hitzesommer”, SRF, Tagesschau, October 16, 2018. <https://www.srf.ch/news/schweiz/gletscher-schrumpfen-massiver-eisverlust-wegen-hitzesommer>

“Bergwelt Schweiz: Aletschgletscher – Das grosse Schmelzen”, SRF, mySchool, November 5, 2018.

<https://www.srf.ch/sendungen/myschool/bergwelt-schweiz-aletschgletscher-das-grosse-schmelzen-1-5>

Address

Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie (VAW)
 ETH Zürich
 Hönggerbergstr. 26
 CH-8093 Zürich
 Switzerland

Contacts

Dr. Andreas Bauder
 Tel.: +41 44 632 4112
 e-mail: bauder@vaw.baug.ethz.ch