Climate change and tourism in the Alps

Bruno Abegg, Rolf Bürki & Hans Elsasser

Abstract

Winter tourism has been repeatedly identified as vulnerable to global climate change due to diminished snow conditions required for alpine and nordic skiing that dominate the winter tourism market. Vulnerability to climate change, however, is not only depending on the impacts of global warming on natural snow conditions but also on the tourims stakeholder's willingness and ability to adapt to changing circumstances. First, the impacts of climate change on the number of naturally snow-reliable ski areas in the Alps will be presented. Second, the potential as well as the limitiations of two selected adaptation strategies – artificial snowmaking and all-year tourism – will be highlighted. And finally, the significance of climate change as a decisive variable in determining the future of Alpine (winter) tourism will be discussed, keeping in mind that the tourism sector will be affected by many factors over the next decades.

Keywords: climate change, tourism, skiing, adaptation, Alps

Introduction

Regional climate models for "double-CO_2" indicate a general warming for the Alps. Summer warming is projected to be more pronounced than winter warming. Temperatures are also expected to increase much more at higher elevations. Meanwhile, precipitation is projected to increase and become more intense over the winter, but be significantly reduced over the summer. These general observations are consistent with climate change scenarios that have been developed for Switzerland, where temperatures in the northern part of the Swiss Alps are projected to increase by about 1.8°C in winter and about 2.7°C in summer by 2050, as compared to 1990 (median values). Precipitation is projected to increase by about 8% in winter, and to decrease by about 17% in summer (OcCC 2007).

The sustainablility of winter tourism and the ski industry in particular, has been repeatedly identified as highly susceptible to global climate change. According to the European Environment Agency, for example, Alpine winter tourism will be facing increasing risks of economic losses due to warmer winters with less snow, especially in low altitudes (Abegg et al. 2007).

Impacts of climate change on winter tourism

There are quite a few studies dealing with the impacts of climate change on winter tourism: from Europe (Alps, Scandinavia and Scotland), North America (Canada and

Table 1: Number of naturally snow-reliable ski areas in the European Alps under present and future climate conditions (national level).

Country	Number of ski areas	Snow-reliable under current conditions	+1 °C	+2 °C	+4 °C
Austria	228	199	153	115	47
France	148	143	123	96	55
Germany	39	27	11	5	1
Italy	87	81	71	59	21
Switzerland	164	159	142	129	78
Total	666	609	500	404	202

the US), Australia and Japan (see Scott 2006a for an overview). The first systematic cross-country analysis for the Alps, for example, shows a rather pronounced decline in the number of naturally snow-reliable ski areas (see table 1): Under present climate conditions, 609 out of 666 (or 91%) Alpine ski areas can be considered as naturally snow-reliable. The remaining 9% are already operating under marginal conditions. With future climate change the number of naturally snow-reliable ski areas in the Alps could drop to 500 (75% of current Alpine ski areas) with a 1°C warming, to 404 (61%) with a 2°C warming and to 202 (30%) with a 4°C warming (Abegg et al. 2007).

While the precise numbers are a function of the assumption made, it is the overall trend as well as the spatial distribution that are noteworhty. The sensitivity of the ski areas to global warming differs markedly among and within the Alpine countries. On a national level, Germany (i.e. the Bavarian Alps) is the most sensitive of the countries considered whereas the Swiss ski areas can rely on the most favourable natural snow conditions. On a regional level (see figure 1), it must be noted that the most important destinations (from an economic point of view) are usually the least affected (e.g. Wallis/Valais in Switzerland, Savoie in France, and Tirol in Austria).

Most climate impact assessments depict a rather "dark picture" for the future of Alpine winter tourism: As sufficient amounts of snow and the inter-annual reliability of climatic conditions to provide good snow conditions are crucial in determining the economic success of ski resorts, global warming is expected to affect winter tourism seriously. While the low-lying ski areas are likely to disappear, ski tourism will concentrate on the more favourable locations.

Climate change is definitely a serious challenge for Alpine winter tourism. Vulnerability to climate change, however, is not only depending on the impacts of global warming on the snow pack but also on the tourism stakeholders' willingness and ability to adapt to changing circumstances.

