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Stakeholder responses to Climate Change in the Swiss Alps.

By

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A report submitted in partial fulfilment of the requirements for the MSc in Environmental Technology.
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DECLARATION OF OWN WORK

I declare that this thesis

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is entirely my own work and that where any material could be construed as the work of others, it is fully cited and referenced, and/or with appropriate acknowledgement given.

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ABSTRACT

The Alps will experience some of the most pronounced effects of climate change due to a combination of their latitudinal positioning, altitude and unique eco-systems, placing socio-economic stresses on alpine communities, particularly those that rely on seasonal tourism. How stakeholders need to respond to climate change within the Alps has been well documented in the academic literature (Abegg, pers com, 2007), with studies focussing on measures to minimise damage on winter ski tourism and from increased natural hazards. During the winter of 2006/2007 there was increasing academic and media attention on the ability of mountain areas to maintain successful winter tourism. Studies into tourism adaptation within the Swiss Alps have so far focussed on the adaptation options and needs of different stakeholders. These concepts of adaptation measures were tested on stakeholders from the private and public sector within two case study areas within the Swiss Alps, both part of the communes of the UNESCO World Heritage Site, Jungfrau Aletsch Bietschorn. The qualitative methodology aimed to better ascertain the barriers to adaptation that local communities faced. Within Switzerland there is a well-established decentralised framework for decision-making and planning, which this study takes into account in its analysis of the measures in place within different stakeholder groups. A series of semi-structured interviews took place to assess the response of stakeholders from the private and public sectors across the local, regional and national level to the increasing risks of climate change on their economic livelihoods. Adaptation strategies were found to be evenly segmented across the different sectors and levels, but also focused almost entirely on maintaining the status quo of winter tourism, through technical or marketing measures, while increasing the market share of summer tourism for the destination. In general, apathy towards alternative adaptive measures, as well as frustration with tourists' expectation and understanding of the natural alpine environment was found to be most prevalent at the local level. The final section looks at how these issues can be addressed within the local, national and international context, within and outside of the tourism sector. It concludes that the socio-economic consequences will only be minimised if stakeholders take action to significantly diversify the alpine economy outside the realms of winter tourism, increase the understanding of nature and the climate change issue within the alpine region, and improve the dissemination of information across the research, administrative, local and tourist communities.

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GLOSSARY

ART- Forschungsanstalt Agroscope Reckenholz-Tänikon

AUE - Amt für Umweltkoordination und Energie

BAFU - Federal Office for the Environment (Bundesamt für Umwelt)

BECO – Bernese Economic Office **(**Berner Wirtschaft)

CDE = Centre for Development and Environment, University of Bern

CIPRA –International Commission for the Protection of the Alps **(**Commission Internationale pour la Protection des Alpes)

ETH - Swiss Federal Institute of Technology, Zürich

FIF, Bern University – Research Institute for Free time and Tourism **(**Forschungsinstitut für Freizeit und Tourismus)

MRI – Mountain Research Initiative

MRD – Mountain Research and Development

NCCR North South – Swiss National Centre of Competence, North-South

NCCR Climate - Swiss National Centre of Competence, Climate

SECO - State Secretariat for Economic Affairs (Staatssekretariat für Wirtschaft)

SBS – Swiss Cable Car Association (Seilbahn Schweiz)

SAC – Swiss Alpine Club **(**Schweizer Alpen-Club)

SBV – Swiss Mountain Guide Association **(**Schweizer Bergführer Verband)

SLF - Swiss Federal Institute for Snow and Avalanche Research, Davos (Eidgenössischen Institut für Schnee- und Lawinenforschung)

Seilbahn – Cable Car Company. Bahn in parentheses as featured in Section 4 and 5 refers to those stakeholders from this sector.

UNWTO – United Nations World Tourism Organisation

UNESCO WHS – UNESCO World Heritage Site

WSL - Swiss Federal Institute for Forest, Snow and Landscape Research (Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft)

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1: INTRODUCTION

Mountain ecosystems are some of the most fragile, yet most valuable to the planet. Almost a quarter of the world's forests are housed in mountain areas, being home to a richness of bio and cultural diversity (Mountain Forum, 2006). Yet their natural resources, community livelihoods undergo persistent threats from marginalisation, environmental damage, unsustainable tourism and development and increasingly, climate change. Although their role as watersheds is probably the most significant one (Wohl, 2006), since almost half the world's population rely on this watershed resource, either for hydroelectricity, drinking supplies or other water resources (Thapa, 2001), mountains also provide a refuge for unique species and traditional cultures.

Despite the political, environmental and economic value of mountain resources, mountain development is often awarded low priority at the national policy level (Thapa, 2001). 2002 was designated as the International Year of Mountains, and a framework was established to address the impacts of environmental change. The programme has been centred around four work streams; Water, snow and ice; Vegetation, forests and biodiversity; Health, and economic and social factors; and Tourism, the sector that this study is concerned with.

In addition to the established socio-economic, political and environmental difficulties climate change is adding further pressure on stressed communities and landscapes. The socio-economic consequences of climate change on Alpine areas have been summarised by Bürki et al (2003) as:

- Significant impacts on the mountain tourism sector, in particular ski tourism, threatening the loss of livelihoods
- Direct impacts on mountain agriculture
- Indirect impacts on mountain agriculture due to the consequences of reduced tourism has on the viability of today's low impact alpine agriculture
- Impacts on mountain hydropower from snow and glacial loss
- Infrastructure damage from melting permafrost (i.e. instable mountain cableway stations, train tracks, lift masts)

- Further negative impacts from expensive adaptation strategies (e.g. artificial snowmaking, flattened slopes and increased pressure on sensitive higher altitude mountain regions.

This study is focussed on the issues that face alpine tourism, in respect to the challenges that the changing environment poses due to climate change. The main rationale is to evaluate the adaptive responses of private and public sector stakeholders at different levels (local, regional, national and federal) to the impacts of climate change on tourism in two case study areas in the Swiss Alps (see Table 1 for further description of these different levels).

There is currently a significant amount of literature concerning the impacts climate change will have on alpine areas, and the consequences these will have on tourism (Abegg, pers com, 2007) and a growing body of work that details or proposes potential adaptation recommendations. The OECD (2007) report clarified the snow scenarios for the European Alps from which the report then proposed a series of adaptation strategies to deal with the varying country and regional snow loss scenarios. The work by Abegg, in the OECD (2007) report provided significant detail for further, Swiss based studies such as OcCC (2007) and the Müller & Weber (2007) report for the Institute of Free time and Tourism, Bern (FIF), which focussed, respectively, on how stakeholders within Switzerland and the Bernese Oberland need to respond to climate change in order to reduce the potential negative effects on tourism. These reports focus on measures to minimise damage on winter ski tourism and from increased natural hazards, but do look at both summer and winter tourism.

Bürki et al (2003) also produced quantitative results on the adaptive behaviour of tourists to reducing snow security in Switzerland. These reports form the basis of the academic concepts of alpine tourism adaptation measures. The measures generally concentrate on technical measures to maintain snow security and reduce potential danger from natural hazards (Müller & Weber, 2007) as well as diversifying alpine tourism offers. They can be further broken down into technical, innovation & diversification, increased research, communication & marketing and financial measures (Ref Table A2). Additionally, during the winter of 2006/2007 there was increasing media attention on the ability of mountain areas to maintain successful winter tourism, in addition to the academic reports published in

recent years.

