

Tourism

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1. Introduction

Background

Aspects of climate play an important role in tourism. Climate change can directly influence the behaviour of the tourist market, as well as significantly shape the conditions at a holiday destination. In many places, the first effects of warmer temperatures, higher snow lines or more frequent extreme events are already noticeable. However, how tourism will look in the year 2050 depends on numerous additional factors that are not related to climate change. Thus, for instance, globalisation, new technologies, war-like incidents, health risks or other environmental changes very strongly affect travel behaviour. Furthermore, the tourism industry continually adapts to the new challenges. For all these reasons, predictions are difficult. Despite this, an attempt to highlight and discuss the possible effects of climate change on tourism should be made.

Overview

Impact on the different tourism zones

1) City tourism

More frequent extreme weather conditions may increasingly result in adverse health phenomena, such as high ozone or particulate matter concentrations, and thereby harm the attractiveness of cities. On the other hand, hot summers may lead to an increased revival of the public space, whereby more people spend their holidays at home and activities are moved outdoors.

2) Rural tourism

In winter, the rising snow line will mean that some of the ski resorts in the foothills of the Alps cannot be run profitably anymore. In summer, lake regions may profit from excursion tourism by city dwellers, due to higher temperatures.

3) Alpine tourism

Climate change will lead to an increased threat to traffic routes in the alpine region, which will make the accessibility of tourist resorts more difficult. The decreasing snow-reliability and the expected changes in the landscape, in particular due to glacier retreat, will strong-

ly affect the attractiveness of alpine tourism regions. However, heat waves also represent an opportunity for alpine tourism.

Impact on tourism service providers

1) Mountain railways

With climate change, the line of snow-reliability will continue to rise. As a result, the number of ski resorts with unreliable snow conditions will increase considerably. The melting permafrost also poses a costly risk to mountain railways, since the foundations of pylons and stations are frequently anchored in frozen loose rock. Even if warm summers with long periods of fine weather result in an increase in tourism demand, for most mountain railways, winter tourism is critical to their financial survival. Mountain railways at high elevations could possibly profit.

2) Accommodation

The accommodation sector will be affected by climate change, primarily due to the expected changes in winter sports. In areas where snow-reliability decreases, accommodation will suffer from massive slumps. On the other hand, the pressure, particularly on the second-home sector, will increase in snow-reliable and easily accessible areas. In addition to climate change, the hotel sector will also be confronted with numerous unrelated problems (cost pressure, profitability, investment needs, etc.).

3) Outdoor promoters

Glacier retreat changes the alpine landscape and may lead to a loss of appeal, while the melting permafrost will increase the risk of rockfalls and avalanches. The occurrence of more frequent extreme events will change the degree of danger.

Measures

Mitigation and adaptation strategies have to complement one another. Although adaptation measures are absolutely essential, they will only be perceived as credible if tourism, as a contributor to climate change, helps to fight its causes.

- In order to maintain the attractiveness of tourist destinations, tourism managers need to adapt offerings to the new conditions. New concepts or an adequate shift in the focus can help to maintain the attractiveness of a destination.
- Service providers are required to collaborate in order to optimise their offerings, and to work out development and adaptation strategies.
- Tourism providers and managers need to observe climate and landscape changes and consider them in their planning, in order to ensure the future survival of a destination.
- The increasing threat to infrastructure and activity spaces must be met by suitable measures. Spatial planning, development strategies and communication concepts need to take into account the modified risks.

Links to other topics

As a cross-section phenomenon, tourism is linked in numerous ways to other climate-relevant topics. Among these, the following are particularly critical, while others (e.g. agriculture) should not be disregarded either:

Land ecosystems

Landscape changes also mean changes in tourist attractions. The loss of protective capacity particularly affects alpine tourism.

Water management

Water shortage has an impact on passenger boating and water-related tourist activities. In winter, possible shortages in water supply may affect snowmaking.

Health

New health risks may increase the demand for wellness. Rural or alpine areas might become more attractive as recreational areas.

Insurance

Insurance rates for tourist businesses will become more expensive due to the increased danger risk of more frequent natural hazards.

Buildings/infrastructure

The mobility and travel behaviour is a determining factor for the building and infrastructure sector. Changes in the development of tourism affect building activities (second homes, facilities, etc.). The protection and maintenance of traffic routes using structural measures are very important to tourism.

2. Change in offerings and demand due to climate

With climate change, the climatic and environmental conditions change not only in Switzerland but also in the country of origin. This leads to a change in offerings and demand, which may result in a shift in tourist flow, also within Switzerland.