Adaptation strategies: technological and behavioural

Tourism stakeholders and ski area operators are not sitting back idly waiting to face the consequences of climate change – they are adjusting right now (Elsasser & Bürki 2002). The range of adaptation practices found among ski area operators can be di-

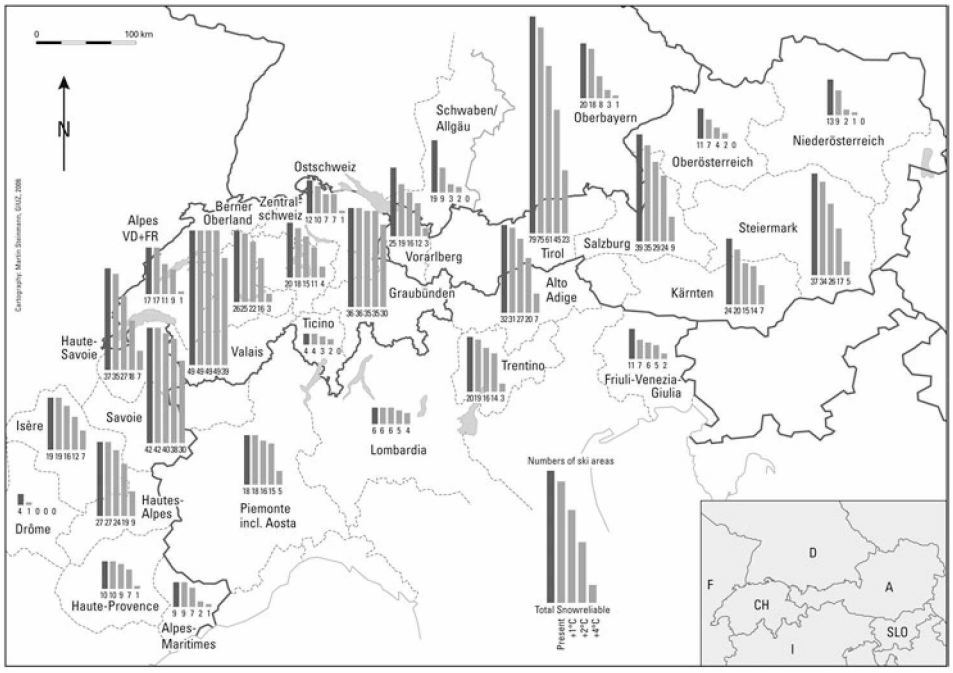

Figure 1: Number of naturally snow-reliable ski areas in the European Alps under present and future climate conditions (regional level).

vided into two main categories: technological and behavioural (Abegg et al. 2007). There are four main types of technological adaptations: landscaping and slope development, a move to higher altitudes and north facing slopes, glacier skiing and artificial snowmaking. And there is a variety of different types of behavioural adaptations, ranging from operational practices and financial tools to new business models and a move towards the diversification of activities. A detailed despriction of the various adaptation measures can be found in Abegg et al. 2007 (European Alps) and Scott 2006b (North America). In this paper, however, only two adaptation practices – artificial snowmaking and all-year tourism – will be highlighted.

Artificial snowmaking

Snowmaking is the most widespread adaptation strategy. It is used to extend the operating season and to increase the range of climate variability and change a ski area can cope with. In the early days, snowmaking used to be a luxury, then it became a back up strategy, and now it seems to be a necessity, a fully integrated part of present-day ski operation. According to Pröbstl (2006), the rapid expansion of snowmaking in the Alps has been triggered by the need to secure the revenues of the ski area operators, the success of the ski resorts providing a "snow guarantee" and the timely holding of international ski competitions as required by the Fédération Internationale de Ski (FIS).

Hundreds of millions of Euros have been invested in snowmaking equipment throughout the Alpine countries. In France, for instance, almost half a billion Euros were spent between 1990 and 2004. The area covered by snowmaking increased from 121 hectares in 1983/84 to 4003 hectares in 2003/2004. At the same time, the number of ski areas using snowmaking equipment increased from 25 to 187 (Abegg et al. 2007, 42).