These academic concepts of adaptation formed the building blocks to this qualitative study, which seeks to better ascertain the barriers to the tourism sector adaptation for different stakeholders. The choice of qualitative methodology aimed to assess the response of local communities and stakeholders from the private and public sectors across the local, regional and national level to the increasing risks of climate change on their economic livelihoods.

Since few adaptation strategies have been implemented (Wallner, pers com), the aim of this study is to explore ideas for such strategies by stakeholder group, rather than to deconstruct existing adaptation plans and to establish the perceived barriers to their implementation.

The objectives of this study are to:

- Review the socio-economic impacts of climate change in the specific alpine areas
- Explore what policies and plans are in place or projected within the areas across the different sectors and levels
- Establish how the perceptions of climate change rank with different issues across the different sectors, levels and regions
- Establish what adaptation plans are proposed to cope with the projected impacts on tourism and infrastructure in both locations
- Establish how differently the private and public sector respond to these impacts
- Establish what the contingencies or alternatives are available
- Explore the different technical and behavioural measures so far implemented, and projected to be implemented
- Develop a matrix of responses and projected by sector and case study area

The qualitative methodology will allow the study to elicit qualitative judgements from the experts about their individual perception of the climate change issue for tourism, key climatic impacts on the tourism sector, and the range of potential adaptive behaviour to best reduce the negative impacts and maximise any potential benefit. It will also seek to determine stakeholder awareness of proposals for adaptation methods within current academic discourse, as well as establishing judgements about future adaptive behaviour,

possible alternatives and how adaptation strategies might be financed, as well as collating judgments on the priority of adaptation measures discussed in the literature.

2: BACKGROUND

2.1: The Study Site

Switzerland and its Political System

Within Switzerland there is a well-established decentralised framework for decision-making and planning. Understanding this political system is key to understanding the interactions between the different levels of stakeholders that have been interviewed for this study. A far greater share of power is devolved to the cantonal and communal level, rather than being maintained in the capital as it is in the UK. This is known as the 'principle of subsidiarity' and is vital to Switzerland's highly decentralised system, allowing each administrative task to be carried out at the lowest level possible (Hoppler, pers com, 2007).

The Confederation

At the level of the confederation, the political system is made up of the Federal Council, which has 7 members, with a different member becoming Federal President every year. This post confers no special powers or privileges, with the president remaining in charge of his/her own department and affairs. The four strongest parties are represented in the council. There are 7 federal departments, each headed by a federal councillor, the ones relevant for this study being the Federal Department of Environment, Transport, Energy and Communication (BAFU) and the Federal Department of Economic Affairs (seco) (Swissinfo, 2007).

Cantons

Switzerland is divided into 26 cantons. Each canton has its own constitution, government, parliament, courts and laws, though they must be compatible with those of the Confederation. The cantons enjoy a great deal of administrative autonomy and freedom of decision-making, with independent control over their education, justice, health and social services, and its own police force. Each canton also sets its own level of taxation. Similarly, environmental policies and issues are settled at the canton or communal level (Swissinfo, 2007). Within the UNESCO World Heritage Site, Jungfrau-Aletsch-Bietschorn area, there

are 2 cantons, that of Bern in the north and the Valais in the south (Hoppler, pers com). The Bernese Oberland has been long recognised as a highly developed tourist region. On the other hand, the upper part of the main valley of Canton Valais, where Bettmeralp is situated, had a later tourism and industrial boom, which superseded the remote traditional agriculture from the 1970s onwards (Hoppler, per com, 2007).

Communes

The cantons are divided into communes, of which there are about 2,900. All Swiss are first and foremost citizens of a commune and from there automatically derive citizenship of a canton and of the country as a whole. Just like the cantons, the communes have their own elected administrative authorities. For some local issues they take autonomous decisions; in other cases they carry out decisions of the canton or the confederation. The areas for which they are responsible include security, education, health, and transport affairs. In 90% of communes (mostly the smaller ones), the citizens gather at least once a year in an assembly where each individual votes on important subjects, but even in the biggest communes all members are balloted on items like the budget (Swissinfo, 2007).

Within the World Heritage Site, the communes (18 Valaisian and 8 Bernese) play a strong role in the effective creation, implementation and management of the WHS management. Additionally, the 5 designated mountain regions within the WHS of Goms, Brig-Aletsch and Visp/westlich Raron in the Valais; Oberland-Ost and Kandertal in Bern play an important role within the area (Hoppler, pers com, 2007).

In the Swiss Confederation, these democratic traditions have led to a high number of public administrative units and a complex decision making structure (Hoppler, pers com) as detailed in Table 1. Within this structure, at the communal level, there are various semi-public organisations, such as the local tourism office, which while they are not a governmental body, do sit more in the public administrative sphere than in the private sector. This office acts as an administrative body for the Tourism Association (Verein) at the communal level, whose members constitute representatives from local hotels, tourist shops and the cable car companies. The Association meets regularly to discuss tourism issues in the village and takes some responsibility for the direction of tourism development for the

resort.

Table 1: Administrative and commercial roles in the different stakeholder levels and sectors.

	Federal / National	***Canton***	***Destination***	***Local / Communal***
Public (admin)	Agriculture & Forestry Tourism Economics Nature Conservation Energy & Transport	Tourism Agriculture & Forestry Spatial Planning Nature Conservation Energy & Transport		Building Authorities <u>Semi-Public Organisations</u> Tourist Office (Vekehrs Buro) Tourism Association
Private (business)	Swiss National Tourism Organisation (My Switzerland)		Tourism Organisations & Conglomerations	Mountain Guides Ski schools Small Family Businesses (Hotels, Shops)

For this study, two case study areas, Mürren and Bettmeralp were chosen. They are both situated within the perimeter of the WHS Jungfrau-Aletsch-Bietschorn (JAB). For more detail of the area view Figure 1 below. Both villages have a similar profile, as detailed in Table 2, but are situated in different cantons. Canton Valais traditionally has more smaller sized communes than Bern, thus within the WHS JAB there are 18 Valaisian and 8 Bernese communes. The area has been an UNESCO site since December 2001 (UNESCO, 2007), making it the first alpine area on the WHS list. The area encompasses 824 km^2, including an extension approved in 2007, (Hoppler, pers com) of the most glaciated part of the Alps, (UNESCO, 2007).

