

## Climate change and possible impacts on alpinism: a case study on the Nationalpark Hohe Tauern

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### Abstract

Besides its importance for nature conservation as the largest protection area of the Alps and for scientific research, the Nationalpark Hohe Tauern (NPHT) represents a major tourist attraction in the central part of the Eastern Alps. Mountaineering in many forms, especially high alpinism has a long tradition in the region. Several economic branches (e.g. hiking tourism) depend on tourism. Studies from Switzerland show that climate change and subsequent effects (e.g. glacier and permafrost retreat) can have a considerable impact on those and related alpinistic fields. The results of such studies do of course depend on the region. Therefore the recent climate change and the glacier retreat in the Glocknergruppe/Goldberggruppe in the NPHT have been examined. Furthermore an opinion poll has been undertaken, addressing mountain guides, mountain huts and alpine clubs, regarding their perception of and reaction to climate change. The compiled results of a sample of more than 100 participants show that most of the respondents are concerned over the issue of climate change. Besides new information on impacts on certain routes and huts, there is common sense in each focus group that an adaptation of current strategies is already in progress or will be necessary in the future. Problems resulting from permafrost retreat or from changed water supply may lead to substantial financial issues for singular huts and also for maintenance of routes, especially in an area of conflict with strict regulations in protected areas.

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### Keywords

Glacier, climate change, alpinism, Hohe Tauern, socio-economic impact

### Area

The area of investigation was defined as the Goldberg-, Granatspitz-, Schober- and Glocknergruppe (see figure 1), regions famous for its mountaineering facilities. It covers an area of approximately 1370 km<sup>2</sup> lying predominantly within the Nationalpark Hohe Tauern (NPHT). The highest elevations in both regions are Hocharn (3254 m) and the highest peak of Austria, the Großglockner (3798 m). Approximately 75% of the area is situated between 2000m and 3000m a.s.l. The Pasterze, Austria's largest glacier, is one out of many glaciers in the area.

Tourism has a long tradition in the region not only as downhill skiing, cross country skiing and mountaineering but also in its more extreme variants of alpinism like ice/rock climbing. All these activities are supported by a dense infrastructure provided by the alpine mountaineering clubs, private owners and public authorities. More than 30 mountain huts and more than 1.100 km of trails are found in the area. The economic value of alpinistic infrastructure of Alpine mountaineering clubs is huge not only for mountain huts, mountain guides etc. but also in general for Alpine tourism.

### Climate / Glacier change

A climate observatory has been built at the summit of Sonnblick more than 100 years ago. Since then, continuous monitoring of climate is available. Within the last decades, many more scientific programmes have been established at the observatory. These data sets allow a very detailed analysis of climate change and glacier retreat in this area.

Figure 2 shows the temperature increase since the end of the Little Ice Age. The average annual temperature has risen by 2°C since 1890. A strong increase can be observed since the mid 1980ies.