Countries and regions of origin

Changes in international tourist flow are to be expected due to climate change. While certain areas will lose attractiveness from a climatic perspective, for others new chances will arise. For the foreign tourist flow in Switzerland, the conditions in the countries of origin are of great relevance. If the temperatures rise strongly in the Mediterranean region as a result of climate change, the demand for holidays in the mountains will be favoured. In summer, holidays in the alpine area may profit from hot temperatures in Europe.

Shifts may also take place within Switzerland. Thus, for instance, it is important to ski resorts whether there is snow in the midlands and thereby whether the need to drive to the mountains will increase. Again, in summer, hot temperatures in the lowlands may motivate its inhabitants to seek alpine coolness.

Altogether, it can be assumed that the needs, demands and expectations of tourists alter with climate change. Travel preferences may change in time as well as place.

Target countries and destinations

Climate change not only means warmer temperatures and a changed precipitation regime but also a change in environmental conditions. Environmental and landscape changes will have a direct impact on tourism, even if the effects are hard to predict.

Climate change also affects what a destination has to offer indirectly. The change in climatic conditions means that the opportunities for certain activities at a destination change. Tourism service providers need to adapt insurance and investment strategies to the new conditions, which in turn affect the labour market and value creation.



Figure 1: Glacier retreat, which had already begun in the 19th century, had at first primarily natural causes. Enhanced global warming caused by human impact has dominated glacier retreat in the Alps since the mid-20th century.

a) Lower Grindelwald glacier in 1858 (photographed by Frédéric Martens, 1809–1875, Alpine Club Library London; photograph: Heinz J. Zumbühl)
 b) Lower Grindelwald glacier in 1974 (photograph: Heinz J. Zumbühl). The arrow, as well as the small embedded picture, show the location and state of the glacier front in 2006 (photograph: Samuel U. Nussbaumer)

3. Impact of climate change on natural tourism offerings

Climate change has far-reaching impacts on tourism, due to the decreasing snow-reliability, changed landscape and increased threat to infrastructure (traffic routes, transport facilities).

Decreasing snow-reliability

By 2050, the snow line is expected to have risen by up to 350 m. Warmer temperatures will shorten the duration of snow cover, as well as reduce the number of days with snowfall at lower elevations. For many skiing regions, this is the most direct and greatest challenge. In particular, stations at lower elevations will hardly have enough snow anymore by 2050 to continue to operate skiing facilities (see section 4). However, the expected increase in winter precipitation (see Background chapter) will mean an increase in snow quantity at elevations above 2000 m, which could possibly increase the danger of avalanches.

Glacier retreat

Due to the strong glacier retreat (fig. 1), the alpine landscape will change considerably and with it possibly also its attractiveness to tourists. By 2050, the glaciated area in the Alps will probably have decreased by about three-quarters in comparison to the reference period 1971–1990 (see Background chapter, section 3). Some tourist locations are already in trouble, particularly if the glaciers are used for activities like skiing, glacier hiking or ice-tubing. The maintenance of glacier grottoes is becoming increasingly difficult and expensive. Measures to prevent melting, such as the covering of glacier areas with protective sheets, will not be able to stop the retreat.