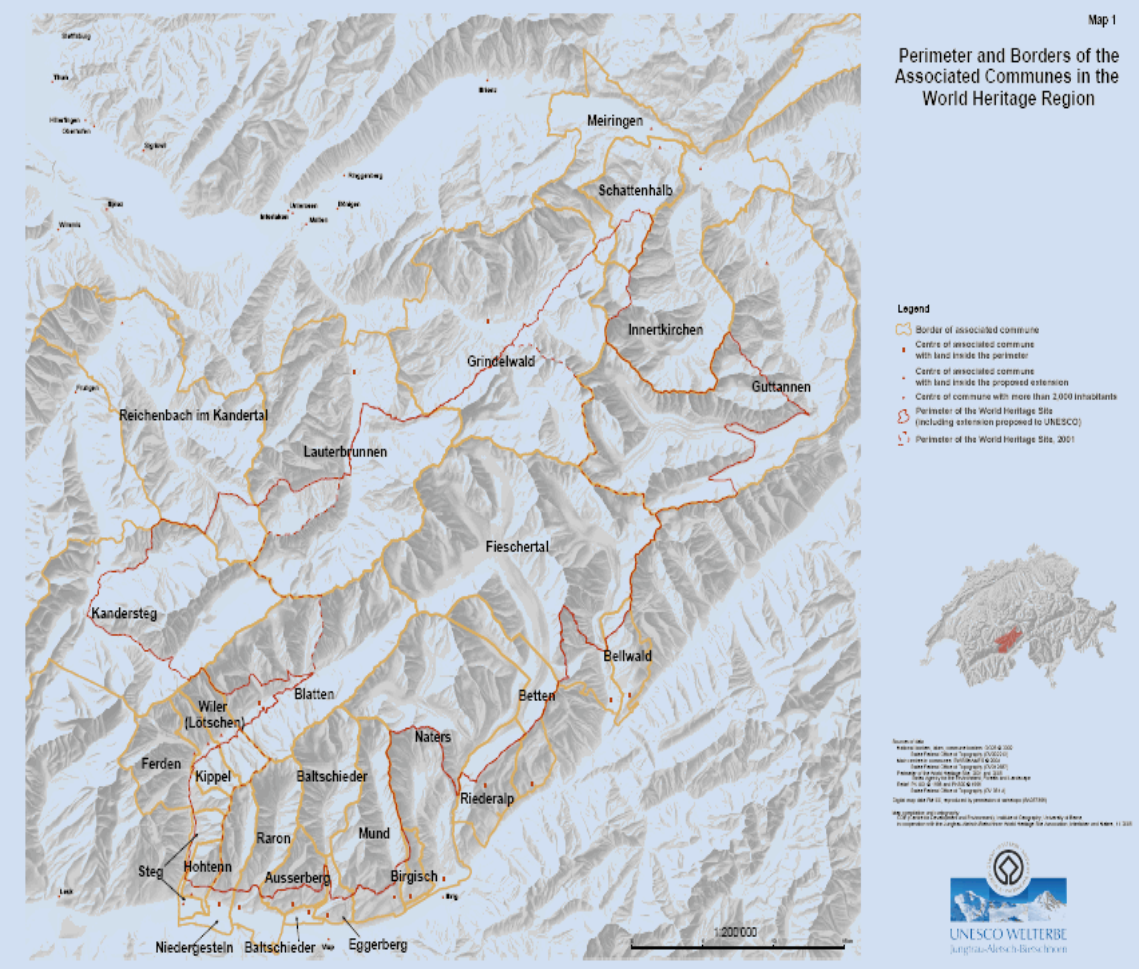

Figure 1: Map of the UNESCO JAB Perimeter.

The overall Jungfrau-Aletsch-Bietschhorn (JAB) region extends beyond the perimeter of the WHS to include the communes whose territories contain shares of the Alpine World Heritage Site. This overall WHS region covers 1629 km^2 and is home to 35,000 inhabitants (UNESCO, 2007). All the communes in the UNESCO area signed the Konkordiaplatz Charter, vowing to retain the aesthetic beauty of the JAB landscape for future generations and maintain a sustainable use of the countryside in the core zones of the UNESCO site.

Table 2: Differences between the 2 case study areas to show similarities and differences between the two local communities.

(Source: Mürren: http://www.wengen-muerren.ch/index.php?id=225&lang=en&L=1)
(Source: Bettmeralp: http://www.tiscover.ch/ch/guide/645ch,de,SCH1/objectId,RGN335ch,curr,CHF,season,at1,selectedEntry,home/home.html)

Case Study Area	***Mürren***		***Bettmeralp***	
Canton	Bern		Valais	
Commune	Wengen-Mürren-Lauterbrunnental		Betten - Bettmeralp	
Language	Swiss-German (Bern Deutsch)		Swiss-German (Valaiser Deutsch)	
Form and Size	Car Free Village accessed by either a Gondola and Train (BLM) or a Gondola from Stechelberg (LSMS)	Highest Altitude ski village in the Bernese Oberland	Car Free Village accessed by Gondola from Betten.	
Climate	North Alpine Climate		Inner Alpine Climate	
Altitude	1650 m		1950m	
Ski Piste Area	53km	213km (Jungfrau region)	30km	90km (Aletsch region)
	12km (Langlauf)			
Hiking Paths	200km		150km	
Inhabitants	350		520	
Hotels	14		9	
Apartments	250		440	
Beds Available	2000		4000	
Agriculture	Yes		Yes	
Infrastructure	1 Bank	1 Post	2 Banks	1 Post
	0 Pharmacy (closed in 2000)	1 Doctor	1 Pharmacy	1 Doctor
	1 Ski School	1 Sports Centre	2 Ski schools	2 Sports schools
	1 Bakery (only open in high winter season)	1 Butcher	1 Bakery	1Butcher
	3 Souvenir Shops	3 Sports Shops + clothing shops	2 Souvenir Shops	2 Sports Shops
	1 Supermarket		3 'Supermarkets'	
Industry	Tourism / Agriculture		Tourism/Agriculture	
Advertised Activities	Alpine Skiing	Handball	Alpine Skiing	Fishing
	Alpine Curling	Tennis	Asphalt/Alpine Curling	Badminton

	Volleyball	Hockey	Beach Volleyball	Hang-Gliding
	Ice Skating	Badminton	Ice Skating	Cycling
	Hiking	Squash	Workout	Paragliding
	Mountain Biking	Miniature Golf	Climbing	Miniature Golf
	Nordic Walking	Workout	Mountain Biking	Horseback Riding
	Tours and Mountain Huts	Swimming	Tobogganing	Rowing
			Snow-shoeing	Swimming
			Nordic Skiing	Tennis
			Table Tennis	Hiking
			Snowboarding	Billiard
			Running/Nordic Walking	

2.2: Threats to Mountain Environments

The highly sensitive and valuable environment of the world's mountains face threats from all sides; environmental, socio-cultural and economic. The threat of mountain resource degradation is one that affects nearly 50% of the world's population according to Michaelsen (2000), and will be felt by both highland and lowland inhabitants. There are a number of factors causing environmental stress within mountain regions, most of them exogenous (Beniston, 2005). Long distance trans-boundary air pollution is a major cause of environmental stress within mountain areas (Batterbee, 2007) such as acid rain and ozone from heavy industrial sites at the boundaries of the mountains, which are some of the major factors responsible for forest die back within the European Alps (Beniston, 2005). Climate change is another factor that has in recent years risen on the international agenda as a major threat to mountain resources and communities.

Most notably, increased mean temperatures have had a major impact on the thickness of the European Alpine glaciers, which have decreased roughly 5 times more than the average loss from 1980-2000 (Büchler et al, 2004). Further threats to mountain environments come from the negative impact of tourism such as trampling, littering and loss of vegetative cover (Cheng, 2005 & Heer, 2003). Mountain forests have a variety of highly significant environmental benefits for protection against natural hazards. However, deforestation has major impacts not only on environmental protection, but also on the socio-economic

standard of rural mountain communities, whose daily livelihoods are heavily reliant on forest resources (Gautam et al, 2004).

Mountain communities

Historically, mountain communities have been marginalised and poor. Their remoteness has been manifested in a disenfranchisement from urban politics and economies. Furthermore, mountain resources have tended to be overexploited to serve downstream, lowland interests, which have been the focal point for economic production. This has in turn led to mountain regions being some of the poorest areas of the world (Michaelsen, 2000).

However, within the context of Switzerland, there have been a number of programs in place in order to avoid such political and economic marginalisation most notably the political decentralisation (Wallner, pers com). However, in addition to this, there are different programmes at the federal and canton level which provide economic support to marginalised communities such as those in the mountain regions. SECO runs the 'RegioPlus' programme that provides financing for local economic development projects through a regional network (RegioPlus, 2007) while the Federal office for Agriculture heavily subsidise alpine farmers in order to maintain the cultural alpine agriculture that summer tourism so heavily relies upon (FOAG, 2007). Additionally, the Swiss Consortium for Mountain Regions (SAB) also funds projects in order to enhance mountain regions' sustainable development (SAB, 2007).