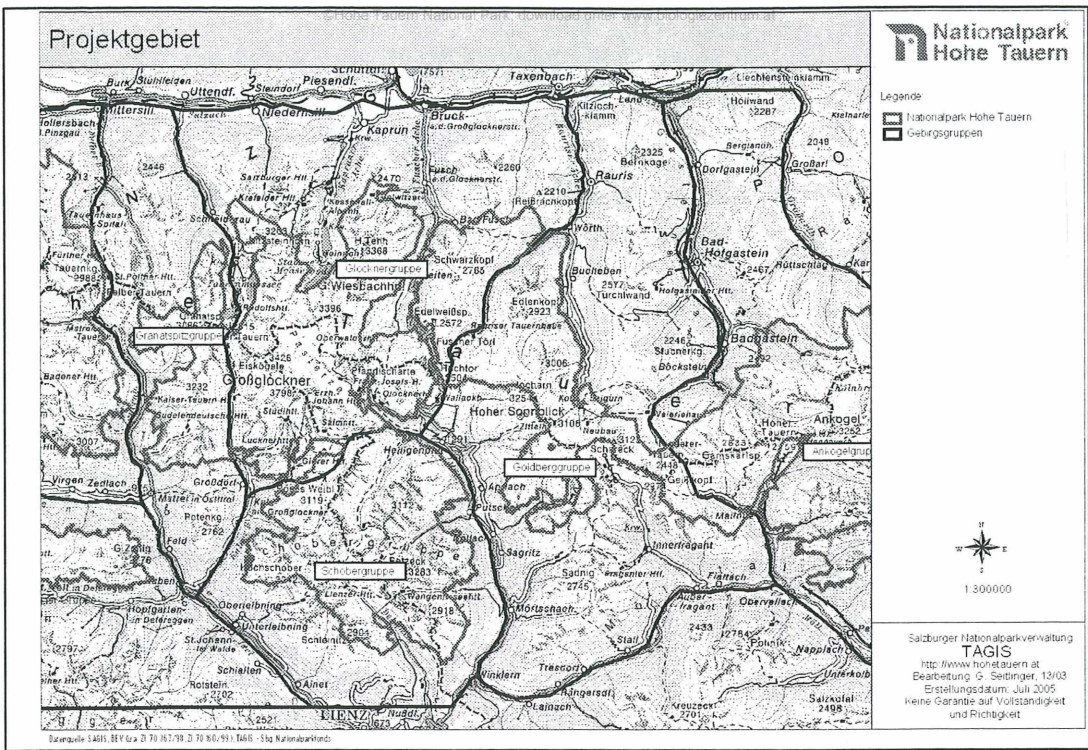


Fig. 1: Area of investigation

**SONNBLICK: AVERAGE TEMPERATURE 1887-2000**

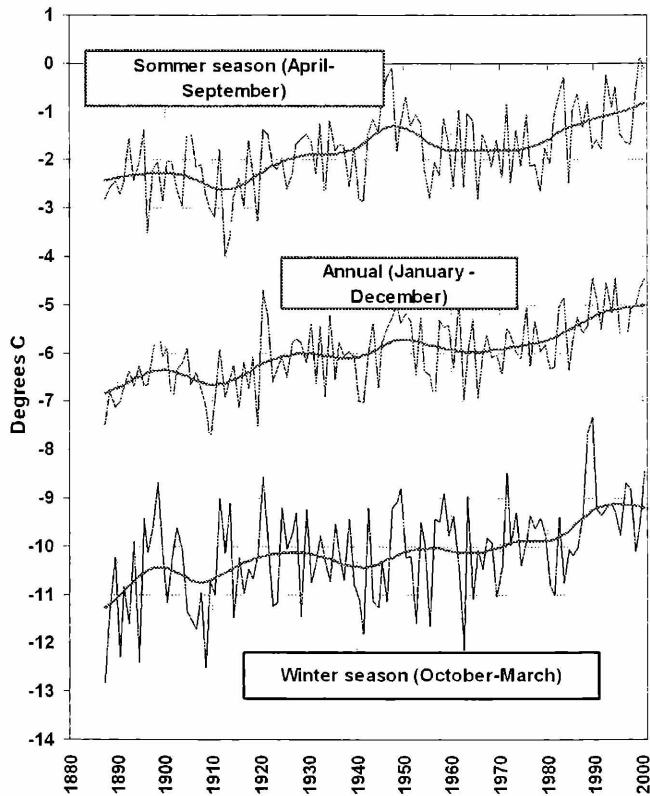


Fig. 2: Average temperature recorded on the Sonnblick observatory (3106 m a.s.l) since 1887. The violet curve shows the smoothed average (low pass filter of 30 years).

Figure 3a and 3b show the cumulated length measurements of individual glaciers since the beginning of their observation. More or less all glaciers have been retreating in the last decennium.

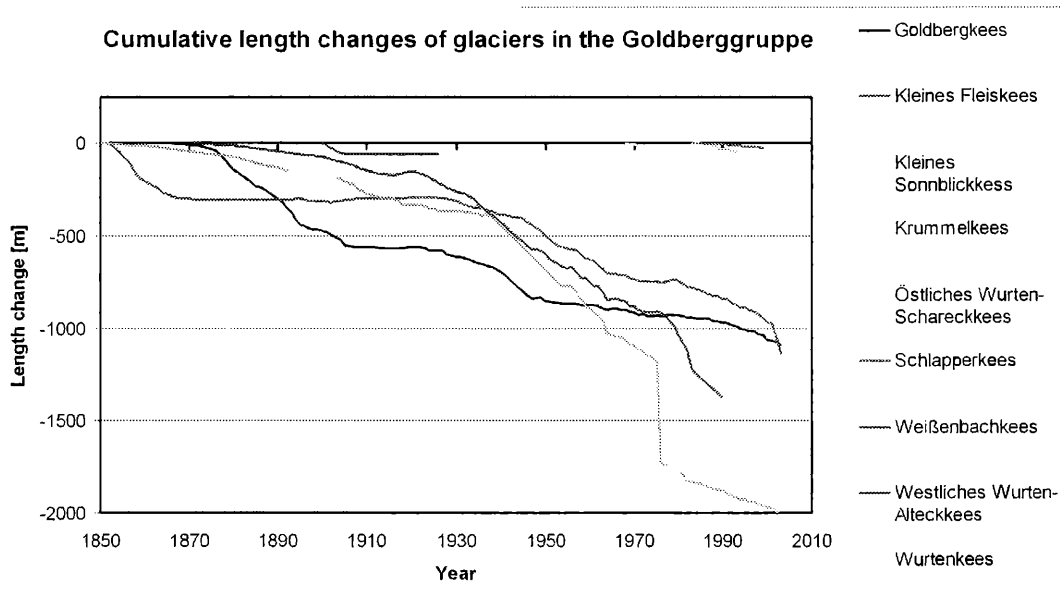
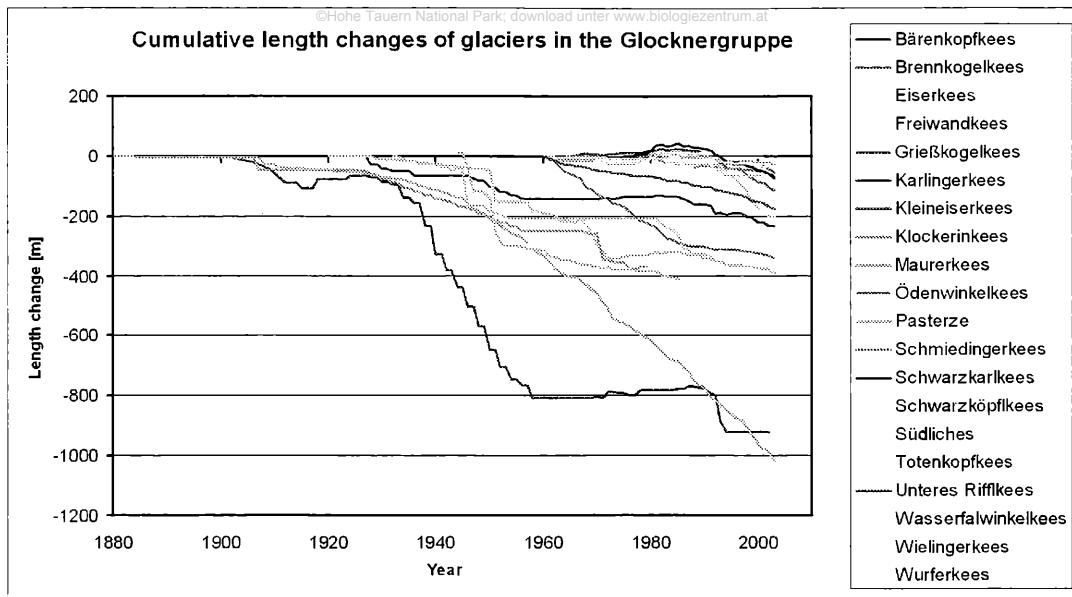