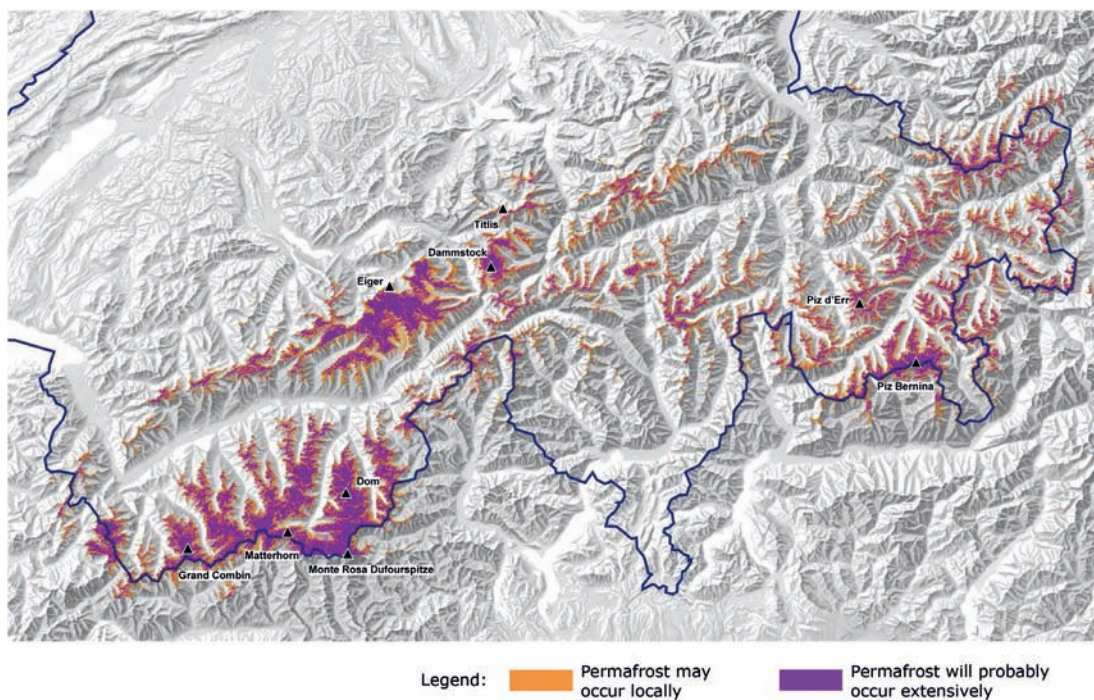


Figure 2: Potential permafrost distribution based on modelling using DHM25. About 15% of the Swiss alpine area, or 4 to 6% of the total land area, are in permafrost territory.

(Source: Federal Office for the Environment FOEN 7/06)

Melting permafrost

Melting permafrost destabilises ground conditions. Most affected are the Engadine, Valais, Bernese Alps and Tödi area (fig. 2). Problems should be particularly expected where infrastructure, such as avalanche barriers or pylons of mountain railways, is

anchored in the permafrost ground.¹ The danger of rockfall and landslides will also be increased by the melting permafrost. Alpinism (walking, hiking and rock climbing routes) is especially affected by the danger of rockfall. Settlements are hardly at risk from these processes.

Extreme events

Much points to the fact that extreme weather events will increase. Since tourism largely depends on the weather, the consequences are considerable:

Heat waves

Heat waves strongly affect the hydrological cycle, as well as the landscape and vegetation. However, more frequent heat waves also offer an opportunity for alpine tourism: The slightly cooler mountain air (summer retreat) may make the Alps a more interesting holiday destination, in particular if competing destinations like the Mediterranean lose in attractiveness due to rising temperatures. For example, the heat-wave summer of 2003 stimulated day trips to the Alps.

Dry spells

Lower precipitation in summer, in combination with higher temperatures, results in more frequent dry spells. From a tourist perspective, activities like bathing in rivers and lakes, fishing,

kayaking or river rafting, as well as passenger boating may be affected. If the reservoirs are not sufficiently filled by the start of the winter season, water shortage may cause supply problems for snowmaking facilities.

Precipitation extremes

The expected increase in precipitation extremes will have an impact on the frequency and intensity of floods, landslides, mudflows and rockfalls (see fig. 3). Many traffic routes are exposed to such risks. If roads had to be blocked more frequently in the future, this would have far-reaching consequences, since the accessibility of a place is central from a tourism perspective. This means increasing costs to ensure security for tourism service providers.

Landscape changes

Warmer temperatures will particularly leave a trace in high alpine landscapes. Many landscape phenomena, such as glaciers, vegetation or terrain, will experience considerable changes. Flora and fauna will adapt to the new conditions,



Figure 3: Two mudslides occurred in Brienz during the storm in summer 2005 (photo of the mudslide at Glyssibach). In addition to financial losses, there were two human deaths.
(Source: Swiss Air Force)

although it should be noted that certain natural processes, like forest regrowth, only proceed very slowly and thus take place with a considerable

time lag (see Land ecosystems chapter, section 2). These changes may represent an opportunity as well as a risk to tourism.

Changes in attractiveness in Val Morteratsch and Val Roseg near Pontresina (2005–2100)