In terms of population distribution, the Alpine region is undergoing a process of urban growth and rural exodus. Additionally, rapid growth is to be observed in both the main urban centres and the low-altitude locations in the mountain valleys, while the small communities in the mountains proper are shrinking at a growing rate (Aerni et al, 2007). Population growth in the mountains is only to be found in a small number of communities where tourism is a main source of income for the local people (CIPRA, 2007), partly since ski resorts have contributed to maintaining mountain community livelihoods in the winter months when farming is no longer an option (Wohl, 2006).

Climate Change in the Alps

The most pronounced effects of global warming are projected to be over land, in the

northern hemisphere in the winter months (Bürki et al, 2003). The warming experienced since the early 1980s in the Alps has been roughly three times as strong as the global climate signal (Beniston et al, 2003). Häberli & Beniston (1998) note that during the 20th Century there has been an increase of minimum temperatures by 2^{o}C, a more modest increase in maximum temperatures and little trend in precipitation data and a general decrease of sunshine duration until about the mid-1980s with the most intense warming periods experienced in the 1990s.

This places alpine ecosystems, classified as biodiversity hotspots, as among the most affected regions (Table 3) from climate change (Bürki et al, 2003) as well as making mountains, their glaciers and lakes particularly valuable indicators of climate change (Batterbee, 2007). It also raises worrying warnings for all those who rely on alpine ecosystem services, from hydropower, to clean water to those that depend on winter tourist season in the Alps to sustain their livelihoods through both winter and summer (OECD, 2007).

Figure 2: Ice loss in the Alpine glaciers, prevalent already in the 19th century, has been increasing since the mid-20th century through anthropogenic global warming. A) The left hand side images shows the Lower Grindelwald Glacier in 1858 (photograph by Frederic Martens, 1809-1875; Alpine Club Library, London; Photograph Heinz J. Zumbühl) b) Image shows the Lower Grindelwald Glacier in 1974 (Photograph Heinz J. Zumbühl). The inset shows the locations and (zustand der Gletscherfront) the front of the glacier in 2006 (Photography: Samuel U. Nussbaumer) (Source: OcCC (2007) pg. 82).

Impacts in the Swiss Alps

In summary, for a double CO2 simulation, higher winter temperatures and a more marked increase in summer temperatures are noted. Temperatures are likely to increase more at higher altitudes, precipitation will also be higher and more intense winter, but much reduced in summer months (Häberli & Beniston, 1998). A more detailed overview of climate change consequences for the Alps features in Table 3. The Aletsche-Gletscher is the largest glacier mass in the Alps (Zumbühl & Holzhauser, 2007), with a volume of 81.7 km2 and length 23 km. It measures 900 metres in thickness at the famous Konkordiaplatz (2,749 MASL). A temperature rise of 3 degrees C by 2100, which is within the IPCC parameters, would lead to about an 80% reduction of the Aletsch glacier, which has already retreated 3.4 km since the end of the Little Ice Age, in the nineteenth century. About 1.4 km of this retreat has occurred over the past 56 years (UNESCO, 2007).

Figure 3: The Aletsch Glacier in the heart of the WHS. Source (http://www.swisseduc.ch/glaciers/earth_icy_planet/glaciers02-de.html?id=0)

Variability

The predicted future climatic changes, for both temperature and precipitation (Weingartner, 2007), will exhibit great regional variation, which is likely to have a strong and distinctive impact on the Alpine region (CLEAR, 2007). The climate of the Alpine region is characterized by Häberli & Beniston (2005) as having a high degree of complexity due to the

interactions between the mountains and the general circulation of the atmosphere, resulting features such as gravity wave breaking, blocking highs and föhn winds. The competing influence of these different climatological regimes also adds to the complexity (Beniston, 2005). Precipitation patterns vary according to altitude, sun exposure (which is greater in the Southern Alps), and dryness of climate (Weingartner, 2007). The Inner and Southern Alpine regions currently have a dryer climate than that of the Northern Alpine area. The Jungfrau and Mittaghorn are the wettest areas in the World Heritage Site with about 3,600 mm/a whereas the Ober Valais region and the Löchental area in their inner alpine position are known as the 'Trockeninsel' (Dry Island) (Weingartner, 2007).

Due to the climatic variability between the inner alpine areas and the northern alpine areas, the Berner Oberland region will be less affected than that of the Jura, eastern and central Switzerland but more so than the Valais and Graubünden (OcCC, 2007). Figure 4 below emphasizes the degree of variability that will be experienced within the different alpine regions in Switzerland alone.

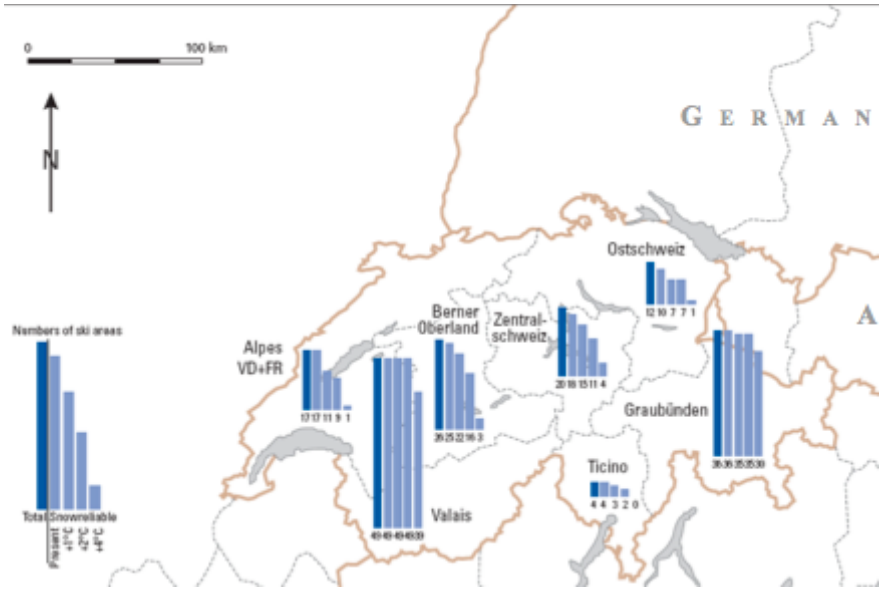

Figure 4: Number of naturally snow-reliable ski areas in the Swiss Alps under present and future climate conditions. Source: OECD (2007).

Table 3: Summary of the different biological and human consequences climate change (temperature and precipitation) in the Alpine area. Including some of the measures and strategies discussed at present to combat the effects. Each of these ecological effects has resulting consequences for the socio-economic systems that rely upon them either directly or indirectly. More information on measures to adapt to these consequences feature in Table 5.

