

# Glaciological investigations on the Grosser Aletschgletscher

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## 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. A further significant volume loss of about 1 km<sup>3</sup> 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). The spatial distribution of the ice thickness change is shown in Figure 1. 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. Between 1950 and 1985 a network of measurements distributed over the glacier was maintained. Presently only a second ongoing measurement series exists maintained by Pro Natura since 1992 on the glacier tongue.

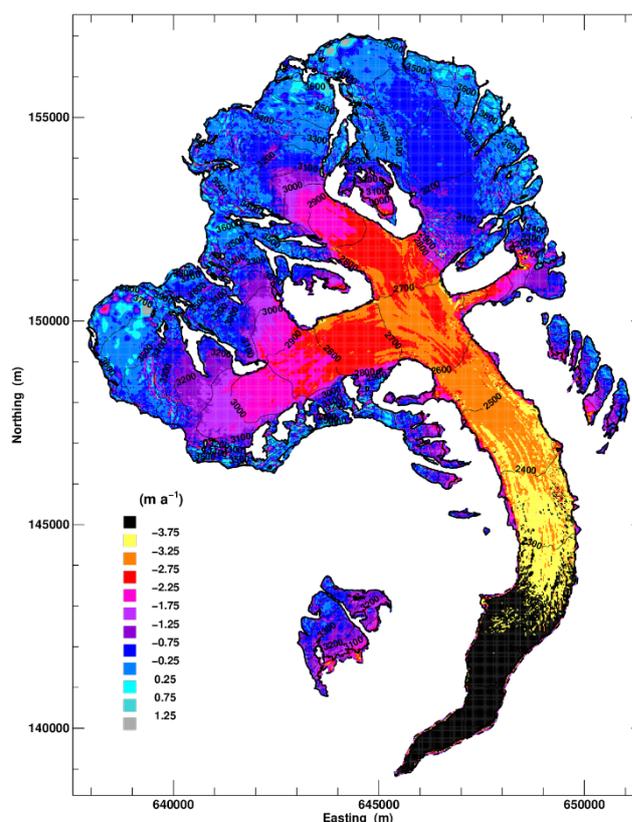


Figure 1. Spatial distribution of ice thickness change (in metre ice per year) of Grosser Aletschgletscher in the period 2009-2017.

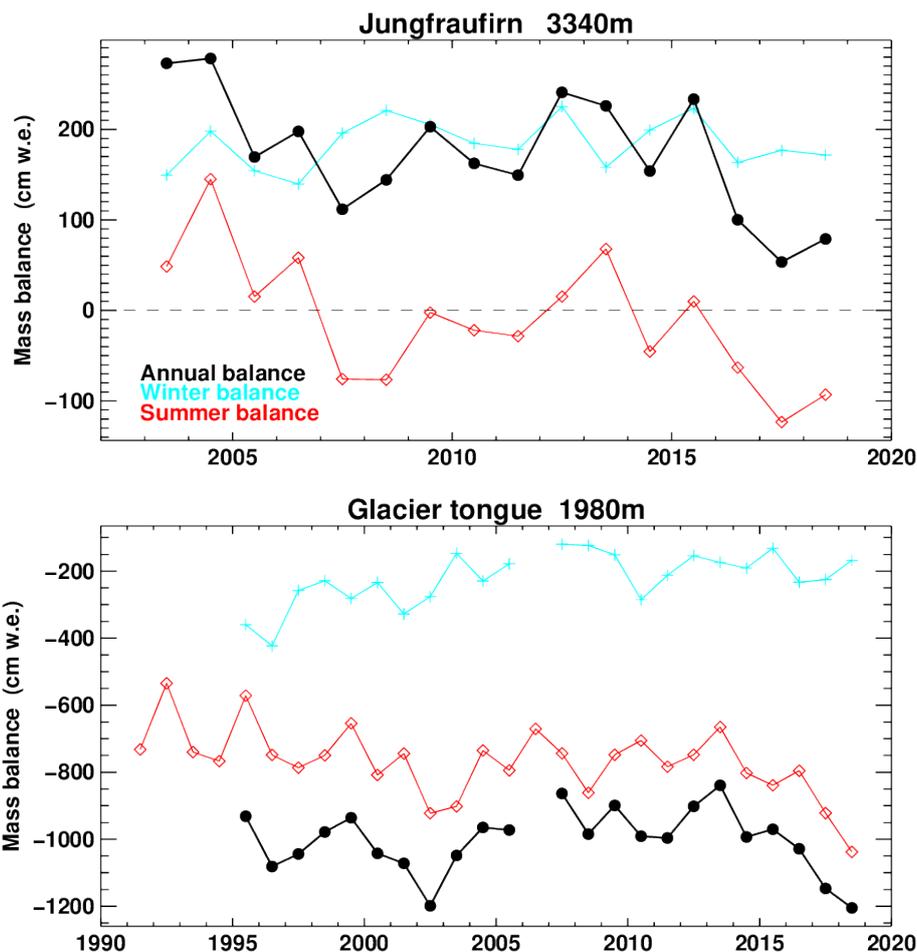


Figure 2. Comparison of winter, summer and annual mass balance (in centimetre water equivalent) at the two sites with ongoing measurement series on Jungfraufirn (top) and on the glacier tongue (bottom).

The last observation period (2018/19) was characterized by average amounts of snow accumulation at the end of the winter period and extreme melt during summer. The melt season started late at beginning of June. Nevertheless two extensive heat periods caused high melt rates, responsible for one of the most negative annual total on record. Figure 2 shows a comparison of the evolution of the seasonal mass balance components at the two sites on Jungfraufirn and on the glacier tongue, respectively.

#### Internet data bases

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

#### Collaborating partners / networks

Laudo Albrecht, Elisabeth Karrer, Pro Natura Zentrum Aletsch, Villa Cassel, Riederalp  
 Dr. André Streilein, Roberto Artuso, swisstopo, Wabern

#### Scientific publications and public outreach 2019

##### Data books and reports

Huss, M., A. Bauder, Ch. Marty, J. Nötzli, Schnee, Gletscher und Permafrost 2017/18 - Neige, glace et pergélisol en 2017/18- Neve, ghiaccio e permafrost 2017/18, Die Alpen - Les Alpes - Le Alpi (Zeitschrift des Schweizer Alpen-Club), 95 (7/2019), 32-37, 2019.

##### Magazine and Newspaper articles

“Gefallene Giganten”, LandLiebe, November/December, 2019.

“Spuren im Ewigen Eis”, Schweizer Illustrierte (Jungfrau), December 13, 2019.

#### Radio and television

“Die Schweizer Gletscher trotzen der Hitze – dank Winterschnee”, SRF, Heute Morgen, July 26, 2019.

“Schmelzende Schweizer Gletscher”, Interview with glaciologist Andreas Bauder, ETH Zürich, Radio 24, “Abig-Show”, August 19, 2019.

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