Fig. 3a and 3b: Cumulative length changes of glaciers in the Glocknergruppe (a) and Goldberggruppe (b) since the beginning of measurements.

Glacier behaviour is better indicated by mass balance than by length measurements. These observations correlate well with climate data (SCHOENER et al. 2000). Periods of mass loss are mainly caused by increased summer temperatures whereas periods of mass gain are more related to winter snow fall.

Besides glacier retreat, permafrost melt is a serious problem in high elevated regions (e.g. Sonnblick Observatory), but is yet not enough investigated. A higher risk of rockfall and damages of infrastructure are examples for first impacts of the decreasing permafrost.

## Opinion poll

An opinion undertaken among swiss mountain guides (SCHWOERER 1997) shows possible impacts of climate change and subsequent effects (e.g. glacier retreat, increased rock fall due to permafrost melt) on their profession. Inspired by this study and the poor general knowledge of impacts of climate change on alpinism in the region, an anonymous opinion poll in the Glockner- and Goldberggruppe was performed. Three focus groups were identified: Hut owners, mountain guides, persons in charge of hiking trails.

- ◆ To examine the perception of and the reaction to climate change in the region
- ◆ To analyse possible changes in the behaviour of local people
- ◆ The identification of heavily effected localities (huts, paths and routes)
- ◆ The estimation of additional costs induced by climate change impacts (conservation of paths, maintenance of huts)

## First Results

The survey was supported by relevant alpine mountaineering clubs in Austria (Oesterreichischer Alpenverein, Naturfreunde Österreich, Österreichischer Touristenklub, Deutscher Alpenverein) and the NPHT itself. Partly thanks to this, a very high participation in the opinion poll was achieved. 114 out of 266 questionnaires were returned, despite that not all of the recipients were affected or based in the region. This shows an enormous interest in the topic. The questionnaire was split in a general part (identical for all three focus groups) and a specific part for each focus group. In detail, 32 hut owners/tenants, 68 mountain guides and 14 persons in charge of hiking trails sent the questionnaire back. Some of the main results are:

- ◆ Climate change is perceived by different factors (e.g. raising temperature), a huge range of changes in the environment is observed (e.g. retreat of glaciers).
- ◆ Most of the participants see direct effects on their profession or activities due to climate change and react accordingly.
- ◆ A clear indication that the behaviour of visitors is changing as a result of climate change.
- ◆ Rock fall due to permafrost melt is increasing.
- ◆ The impact is not evenly distributed: Most huts are not seriously affected, but a few will encounter problems. The same accounts for the conservation of paths and climbing routes.

## Discussion and outlook

The results show that climate change has considerable effects on alpinism in the region. Especially for Alpine clubs climate change will have big impacts for maintaining huts and hiking trails. In future, their financial demands will increase significantly. Furthermore their expertise on this topic will be sought increasingly. The aspect of safety is also a concern (e.g. dismissing certain paths because of increased rock fall) getting more and more important. Adaptation strategies will be necessary in the future. This is already happening on a "personal" scale. According to the results of the survey, mountain guides are aware of a higher risk due to increased rock fall and avoid certain routes. This awareness will have to be also transferred to non-professional hikers. However, issues like stated above are still waiting for answers.

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