Biological Consequences	***Socio-Economic Consequences***
Snow Cover & Security Snow cover is a key climatic factor in alpine ecosystems since it provides frost protection for plants in winter and water supply in summer (Beniston et al, 2003). For every degree centigrade increase in temperature, the snow line is predicted to rise by 150 metres (Beniston, 2005). Declines in snow cover have been most prominent at lower elevations in the Swiss Alps (IPCC, 2007). Where snow cover or snowpack has decreased, temperature has often dominated, whereas where snow cover or pack has increased, precipitation has almost always dominated (IPCC, 2007).	Significant impacts on the mountain tourism sector, in particular ski tourism, threatening the loss of livelihoods. **Cable Car/Railways** Infrastructure damage from melting permafrost (i.e. instable mountain cableway stations, train tracks, lift masts). Increased Cost Decreased Revenues Further negative impacts from expensive adaptation strategies (e.g. artificial snowmaking, flattened slopes and increased pressure on sensitive higher altitude mountain regions. **Private Businesses** Livelihoods from hotels and shops affected. **Mountain Guides & Outdoor Activity Workers** In the summer heat wave of 2003, a number of the Eiger trails needed to be closed. **Tourism Organisations** **Mountain Agriculture** Direct impacts on mountain agriculture Indirect impacts on mountain agriculture due to the consequences of reduced tourism has on the viability of today's low impact alpine agriculture **Water Supply** Impacts on mountain hydropower from snow and glacial loss
Permafrost Perennially frozen mountain areas, along with glacierized areas, will be among the most heavily affected parts of the world as the climate warms (Häberli & Beniston, 1998). 4-6% of Switzerland's surface area is permafrost (Müller & Weber, 2007), existing primarily in four mountain regions; the Engadin, Valais, Berner Oberland and Tödi Area. Permafrost degradation within the rock walls of mountains, is likely to have long term impacts on frost weathering and rock fall activity by reducing the strength of these structures, and increasing the permeability at depths of up to tens of meters (Häberli & Beniston, 1998), leading to an increase in natural hazard events such as rock falls and landslides. 2003 heat wave showed the effect of higher temperatures on the permafrost (Müller, 2007). Borehole observations indicate that permafrost temperatures are now rising at a relatively high rate (Häberli & Beniston, 1998).	
Glaciers Glacial Retreat (OECD, 2007). Glacier melting in the Alps will affect important European rivers such as the Rhine, Danube and the Rhone, posing a major long-term threat to Europe's fresh water supply (UNESCO, 2007). Short term, the discharge from glacial melt is likely to increase, with the potential effect of increasingly natural hazards such as flooding (UNESCO, 2007). While glacial melt water runoff represents a small contribution to the annual water supply, it can have a strong influence on stream flow during the warm dry season (Häberli & Beniston, 1998).	
Hydrology There have been a number of projects within the watershed area of the Aletsche-Gletscher, such as 'Verband für Wasserwirtschaft und	

Entwicklungsplanung im Aletschegebiet'. Their findings show that without long term significant water saving, local regional demand cannot be met (Weingartner, 2007). Furthermore, it has been shown that while there is no great cause for concern regarding water supply on the north side of the World Heritage Site, it is a very different scenario for the inner alpine area (Weingartner, 2007).	
Landscape Taxonomic Shifts (OECD, 2007). Glacial retreat and melting permafrost leads to corresponding changes in the alpine landscape and scenery, that will in fact be some of the most visible effect of climate warming (Häberli & Beniston, 1998), especially since thin mountain soil has an extremely slow regeneration rate (Körner, 2007). Technical adaptations to the effects of climate change are also likely to leave their mark on the landscape (Müller & Weber, 2007), detracting from the natural scenic beauty.	
Vegetation Species loss (OECD, 2007). Montane and alpine vegetation is vital in its protective role against slope erosion and as a component of mountain hydrology and water quality (Beniston et al, 2003). Its protective role is particularly vital, since at higher altitude soils tend to be very thin, not protected by a great deal of vegetation and easily eroded (Batterbee, 2007) and vital to slop stabilisation (Körner, 2007). Winter cooling is vital for forest regeneration and the robustness of trees (Beniston et al, 2003). In recent years the winter mortality rate of deer has been falling, meaning that more young shrubs are being grazed, affecting the ability of forest regeneration (Ghazoul, pers com, 2007). In Switzerland, 2-5% currently forested areas would undergo a steppe-like transition, particularly on the south facing sides and on dryer inner-alpine valleys (Beniston et al, 2003).	
Natural Hazards Natural Disasters have always been a threat in the Swiss Alps (Elsasser, 2004) but the recent avalanche winter of 1999 (Nöthiger, 2003) was the worst since 1955 (Kienholz et al, 2007). Deglaciated morainic deposits left unprotected against erosion for significant time periods lead to possible side effects of increased sediment load in the water systems and increased debris flows of varying magnitude on slopes steeper than 25-30^{o} (Häberli & Beniston, 1998).	
Heat Waves **Forest fires: with a reduction in summer precipitation, summer drought could mean a sustained fire hazard may lead to forest dieback because of the weakening response to external stress factors (Beniston et al, 2003).**	

2.3: Alpine Tourism

The ecological and environmental consequences of climate change on the Alpine region have so far been detailed in Table 3 above, which in turn will result in a number of impacts on the social, cultural and economic spheres of the Alpine region. Tourism is one of the most important sectors of the Swiss economy as well as one of the more important employers. In 2004, approximately 3% of GDP derived from tourism, making it the third most important source of revenue, after the metal and machine industry and the chemical industry. Almost one twelfth of Switzerland's workforce is employed directly or indirectly in tourism, a proportion, which is much higher in mountain regions (Price et al. 1999).

Mountain tourism survives on the basis of unique natural scenery, well-tended cultural landscapes and opportunities for specific sports as well as clean air and recuperation (Messerli, 1999). Tourism has brought many benefits and opportunities to the Swiss mountain communities, yet with development have come many challenges (Price et al, 1999). In contrast to the generally small contribution of mountain regions to national economies, the value of mountains to tourism is significant. Notably, the Alps alone account for an estimated 7-10% of annual global tourism takeover (Price et al, 1999). Economic benefits must also be weighed against the biophysical impacts of tourism in the Alps, as shown in Table 4 below. Paths and ski pistes alter sensitive alpine areas, while tourists along walking trails or biking paths often disturb fauna and flora. Elsasser and Messerli (2001) estimated that in Switzerland 8% of the slopes were helped by snow canons (Elsasser & Messerli, 2001), however this was in 2001 – and since then the number is likely to have increased. The snow canons require low temperatures, energy and a significant amount of water. Per snow canon, 20 – 75 l/s of water is needed, creating a conflict with the need to save water in the winter months.

Table 4: Impacts of Tourism on Mountain Environments: Summary of the positive and negative social or environmental impacts on mountain communities and environments (Messerli, 1999)		
	Benefits	***Negative Impacts***
Social	Improved access Improved communication & infrastructure Improved levels of education Reduced out migration to urban areas Potential corrective to the trend of widening global economic disparities	Loss of social and economic integrity Increasing local prices Out-migration due to
Environmental	Economic alternative to resource use	Degradation of environmental resources Biodiversity impacts Destruction of the aesthetics of the landscape Destruction of unique environments Forced expansion of tourism infrastructure led to decline of agriculture and forestry

Socio-culturally, tourists may also disrupt communities and traditions, while attracting service providers and seasonal staff from outside the region leading often to economic benefits being transferred outside the actual alpine region (Siegrist, 1999), while negative environmental and cultural impacts are relayed onto the local community and environment.

Although, summer tourism is not as impacting as winter tourism, current trends into mass tourism are moving further away from being environmentally friendly (Price et al, 1999), with an accelerated growth of resource-consuming forms of tourism, such as heli-skiing and longer distance, shorter duration travel. Yet, mountain sports and tourism are increasingly being recognised by mountaineering and ecotourism organisations, many of which have established codes of best practice (Siegrist, 1999).