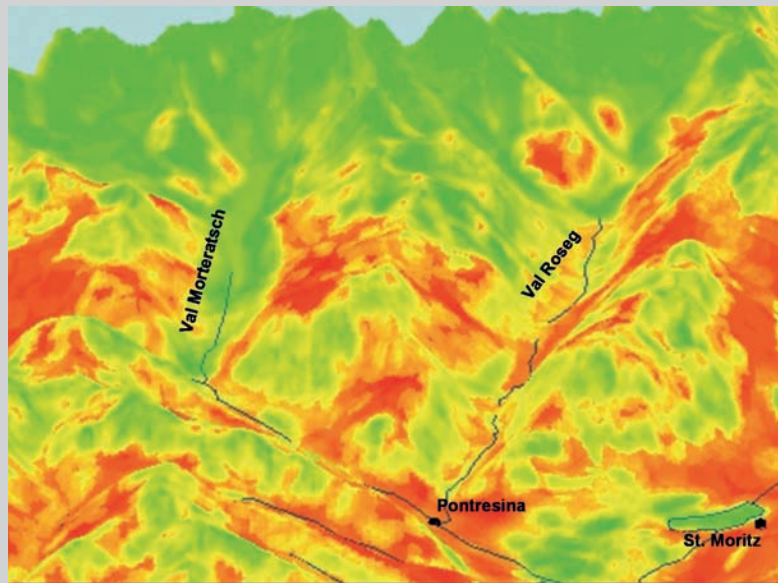
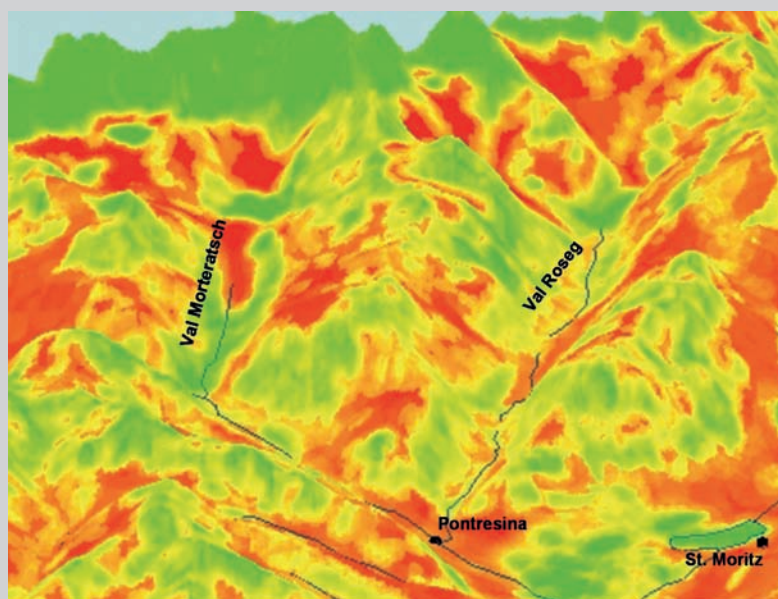


Figure 4: The GISALP-calculated landscape attractiveness in 2005 (4a, top) and 2100 (4b, bottom) after a climate warming of +3 °C.

a) Glacier areas, lakes and diversified areas with good visibility have a higher calculated landscape attractiveness (green). Settlement areas and areas with little variety of form and less visibility are considered less attractive according to the calculation model (red).



b) Debris dominates in the areas of Val Roseg and Val Morteratsch from which the glaciers have retreated. Two new lakes in the foreground of the Morteratsch glacier represent new landscape attractions. Thus, landscape attractiveness increases in certain areas, even though overall it decreases considerably in the high mountains.

(Graphics: Ch. Rothenbühler, Academia Engiadina)

Landscape attractiveness of the high mountains generally decreases as a result of debris areas, which are mainly due to melting glaciers. Although areas with an increased landscape attractiveness may also arise, they are less numerous.

4. Impact of climate change on tourism in Switzerland

The tourism sector represents 3.4% of the GDP and is thus of great importance to Switzerland. Based on the expected effects of climate change and the economic vulnerability of some destinations, the most important changes are expected in alpine tourism.

Tourism in Switzerland

It is beyond dispute that the tourism sector represents an important branch of Swiss economy. The direct gross value added of tourism (at current prices, 1998) amounts to 12.9 billion CHF, which corresponds to 3.4% of the GDP. The directly associated, full-time equivalent (FTE) employment amounts to 165,500 employees and corresponds to a share of 5.2% of the tourism sector in the entire full-time equivalent employment in Switzerland. The distinctly higher share in comparison to the gross value added is due to the lower level of labour productivity. The share of the most important economic sectors in the tourism value added is divided as follows: accommodation (31%), restaurants (14%), passenger transport (20%) and travel agencies/tour operators (9%).²

In 2005, hotels and health resorts recorded 13.8 million arrivals and 32.9 million overnight stays. In hotel and non-hotel business, a total of 65 million overnight stays were registered. 56% of the bookings were Swiss guests. The largest proportion of guests came from Germany (18%), Great Britain (4%), the Netherlands (4%), France (3%) and the USA (3%).

The winter season accounts for 46% of overnight stays and the summer season for 54%. However, the winter season has a considerably higher turnover due to winter sports.³

Impact on tourism zones

Basically, three tourism zones can be distinguished in Switzerland: city, rural and alpine. Tourism statistics report mountain health resorts (located above 1000 m a.s.l.), lake zones (locations bordering lakes) and big cities (Basel, Berne, Geneva, Lausanne and Zurich) separately. Mountain health resorts account for 39.1% of the overnight stays in hotels, lake zones for 19.9% and big cities for 17.6% (2003). The remaining 23.4% fall to the other, more rural areas. 60.9% of the hotel overnight stays are generated in the alpine area, 34.6% in the midlands and 4.8% in the Jura.³ In the description of possible impacts of climate change on

the tourism zones in Switzerland, the focus is on alpine tourism.

