

## **Current evolution of Unterer Grindelwaldgletscher (Bernese Alps, Switzerland): from the glory of ice during the “Little Ice Age” to complete decay of the glacier tongue**

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Glaciers affect us with their great visual aesthetic appeal, and glaciers are considered prime climate indicators. The Unterer Grindelwaldgletscher (UGG) in the Swiss Alps gives unequivocal testimony of the rapid, currently progressing disappearance of glacier landscapes. This presentation focuses on the recent development of UGG, a glacier with a unique historical record dating back to the 16<sup>th</sup> century. Thanks to dendrochronological evidence, the history of UGG can even be traced over the past 3000 years.

During the “Little Ice Age” (LIA) from about 1300 to 1850/60, UGG threatened people in the valley and their farmland. The great advance from 1580 to 1602 brought the culmination of the LIA. Thanks to the unique collection of paintings by C. Wolf, the advance of UGG towards 1780 is richly documented. The long lasting advance in the 19<sup>th</sup> century reached a first culmination in 1820/22 and is documented on the topographically very precise drawings of S. Birman. After a further advance, UGG reached a second historical maximum extension in 1855/56, which is shown by a growing number of photographs.

Over the past 160 years, UGG has retreated considerably. Nevertheless UGG is still today one of the larger glaciers in Switzerland. In the upper glacier area, we can find an ice thickness of about 230 m as shown by GPR data. The entire lower part of the glacier, however, has been down-wasting and retreating dramatically over the last decades. This has resulted in a landscape of ruins of ice, which was depicted in great detail by a survey using a professional mapping drone in 2014. Several rockfalls, debris flows and landslides have occurred around the glacier tongue in recent years, and a dangerous glacial lake has formed. In comparison to 1855/56, UGG has lost 35-45% of its length (today the glacier is divided into two parts), and the volume of ice has practically halved (loss of ice of about 40 cm/a, averaged over the entire glacier surface).

UGG and its surroundings are increasingly moving away from equilibria conditions that were relatively stable, as in the Holocene, to situations far beyond our historical-empirical knowledge. Model simulations confirm this trend and predict a complete disintegration of the original glacier towards 2100, with small glacier remnants found only in the highest regions. The glory of ice as it was to admire during the LIA and partially in the first half of the 20<sup>th</sup> century, is now definitely confined to history.