2.4: Threats and Adaptation in Tourism

In Switzerland, about 100,000 jobs rely on tourism (UNESCO, 2007), many of which face an uncertain future in terms of climate change (Häberli & Beniston, 1998). Additionally, international competition is fierce and the media like to proclaim the death of skiing each time a new study on rising temperatures is published, doing untold damage to the industry's image (Regli, 2007). In recent years a number of winter sports resorts have been facing

financial difficulties even during favourable winters. Many are now reorganizing their sports and cultural infrastructures in order to attract tourists whatever the climatic conditions (Häberli & Beniston, 1998).

For the last few decades, the economy of mountain areas in the Swiss Alps has been mostly dependant on tourism, particularly during winter as snow sports have become the major source of income (Beniston, 2007). The Alpine Convention has recognised the critical importance of implementing effective and viable adaptation measures by inviting member countries (Austria, France, Germany, Italy, Switzerland, Liechtenstein and the EU) to promptly develop adaptation strategies for the most affected sectors (OECD, 2007).

Snow reliability plays the key role in the financial success rate of a season and is becoming increasingly important to ski tourists' choice of destination (Behringer et al, 2000). In the context of climate change, there have thus been a number of projects to evaluate the potential change of snow amount (OECD, 2007). Much of the work on tourism impacts adaptation possibilities has been based on the projected rise of the snow line by 150 metres with every degree of warming.

The country's cable car and ski lift operators, which are the main economic force in many mountain regions, will be and have been particularly affected by climate change. There are about 650 cable car companies in Switzerland, with 2,500 cable cars and ski lifts in operation, 11,000 employees and an industry turnover of CHF 840 million (Schweizer Seilbahnen, 2007). The most vulnerable ski resorts in the lower regions of the Alps have already had to deal with a significant decrease of younger guests, day tourists and novice skiers. The study of Behringer et al (2000) also showed that while tourism managers perceived climate change as a problem, they gave it a low priority. Yet, the future of winter tourism was never discussed without a mention of climate change.

Additionally, interviewees perceived media coverage and political and scientific reports on the topic as negative press, affecting demand for winter sports and reducing the ability of the sector to find adequate financial support because of low credit ratings and fewer subsidies. Measures will also need to be implemented to ensure the structural stability and durability of

installations for tourism, transportation and telecommunication in permafrost areas affected by climate warming (Häberli & Beniston, 1998). The Müller & Weber (2007) showed how widely differing adaptation strategies were and touches on the role of resorts in the wider mitigation context, but the general focus remains on adaptation possibilities.

The impacts of climate change on alpine tourism in Switzerland are well documented. The phenomenal growth in the Swiss alpine tourist industry between the end of WW2 and early 90s, led to a series of 'negative social, environmental and ecological impacts' (Wiessman, 1999). The OECD (2007) report gives a comprehensive summary of the options available to alpine resorts to adapt tourism to the changing climate, detailing how the public sector is focusing on natural hazard management while the private sector focuses on adapting winter tourism to reduced snow reliability (OECD, 2007).

Research is currently moving towards trying to better understand the market response and potential effect on summer tourism in particular (Abegg, per com, 2007). An overview of the current adaptation measures being discussed, and in some cases implemented, is detailed in Table A2 in the Annex. Measures tend to fall into 4 categories (OcCC, 2007); Promote Innovation and Diversification; Strengthen Hazard Prevention through technical measures; Intensify research and close off knowledge gaps; Diversify Risk factors through organizational measures.

In some areas, measures have already been documented such as the Arosa Climate Neutral Holiday Offers, Alpine Wellness offers in Adelboden and the Bernese Oberland, and clean energy measures in St. Moritz and Davos in Graubünden (Müller & Weber, 2007).

2.5: Factors in the Adaptation Processes:

Adaptation processes within mountain regions can be controlled and influenced by external or internal factors (ref Figure 5). Outside influences create tension and conflicts within the Alpine region, causing the affected actors to either resist, resign themselves or adapt depending on their 'socio-cultural predisposition (property relations, degree of social

integration, and regional identification)' (Brugger et al, 1984). While in the last 50 years, the alpine areas have enjoyed rates of economic growth with the rise of winter tourism, such adaptation processes have continued on. Socio-cultural change has followed economic change as villages have developed to attract and accommodate more and more winter ski tourists from outside of the valley area and the country.

In the eighties, when Brugger et al (1984) were writing their 'Transformation of Swiss Mountain Regions', the main worry was the out migration of local actors from upland areas to urban centres, due to economic migration. This worry was also addressed in the seventies by the UNESCO Man and Biosphere programme, with one of it's focal points being to 'enhance social, economic and cultural conditions for environmental sustainability' (UNESCO, 2007). Equally, in 1974, the Swiss Confederation initiated broad activities to invest and assist the mountain regions. The designated mountain regions of the Swiss Alps could each apply for state subsidies based on 'regional development concepts', which they in turn had had to prepare (Hoppler, pers comm., 2007). To date, these regional concepts play an important role in the economic and social investment into the WHS region.

While tourism has replaced agriculture as the main livelihood within the alpine space (Wiesmann, 1999), Mühlinghaus and Wälty (2001) cite the stagnation of the Swiss tourism industry, in addition to the reorganization of Swiss agricultural and regional policies as reasons for establishing new concepts in regional development. The tourism invasion, which accompanied the decline of other economic fields, was a major factor (along with increased mobility and other communication networks) within the socio-cultural sphere in initiating the adaptive processes (Brugger et al, 1984).

Studies of development and change in areas such as Urnäsch and Schamserberg in 2001 have both shown that often it is a 'returnee' to the area that is the catalyst and idea bringer as well as the leader of change (Mühlinghaus & Wälty, 2001). They bring the combination of being familiar with the area but also having gained new experiences and insights.

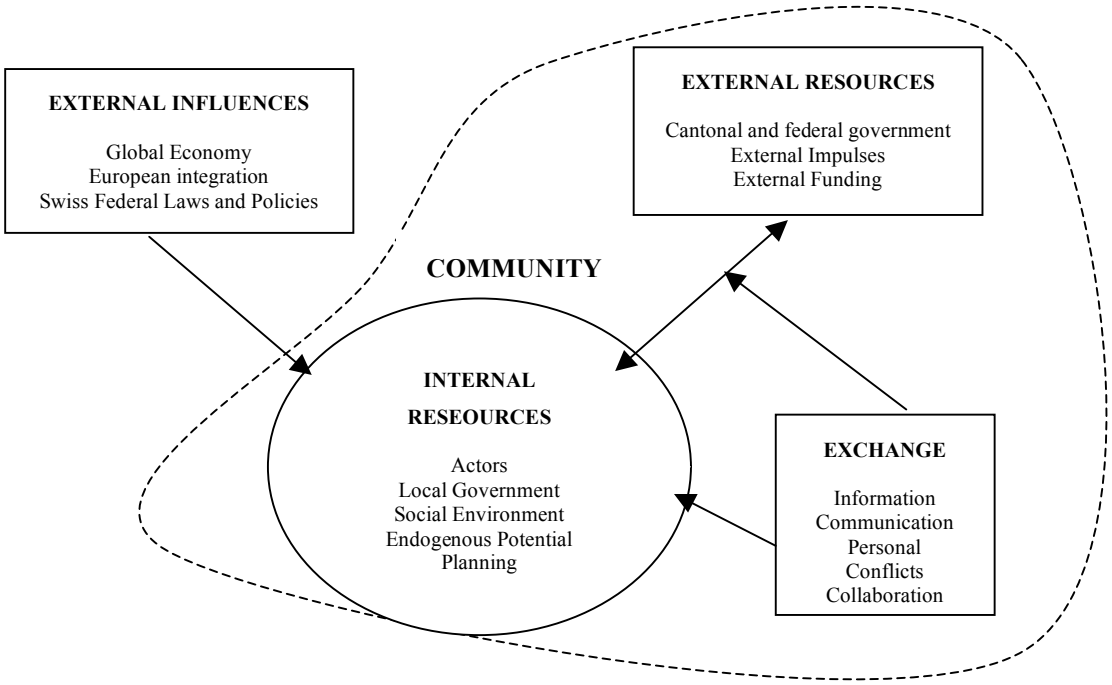

Figure 5: The 4 groups of factors that influence local initiatives and the interplay amongst them. (Source, Mühlinghaus & Wälty (2001), (pg 240). External and Internal influences can be seen to be further broken down in Figure A1.