City tourism

In 2003, the five biggest cities generated almost one fifth of overnight stays in hotels in Switzerland.³ The proportion of foreign guests amounts to 76.4%. In cities, short stay and cultural tourism play an important role in addition to business tourism. Due to their man-made environment, cities are less vulnerable to visible effects of climate change. Nevertheless, climate change will be noticeable in cities.

Cities are not immune to natural hazards, in particular floods, though entire cities are hardly ever affected. As a rule, such events are perceived to be less dangerous in cities than in rural areas. The occurrence of more frequent extreme weather conditions may lead to an increase in adverse health phenomena, such as high concentrations of ozone or particulate matter. Due to high temperatures and more frequent heat waves, city dwellers may go on excursions to the country or to the mountains more frequently.

On the other hand, hot summers may cause city dwellers to move their activities outdoor more often. Public spaces are thereby revitalised and the city image becomes more attractive (mediterraneanisation). People perhaps increasingly spend their summer holidays at home or shift their main holidays to the low or winter season. A temperature rise in Swiss cities will tend to have a positive effect on the travel patterns of foreign visitors.

Rural tourism

The midlands register 34.6% of all hotel overnight stays, although a large part of them are in cities.³ Rural tourism in the midlands can be subdivided into the lake regions and the pre-alpine areas. The natural scenery in the midlands is primarily shaped by agriculture, so that the changes are not expected to be as strong as in the high mountains. As a result of their proximity to large agglomerations, the lake regions

might profit at warmer temperatures from the increase in day-trip tourism.

The rising snow line will be a great challenge to skiing regions in the foothills of the Alps. Resorts that already have little snow today will not be able to be run profitably in the future. They will have to orient themselves to new offerings. In summer, on the other hand, they might benefit from the increase in short and day-trip excursions by city dwellers.

Alpine tourism

In many places in the Swiss Alps, tourism is the most important employer. In some tourist destinations, the value added of tourism amounts to more than 80% of the regional GDP. The enormous economic significance also means a high vulnerability of this economic sector in the alpine region. Some consequences of climate change are already noticeable today (see figs. 5 and 6) and will pose a great challenge to tourism in the alpine regions in the future. Changed conditions in the original (natural factors, general infrastructure) and the derived offerings (tourist infrastructure and attractions) will affect all service providers of a destination.⁴

Where the general infrastructure of alpine holiday destinations is concerned, an increase in



Figure 5 (left): Slope at Mettenberg near Grindelwald after a landslide. The hut (red circle) was also destroyed by the slide.

(Source: H.R. Keusen, Geotest AG)

Fig. 6 (bottom): Tourism use in a precarious location. The hut at Mettenberg (see fig. 5) is no longer standing. Photo: summer 2005.

(Source: H.R. Keusen, Geotest AG)





Fig. 7: Engelberg Central Railway, storm in 2005. (Source: Swiss Air Force)

interrupted or blocked traffic routes is to be anticipated (see fig. 7). Thus, accessibility, which is central to tourism, could be significantly impaired. The threat to sensitive traffic routes could increase and so could the accident risk. The protection of traffic routes and other infrastructure against natural hazards is complex and expensive. In comparison to incidents (e.g. cyclones) at destinations abroad, the natural hazards in Switzerland, which are mostly localised (avalanches, mudflows), are more easily predicted. In addition, more substantial means for protection and coping with incidents are available, so that this threat to security will not mean a comparative disadvantage for the alpine region.

The changes in the natural landscape that are expected due to climate change will strongly influence the attractiveness of a destination. The tourist offerings will change too. In the Alps, the mountain railways and transportation businesses are expected to feel the effects of climate change the most. However, the accommodation sector (hotel and non-hotel accommodation) and the broader tourist attractions (outdoor activities) will also be directly or indirectly affected by the effects.

Impact on tourism service providers **Mountain railways**

The economic miracle of the post-war period and the development of efficient aerial tramways

and cable cars turned skiing into a national sport. There are about 1790 mountain railways in Switzerland today: 12 cog railways, 58 funiculars, 216 aerial tramways, 120 cable cars, 314 chair lifts and 1070 ski lifts. The mountain railways hold a central position in the value added chain of tourism. Funiculars are often the determining factor in tourist destinations and therefore indirectly induce value added to other service providers as well (e.g. hotel sector, gastronomy, retail trade). The mountain railways offer more than 4700 full-time positions, which are again split into 11,000 jobs (full-time and part-time positions).