Snowmaking is an important strategy to deal with present climate variability. It extends the duration of the ski season, providing large dividends to the ski area operators. Snowmaking as an adaptive tool to (partly) compensate for the decline in natural snow-reliability will become even more important in the future. Scott et al. (2006) examined how current snowmaking capacity affects the climate change vulnerability of ski areas in eastern North America. They found that the range of season losses projected for the 2050s were much lower than in earlier studies that did not account for snowmaking (for example: −4 to −32% instead of −42 to −87% in Quebec). These findings demonstrate the importance of incorporating snowmaking into climate change impact assessments. Unfortunately, such assessments are not (yet) available for the Alps.

However, there are both physical and economic limits to the extent to which snowmaking can offset the impact of climate change on natural snow-reliabiliity. From an economic perspective the cost of snowmaking will increase disproportionately under warmer temperatures, as not only would more quantities of snow be required, but it will have to be produced under higher ambient temperatures. The use and costs of snowmaking will also not be spread evenly throughout the season, as certain periods, such as the early season, will require more artificial snow production due to a likely decline in snow cover, and further investments in snowmaking technologies due to the warmer temperatures during those periods. And if ambient temperatures increase beyond a certain threshold, snowmaking will simply not be viable. In addition, there are considerable externalities in terms of water consumption, energy demand, landscape, and ecology (see Rixen et al. 2003, CIPRA 2004 and Pröbstl 2006).

Revival of Alpine summer tourism?

Many resorts heavily rely on winter tourism. This business model can be very perilous because of the present climate variability (snow-deficient winters) and the potential impacts of projected climate change. In order to reduce the dependence on snow conditions, an enhanced engagement in year-round tourism is often recommended. This includes mainly summer tourism (including the shoulder season) but also climate and weather independent offers such as congress, educational and health tourism. The objectives of this strategy are to back up the business and to reduce the snow-reliance of the resorts.

An interesting initiative is occurring in the Département d'Isère in France. Ski areas in this part of the French Alps, especially the smaller ones with inadequate facilities, cannot compete with their larger counterparts. The same ski areas are also rather susceptible to climate change. In order to be prepared for the future, the Con-

seil Général (regional government) decided to financially support diversification in tourism through the elaboration of "contracts for a diversified development" (Contrats de Développement Diversifié). The financial means are used, for example, to improve the quality of already existing (summer) products, to develop new offers particularly for families, and to pay for the deconstruction of outdated ski facilities. However, part of the money still goes into ski tourism (CIPRA 2006, 128ff.).

Climate change will have negative impacts on Alpine summer tourism, too. Ongoing glacier retreat (Zemp et al. 2006) will severely affect the attractiveness of the mountain environment. The loss of "mountain aesthetic" will be accompanied by the disappearance of tourist attractions such as ice caves and, presumably, the remaining summer ski areas. In addition, climate change will increase the melting of permafrost and will make some mountain areas more vulnerable to landslides. Cableway stations, lift masts and other buildings on permafrost soil may become unstable (Haeberli 1992), and considerable amounts of money will be required to re-fit them. Hiking and climbing could be more dangerous because of increasing rock fall (Behm et al., 2006). And white water activities like river rafting may become less attractive due to lower water levels in Alpine rivers.

Yet Alpine summer tourism may also benefit from climate change. Tourism depends on "good" weather. In comparison to the stable conditions of competing destinations such as the Mediterranean, the Alpine summer weather is rather variable, leading to lower degrees of weather satisfaction by tourists. However, this perception may change in the future, with regional climate scenarios projecting warmer and drier summers in Europe (e.g. Jacob et al. 2007). The climatic attractiveness of destinations can be explored by applying the Tourism Climatic Index (TCI). Under climate change, summers on the Mediterranean may become too hot whereas northern Europe including the Alps will be offering a more pleasant climate (Amelung & Viner, 2006). Alpine summer tourism may indeed benefit from climate change: Not only because of "better" weather conditions and a prolonged summer season, but also because of more frequent heat waves in the lowland surrounding the Alps (cf. the very hot summer of 2003 when people fled to the mountains to temporarily seek relief from the heat) and a decreasing climatic attractiveness of destinations such as the Mediterranean.