3: METHODS

Case Study Areas

Two case study locations were chosen within the area of the UNESCO World Heritage Site, Jungfrau-Aletsch-Bietschorn. The locations of Mürren (Canton Bern) and Bettmeralp (Canton Valais) were selected to represent each of the two cantons in UNESCO area, as well as embodying one area from the northern alpine side, and one from the inner Alpine area. Both areas are of a similar population, altitude and notoriety, yet are differentiated by their situation on opposite sites of the World Heritage Site in different cantons (Table 2). Additionally, the Berner Oberland has long been well known for its strong summer tourism (Müller & Weber, 2007), while Canton Valais has some of the most famous and secure ski areas in the world. Both communes are in the perimeters of the WHS JAB.

Switzerland's federalist political system means that mountain communities in the Swiss Alps do have the 'authority to solve problems (Brugger et al, 1984), unlike in other less decentralised regimes. This makes the Swiss Alps an interesting case study, for how more autonomous and empowered mountain communities are expecting to react to the increased pressures of climate change. The different administrative focuses of the governance levels in Switzerland (Table 1) make for an interesting analysis of how adaptive strategies may interrelate locally and at the different scales. Stakeholders for interview were therefore sourced, as far as possible, from the 4 different levels as detailed in Table 1 and from both the public administrative as well as private business sector. Additionally, since the European Alps are recognised as having a high adaptive capacity they make a useful case study area for finding examples of adaptation or 'constraints and limits to adaptation' (OECD, 2007).

Procedure Choice

Much of the literature on climate change consequences in the Alps, have used quantitative methods making use of snow security and glacial retreat measurements from Häberli and Beniston as a basis to gage adaptive needs (OECD, 2007), snow security influence on ski tourists' choices (Bürki & Elsasser, 2000), or secondary impacts of natural hazards on tourism (Nöthinger, 2003). Behringer et al (2000) also used a standardized survey technique

in a participatory integrated methodology to assess adaptation to climate change in Alpine tourism and mountain agriculture. For this study, a qualitative approach was chosen in order to elicit value judgements on climate change impacts so far experienced, future climate change impacts, key concepts of adaptation proposed in current literature and ideas for adaptation strategies within the two different areas.

Interviews

Semi-structured qualitative interviews (Creswell, 2003) were conducted, since this interview technique is based on the principle of 'greatest possible openness and flexibility' (Hünziker, 1995), where any information about the subject is desirable. Any new insights about the study were then allowed to influence how the ongoing study was structured, and if any further interviews were necessary. The interviewer, as the dominant partner, led stakeholders through a structured set of questions, allowing them the scope to talk more about their own areas of expert knowledge, rather than having to stick rigidly to a formulaic questionnaire, resulting in more detailed information. The added flexibility in the interview structure increased the complexity of the data analysis, but due to the varying yet interconnected profiles of the interviewees was the most valuable (Creswell, 2003).

Table 5: Overview of Interviewees at the different levels and sectors

	Federal / National	***Canton***	***Destination***	***Local***
Public	Federal Office for the Environment, Division on Climate, Economics, Environmental Observation (BAFU) (Abteilung ökonomie, Sektion Klima)	Canton Bern Office for Economic Development, Tourism Leader (beco) Office for Environmental Protection (Umweltschutz) Office for Economic Development		President of the commune council (Gemeinderats-Präsident) Local Tourism Director Tourism Association Members
Private	Swiss Mountain Guide Association Swiss Cable Car Association		Jungfrau Destination Wengen-Mürren-Lauterbrunnental Tourism ProNatura, Villa Kassel, Aletsch Area	Mountain Cable Car Companies (Schilthornbahn, Bettmeralpbahn, Fiesch-Eggishornbahn) • Hotel Owners, Hotel Association • Sports Shop Owners • Ski School Directors

29 stakeholders (5 Females) from the private and public sector were interviewed in the two different geographic areas and at the different stakeholder levels (Table 5). It was taken into account that in the alpine regions, stakeholders often belong to more than one sector and do not tend to have a uniform profile. Due to the time constraint of the project, interviewees in each case study area was chosen to be sufficient to show a snap shot of different sectoral adaptation responses and provide a more detailed insight into the barriers that exist to adaptation for the different stakeholders.

Each set of judgements were viewed as a single considered opinion and therefore were not analysed as an average result for that stakeholder group, but seen as a snap shot from it. No attempt was made therefore, to select individuals that were statistically representative of each stakeholder group, but to speak with experts and decision makers that could provide an insight into the potential plans of each group. The qualitative approach did not aim to obtain a universally representative sample, but rather a theoretical sample of stakeholders from varying sectors and with widely differing opinions (Wallner et al, 2007).

A protocol was produced for the interviews in the form of a short document. This document detailed the aims and objectives of the interviews, the questions that were asked, and the questionnaire of the adaptation measures so far proposed in studies on adaptation measures to climate change in the Alps.

Questionnaire & Rankings

At the end of each interview, a questionnaire was completed in order to assess the priority rankings that different stakeholders placed in the adaptation measures currently discussed in the academic literature (Table A2). Stakeholders were asked to rate the adaptation measures with a priority score of 5-1 (5-High - 1-Low).

Interview outcomes

To record value judgements on:

- Aspects of climate change for tourism
- Impacts of climate change
- Range of potential adaptive behaviour

- Future adaptation needs
- Key concepts of adaptation proposed in current literature
- Sources of financing of adaptation
- Involvement of tourism in the mitigation of climate change

Data Recording

27 out of 29 interviewees took place in Swiss-German. The interviews were all recorded, and then transcribed and translated into English, in order to avoid any mis-recording of information or language complications. Additionally, notes were taken during the interviews. Audio recording and transcription was particularly important, since the interviews were conducted in Swiss-German. Recording ensured that no data was lost through a language misunderstanding. Additionally, demographic information for each interviewee was recorded, as well as the number of different stakeholder groups that he/she may belong to. In the alpine regions, stakeholders often belong to more than one sector and do not have a uniform profile.

Difficulties and Issues:

In general, stakeholders from all desired areas were interviewed, except within the State Secretariat for Economic Affairs (seco), Aletsch Tourism Destination, Ski School Mürren and the Mountain Guides at the local level. Data are therefore missing from some stakeholder groups, but the sample size of 29 expert interviews and 10 academic interviews was sufficient to convey a snap shot of stakeholder behaviour and opinion within this topic.

A number of stakeholder from all levels commented on the difficulty of answering questions about their perceptions and expectations of what changes would take place in the short and long term, with regards to climate change. At the national level, one respondent commented that 'while he couldn't comment on the scenarios, he did have to work with them as part of his job'.

4: RESULTS

4.1: Stakeholder Groups/Levels

Figure 6, below, shows the trend in stakeholder focus across the different levels and sectors, as is in keeping from the findings of the OECD (2007) report. The following section gives a more detailed overview of who is doing what for the stakeholders interviewed. Refer to Table A9, for more detail on the raw data for this break down.