The winters with little snow since the 80s have resulted in sharp declines for the mountain railways in certain areas.⁵ The rising snow line will continue to represent a great challenge to many mountain railway operators in the future. In particular, skiing regions at lower elevations will tend to become less snow-reliable. A shift in the line of snow-reliability considerably increases the proportion of skiing regions in Switzerland that are not snow-reliable. According to a study by the OECD, 97% of the skiing regions in Switzerland are currently considered to be snow-reliable,⁶ where snow-reliability means that in 7 out of 10 winters between 1 December and 15 April, there is snow cover adequate for snow sports of at least 30 cm on at least 100 days. The study considers skiing regions offering at least three

Possibilities for snowmaking

With rising snow lines and the simultaneous rise in expectations of snow-reliable holiday destinations by winter sportspeople, many winter sport regions are increasingly investing in artificial snowmaking. Snowmaking requires that certain meteorological conditions are fulfilled. It only works efficiently if air temperatures are 2 °C or below,⁶ humidity is less than 80% and water temperature is a maximum of 2 °C. In order to make snow at higher temperatures, snow additives are often employed. The energy and water consumption of the machines is relatively high but depends on the technical system selected, the location, water supply and climatic conditions. In addition, high costs arise from infrastructure and operation of the machines.⁸

Technical measures will be able to replace the lack of snow only to a limited extent and snowmaking will be possible less often with warmer temperatures. While the effect on the energy market is hard to predict, it can be assumed that water resources will become more valuable. Water shortage may become a problem for winter sport locations that strongly depend on snowmaking. Snow conditions will make it necessary to invest further in snowmaking facilities, as well as in reservoirs and the maintenance of drainage systems. For mountain railways, snow shortage and an increased danger potential mean strongly rising costs. With artificial snowmaking, these costs cannot entirely be shifted onto the price, since snow-reliability is similar to an insurance benefit, which only offsets a comparative disadvantage and does not represent an additional benefit.

transportation facilities and 5 km slope length. Skiing regions at lower elevations in the Jura are excluded. Based on these criteria, the study includes a smaller number of skiing regions in comparison to previous studies.^{5,7} The skiing regions taken into account are generally located at higher elevations and are therefore less vulnerable to changes in snow-reliability.

With a shift in the line of snow-reliability by 300 m, as is expected by 2050, only 79% of the skiing regions would still be snow-reliable. In particular, ski tourism in the Vaud and Fribourg Alps, in Ticino, and in Central and Eastern Switzerland is at risk, where only 50 to 60% of the skiing regions will be snow-reliable by the mid-21st

century. The skiing regions in the Valais and in Grisons will be less affected (see table 1). In comparison to Switzerland, the effects of climate change will be even more drastic in the skiing regions of the Alpine countries France, Italy, Austria and Germany.⁶

Climate change will not only affect snow-reliability but also the demand for winter sport offerings. In the medium term, the interest of the younger generation for skiing sport may decrease, since children will lack the opportunity to learn skiing locally in early life. In Switzerland, the number of skiers is already stagnating, although this is only marginally related to climate change.

Table 1: Snow-reliability in Swiss skiing regions under current and future climatic conditions. (Source: Abegg et al. 2007)⁶

Region	Number of skiing regions	Snow-reliability			
		today	+1°C ^{a)}	+2 °C ^{a)}	+4 °C ^{a)}
Vaud and Fribourg Alps	17	100%	65%	53%	6%
Bernese Oberland	26	96%	85%	62%	12%
Central Switzerland	20	90%	75%	55%	20%
Eastern Switzerland	12	83%	58%	58%	8%
Grisons	36	100%	97%	97%	83%
Valais	49	100%	100%	100%	80%
Ticino	4	100%	75%	50%	0%
Switzerland	164	97%	87%	79%	49%

a) time horizon: +1 °C: ca. 2020s; +2 °C: ca. 2050; +4 °C: towards the end of the century

Glacier retreat not only means the loss of an important attraction to many winter sport regions but also, particularly in summer, a restriction on offerings of glacier activities. The melting permafrost poses a further threat to certain mountain railways. Infrastructure that is anchored in the permafrost ground may be destabilised by variations in temperature. Since the foundations of pylons and stations of mountain railways as well as of avalanche barriers are anchored in the frozen loose rock, the necessity for costly rebuilding of the foundations increases. The melting permafrost also means an increasing risk of rockfall, landslides and mudflows, which again results in higher investments in safety and may lead to an increase in service interruptions.

In warm summers with long periods of fine weather, the mountain railways may profit from the increase in mobility intensive day-trip and short-stay tourism. With appropriate adjustments, particular sports like mountain biking that are of relevance to mountain railways could gain in importance. Even new offerings for activities could be developed. However, only few mountain railways succeed in making summer business profitable and they cannot survive without a “good” winter.

