

## Modelling the retreat of Unteraargletscher until 2050

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Glaciers are considered to be sensitive indicators of climate change. During the last century, Alpine glaciers suffered major mass losses. Large rearrangements in alpine systems due to glacier retreat or complete disappearance will result from the likely acceleration of climatic warming during the next decades. In this applied impact study, the future evolution of Unteraargletscher, a large valley glacier in the Swiss Alps, is assessed for the period 2005 to 2050. We use a combined model that describes the mass flux into the glacier tongue by ice flow and its mass loss due to melt at the surface.

Detailed measurements of surface velocity from the last decade allow us to relate ice flux to glacier thickness and width and to set up an empirical ice flow model. Glacier mass balance is calculated using a distributed temperature-index model (Hock 1999), which is calibrated with volume changes derived from photogrammetrical analysis of aerial photographs. The combined model was validated for the period 1961 to 2005 and showed good agreement between the simulated and observed evolution of surface geometry.

Regional climate scenarios for temperature and precipitation with seasonal resolution were used to investigate the anticipated response of Unteraargletscher to future climate changes. Three mass balance scenarios were defined, corresponding to 2.5%, 50% and 97.5% quantiles of a statistical analysis of 16 different climate model results (Frei 2005).

The combined ice-flow mass-balance model predicts a retreat of the glacier terminus of 800 m to 1025 m by 2035, and of 1250 m to 2300 m by 2050. The thinning rate in the modelled area increases by 50 to 183% compared to the period 1997 to 2005, depending on the scenario applied. The debris coverage on large parts of the glacier could delay glacier retreat considerably. The effect of debris on mass balance and, thus, glacier retreat is analysed by assuming different melt reduction coefficients. This study reveals a pronounced imbalance of Unteraargletscher under the present climatic setting and in the future. The ice flux into the glacier tongue can currently account for 50% of its ablational mass loss. However, this ratio is supposed to drop to 10% by 2050 and an accelerated down-wasting of the glacier is predicted. However, even with the most dramatic climate change assumptions, the glacier will not completely disappear in the next 50 years.

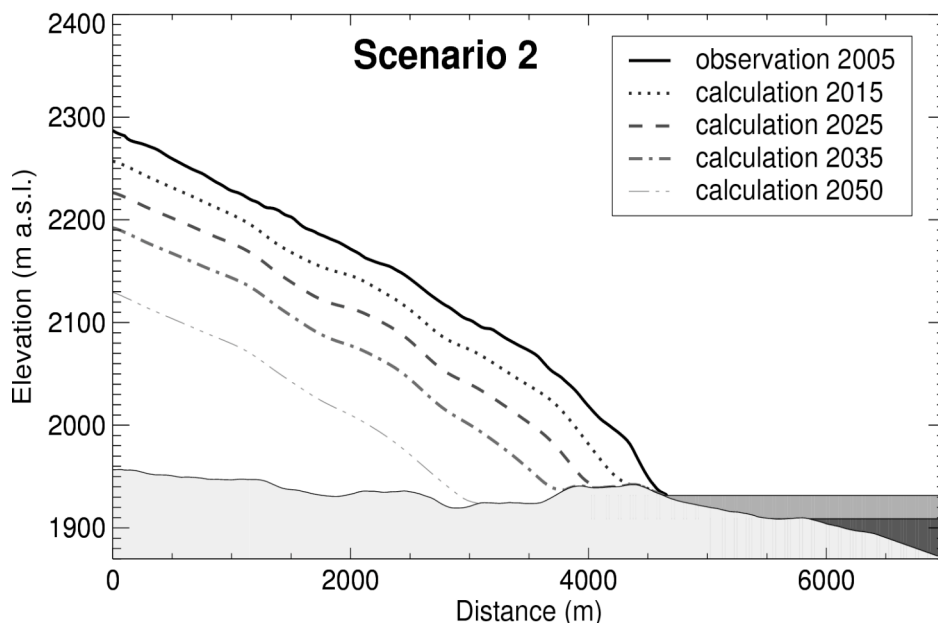


Figure 1. Glacier surface of Unteraargletscher in 2015, 2025, 2035 and 2050 according to Scenario 2 (median scenario) along the central flowline.

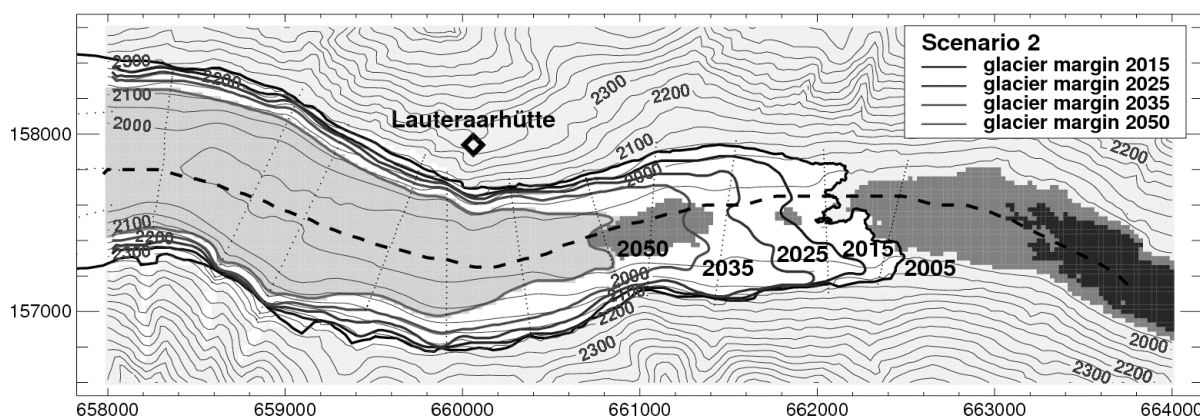


Figure 2. Map of the simulated retreat of Unteraargletscher in 2015, 2025, 2035 and 2050 according to Scenario 2.

REFERENCES

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