It seems very likely that the negative impacts of climate change on Alpine summer tourism will be offset by the positive impacts. In addition, gains in summer tourims may also help to compensate, at least partially, for the potential losses in winter tourism. In a regional study, the financial implications of climate change on winter tourism in the Bernese Oberland (Switzerland) were estimated as of −150 Mio. Swiss Francs. However, summer tourism will turn in an extra +80 Mio. Swiss Francs, resulting in a net loss of −70 Mio. Swiss Francs per year (by 2030). This would be about 4% of today's turnover (Müller & Weber 2007).

Discussion

Climatic changes are already having a significant impact on winter tourism in the European Alps, and anticipated changes are expected to cause a further decline in the natural snow-reliability of Alpine ski areas. These impacts however are not uniform and will lead to "winners" and "losers", both in terms of regions (with pre-alpine regions being considerably more susceptible than inner-alpine regions), and in terms of the ski areas themselves (with areas with high altitudinal range being considerably less susceptible than low-lying ski areas).

The Alpine ski industry is a very heterogeneous industry. Small ski areas operate next to world famous resorts, family-owned businesses next to large enterprises etc. The various players differ in many respects, e.g. in size and economic performance. But they also differ in their susceptibility to (climate) change, and in their capability to cope with (climate) change.

The winter tourism industry has responded to the implications of observed changes, and a range of technological and behavioural measures have been put into practice to offset the adverse impacts. Such adaptation measures, however, cannot be isolated from other business decisions and are influenced by a wide range of other factors namely market demand, competition and environmental regulations. So far, most climate change adaptations are likely to be incremental adjustments of existing strategies to reduce the risks caused by present climate variability and/or one-sided business models.

Climate change has been recognised as a serious challenge for winter tourism. It is, however, not perceived as a substantial threat. Tourism stakeholders, particularly ski area operators, strongly believe in their ability to adapt to the potential impacts of climate change (Wolfsegger et al. 2007). Technological measures, mainly snowmaking, are clearly preferred. There is more emphasis on preserving the status quo, and less on exploring new grounds. Only little evidence can be found that ski areas/winter sport resorts are engaging in long-term business planning in anticipation of changes due to global warming.

For a number of reasons, climate change adaptation is expected to remain largely individualistic. The availability of adaptation options will vary according to geographic characteristics (e.g., available altitudinal range, local climate conditions and distance to major markets), business models (e.g., independent ski area operators versus ski conglomerates) and governmental jurisdiction (e.g., tourism policy, environmental regulations and water access rights).

Given the time horizon of projected climate change, (winter) tourism will not undergo a sudden, radical change. Climate change can be viewed as a catalyst that will reinforce structural changes in the (winter) tourism industry by highlighting the opportunities and risks inherent in already existing, and future, tourism development (Bürki et al. 2005). Ultimately, it is the adaptive capacity (not climate) that will determine the future of the resorts under climate change.

The future of Alpine tourism will be determined by many factors. Under the assumption of "everything else will remain the same", climate change will be of major importance. Of course, "everything will NOT remain the same", particularly in

the very dynamic tourism industry (Abegg et al. 1997), and variables such as "globalisation and economic fluctuations, fuel prices, demographic changes in existing and future demand markets, increased travel safety and health conernss, increased cultural awareness, advances in information and transportation technology, regional and local environmental limitations (…) will affect the tourism sector over the next 50 years in unknown ways" (Scott 2006a, 70).

This article focuses on adaptation. However, as an industry that is not only susceptible to climate change, but also contributes to the emission of greenhouse gases, Alpine (winter) tourism should engage in climate change mitigation too. There are many initiatives going on. With regard to tourism, a main focus is on promoting sustainable tourism and environmentally friendly mobility. Driven by governmental bodies, in association with NGOs and municipalities (also ski resorts), the tourism industry is involved, but hardly a driving force. A stronger commitment of the industry to reduce greenhouse gas emissions and to participate in mitigation initiatives would be desirable.

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