Accommodation

In recent years, the number of hotels has decreased from 6300 (1992) to 5600 (2003). The number of beds has decreased only slightly within the same time period from 261,900 to 258,700. Even if certain concentration processes are under way, small hotels still dominate in Switzerland. The economic situation of the Swiss hotel business is not a pretty picture. Often the profitability is insufficient, the capital gearing is too high and the investment needs are large. The number of overnight stays in hotels also fell by about 14% between 1992 and 2003, from 36 to 31 million. While the number of guest arrivals increased slightly within this period, the average duration of stay decreased strongly. The booming second-home tourism became a primary competitor to the hotel business in the Alps. The manifold problems of the Swiss hotel business are in the minority of cases directly related to climate change.

While the hotel business offers about 260,000 beds, holiday flats and second homes provide about 1.2 million beds. A further 430,000 beds and sleeping places are offered by youth hostels, group accommodation and campgrounds. The alpine area is a popular region for second homes and holiday flats. The number of second homes has increased enormously in recent years, which has brought with it various problems (infrastructure geared to peak loads, urban sprawl, poor capacity utilisation, rising prices for locals, etc.). About two thirds of the second homes and holiday flats in Switzerland are occupied only a few weeks every year but are heated the entire winter. They therefore contribute considerably to CO₂ emissions. In spite of the expected decrease in heating degree days from 98 (2004) to 85 (2050), energy consumption will continue to rise. In addition, there will be increasing demand for cooling in summer (see Energy chapter, section 2).

Climate change will affect the accommodation sector, in particular because of the changes in winter sports. In locations where winter sports are no longer a catalyst, the accommodation sector will experience massive slumps in demand. On the other hand, settlement pressure and thus mobility as well will increase at prime locations. Since the Lex Friedrich (consent to property purchase by foreigners) will be abolished, some regions are trying to restrict the building of new flats using new measures. The dynamics of the second-home market are shaped by many factors, of which until now climate has played a minor role.

Changes in the tourist attractions and in the landscape will affect the attractiveness of a destination and therefore influence property prices. The potential for conflicts in new land development will grow due to the increased risk from natural hazards. The pressure on snow-reliable and easily accessible regions will increase. Insurance premiums and bank loans will tend to get more expensive because of the increased risks⁹ (see Insurance chapter, section 4). Altogether, the added value of tourism will decrease at certain places despite an increasing number of tourist beds. If tourist flow shifts seasonally and spatially, the accommodation sector will feel the effects, although not to the same

extent as businesses depending on daily tourism. Where the attractive winter business with high value added potential collapses, a lot of hotels will have to close down.

Outdoor promoters

Hiking and alpinism have been popular for many years and are currently booming. Furthermore, with carving, snowboarding, snowshoeing, mountain biking, Nordic walking, paragliding etc., new outdoor sports are continually being added.

The alpine landscape is strongly shaped by climate. Climate change not only means a loss of appeal but also increases the risk of rock slides

and rockfalls due to melting permafrost. More numerous extreme events also have an impact on the degree of danger on waterways, which may be of relevance to sports like kayaking or canoeing. The growing number of extreme events increases the risk for all outdoor sports. At the same time, warmer summers with low rainfall increase the attractiveness for hiking, as well as for bathing and other water-related activities, such as kitesurfing.

Outdoor promoters will need to respond to the changing natural conditions by adjusting their offerings. Consideration of the risks and corresponding investments in safety will gain in importance.

5. Strategies and measures

Tourism needs to adapt to the effects of climate change. The adaptation and diversification of offerings, as well as technical and organisational measures may mitigate the negative effects and provide new chances. However, as a co-contributor to climate change, tourism is at the same time required to reduce greenhouse gas emissions.

The tourism sector is not only affected by rising temperatures but is also an important co-contributor to climate change. Individual holiday traffic in particular contributes substantially to the emission of climate-relevant gas emissions. As a result of improved development, increasing motorisation and willingness to travel after the Second World War, traffic in the Alps has strongly increased. Similarly, the mobility-intensive short-stay and second-home tourism has grown. In addition to traffic emissions, heating and, increasingly, cooling energy of tourist accommodation also have a

share in the greenhouse gas emissions caused by tourism. In particular, second homes are of significance.

Thus, measures to reduce emissions must have priority: promotion of public transport, consistent application of the “polluter pays” principle (e.g. to encourage low-pollution cars), improved traffic management, reduction of emissions generated by heating facilities of tourist accommodation, compensation of climate-effective emissions etc. At the same time, tourism needs to adapt to the changed conditions due to climate change.

Promotion of innovation and diversification

Tourism managers are requested to adapt their offerings to the new conditions and to work out coordinated and comprehensive concepts, since every service provider contributes to the attractiveness of a destination:

- Diversify the offerings, adapt to new tourist activities and shift the focus
- Extend the season with appropriate offerings (temporal expansion)
- Specifically further regions at higher elevations that have already been developed, in order to enhance snow-reliability (spatial expansion)
- Broaden the understanding of wellness with regard to air, elevation, light, nutrition and culture (alpine wellness)
- Actively retreat from (skiing) tourism, for instance by closure compensation (managed retreat); diversify into other economic sectors

Reinforcement of danger prevention and technical measures

Infrastructure and activity areas need to be protected from new and partly increasing risks:

- Support biological measures such as afforestation
- Guide landscape changes, set up protected zones and green belts
- Renovate the foundations of facilities and protect them from natural hazards
- Protect infrastructure from avalanches, rock-falls, landslides and mudflows
- Enhance the effectiveness of snow machines
- Target slopes for snowmaking, construct storage lakes, cover glaciers if applicable, etc.

Reduction of risks by organisational measures

With regard to new challenges, co-operation or fusion between service providers should be intensified and new adaptation strategies developed:

- Merge mountain railway companies and carry out compensated closures in order to optimise skiing regions, merge skiing regions
- Work out destination development strategies collectively
- Set up and adapt hazard zone plans (land-use planning measures)
- Develop evacuation and communication concepts
- Inform the population and tourists openly and create a public awareness for climate issues

Intensification of science and closing of knowledge gaps

Many possible effects and, in particular, the interactions between various factors relevant to tourism are not clear as yet. The developments should be monitored and new insights considered:

- Observe developments locally and identify the need for action early
- Monitor changes in the travel behaviour of tourists and adapt offerings accordingly
- Inform the population about weather risks and natural hazards
- Follow and support specific research projects

6. Tourism in the year 2050

Climate change represents a risk and an opportunity at the same time. By suitable adjustment to tourist attractions, core competences can be developed and new guest groups can be appealed to. The concentration of winter sports at top destinations, the promotion of alpine wellness centres and of summer tourism are promising development models.

Revival of the summer retreat

Warmer temperatures and more frequent hot and dry summers will cause a revival of the summer mountain retreat. High temperatures in Southern Europe and in the towns will mean that the Alps are sought after as places of coolness and may profit in comparison to more southerly destinations. The tourist summer season may be extended. In particular, the heavily weather-dependent weekend day-trip and short-stay tourism of the Swiss people will ensure the summer business of tourist locations that have adequately adapted their offerings to the change in travel behaviour. The heat wave summer of 2003 showed that summer tourism at higher elevations could gain in importance. Places with attractive hiking and bathing opportunities profit from more frequent heat waves and fine weather periods. The proximity to large agglomerations and an adequate adjustment of the offerings is also crucial. New guests may be attracted if destinations in Southern Europe lose in attractiveness because of the heat, and the Alps may become a summer retreat again.

Boom of the new alpine wellness

Health spa tourism played an important role in the Alps at the beginning of the 20th century. Climatotherapy at sanatoriums was recognised for curing respiratory diseases, and spas were very popular. In recent times, health spa tourism has largely been replaced by wellness tourism. While some classic health spas have had to close down in recent years, wellness facilities are increasingly becoming part of the expected standard in four- and five-star hotels. More and more frequently, classic health spas are being converted into wellness oases and adventure pools.

Health tourism has developed from curing diseases to the preventive, responsible and holistic understanding of body, mind and soul. The new symbiosis is about fitness and well-being. Demographic development means a further increase in the relevance of health to our society. Alpine wellness, which includes the components water, air, elevation, light, nutrition, exercise and culture, will gain in importance. New health hazards (see Health chapter) and the escape from the summer heat may support this trend, so that the appreciation of altitude for recovery will rise again.

Concentration on top winter sports destinations

The conditions aggravated by climate change will lead to a concentration of the viable winter sports resorts. Structural problems and financing difficulties of mountain railways will be intensified by the unfavourable natural conditions at many locations and push forward the change in structure. Lack of snow and water scarcity will be particular bottlenecks for pre-Alp destinations where higher temperatures make it difficult to compensate for the lack of natural snow by artificial snow. Overall, the importance of ski sports will decrease and the choice of winter sport activities will broaden. The costs for artificial snowmaking will rise and the assurance of safety will require financially costly measures. Large businesses that are able to use synergies efficiently will be able to compete most effectively. Small places will focus more on alternative offerings and will specialise in niches in order to gain new markets and win their share of customers.

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