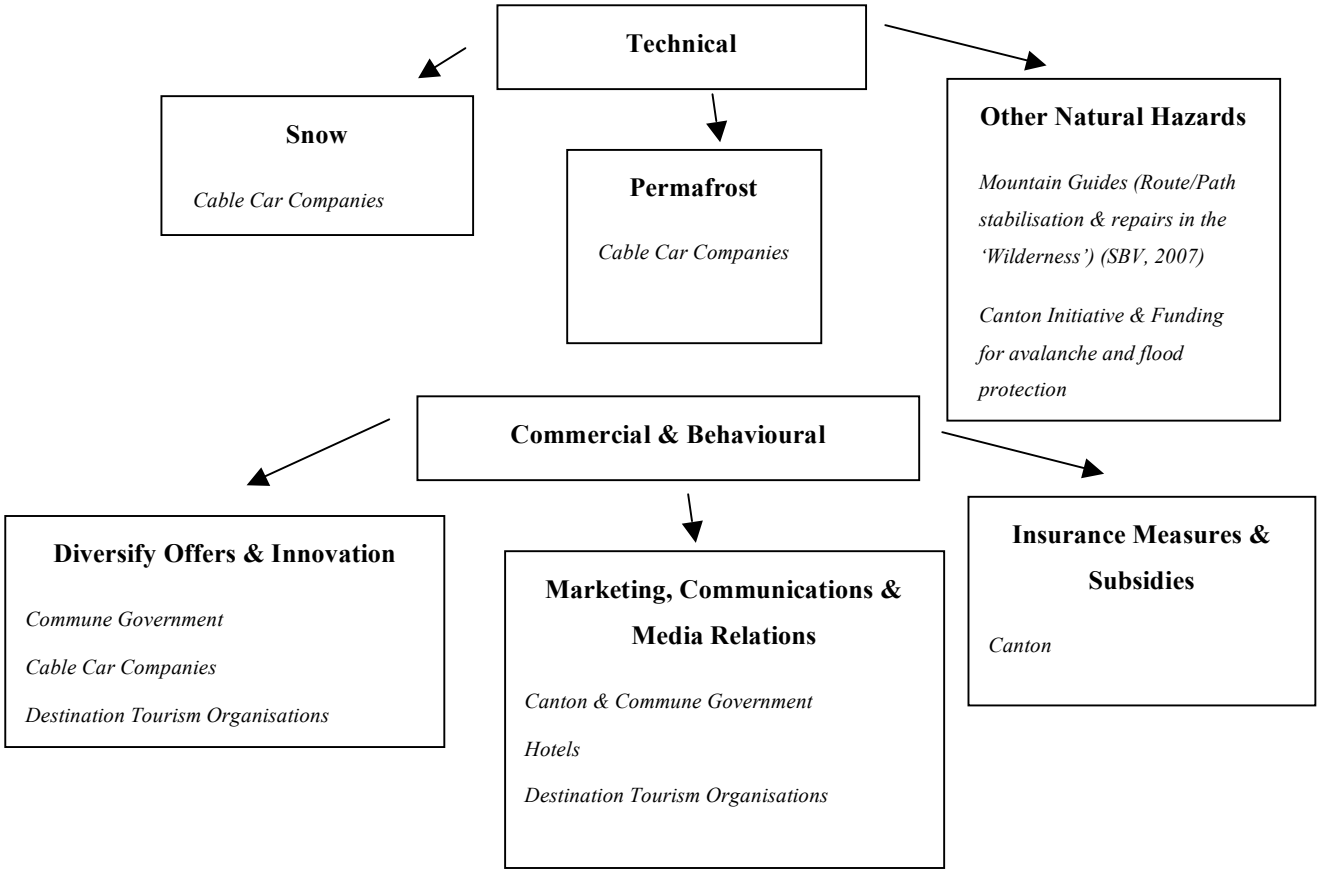

Figure 6: Trend in focus areas for adaptation measures by Stakeholder Group

In the areas of implementation, it is the cable car companies that have so far done the most work and since a number of years have implemented technical measures to mitigate and contain infrastructural damage from melting permafrost as well as invested heavily in

artificial snow making capacity in order to ensure skiing is possible at the beginning of the winter ski season. Whereas, technical measures for natural hazard protection, such as measure to protect against flooding, rock falls, land slides and avalanches are implemented mainly at the cantonal level, with some work in the wilderness being completed by the mountain guides themselves. Business and communication measures such as offer diversification and tourist sensitization are the focus within the private sector, and more at the destination or local level. Financial compensation measures, if implemented at all, are the responsibility of the canton - but these proved to be the least favoured response at all levels.

Table 5, below, shows the costs and benefits that are experienced at the different levels for the measures that stakeholders said were their particular focus. Most notable, at the local level, the costs tend to be born by the cable car companies, yet the benefits tend to be transferred to the destination level, particularly for technical solutions such as artificial snow producing. The benefits in this realm are that the destination as a whole is recognised to be 'snow secure'. More discussion on the concept of 'snow security' and costs incurred by the cable car companies is featured in Section 4.6. The chart shows that currently the majority of transfer is from the top down, with the exception of the local technical measures.

Table 6: Transfer of costs and benefits from adaptive measures implemented across different levels of stakeholder shown as a green arrow from the local level up by the green arrow, and from the top down by the purple arrows

Local	*Destination*	*Canton*	*National*	*Federal*
Artificial Snow Making	Awareness Raising	Natural Hazards Protection	Education & Training	Research
Permafrost Measures		Awareness Raising & Information Publication		
Offer Diversification	Offer Diversification	Financial Support	Knowledge & Experience Transfer	Awareness Raising & Information publication
Information Publication		Research		
Other Technical Measures				

Federal Level

The federal level stakeholder commented that it was not in the remit of BAFU to implement any adaptation measures to climate change effects in tourism. Their focus has so far tended to be on consequences such as the effects of the 2003 Heat wave, drought, flooding events such as those in 2005. The consequences of the drought and heat wave for instance wrought havoc on the fish populations of Swiss rivers. The devastation of such extreme weather events on both agriculture and nature are the particular focus of BAFU, rather than setting guidelines for adaptation policies at canton, destination or the local level. Although BAFU is involved in 'Climate Politics' in terms of mitigation it also has natural hazard competencies.

As far as Adaptation goes, BAFU only has jurisdiction or responsibility in certain sectors, such as water protection, environmental protection) and protection against natural hazards such as rock falls. However, projects to do with events and hazards such as flooding have more direct involvement from the canton level public offices and it is the cantons that give financial assistance for the implementation of natural hazard or environmental protection projects. For other areas, such as the knock on effects in agriculture and tourism, there is not much they can do apart from the sensitization of the public to the problem and promoting education at the cantonal political level.

Additionally, the federal office keeps an eye on measures such as use of artificial snow, where it is their responsibility to make others aware and clarify about its ecological effects. It is SECO, rather than BAFU though, that plays a larger role in promoting collaboration between different areas and stakeholders within this scope. Although the federal level stakeholder expressed a personal concern over the sense in certain adaptation measures, such as increased levels of air conditioning to combat rising temperatures, he highlighted that BAFU does not have any authority to institute a ban on any energy policies, but that they do work very closely with the Federal Energy Office. BAFU also started working closely with the Federal Secretariat for Health (Amt für Gesundheit) after the Heat wave effects on health in 2003.

National Level

The organisations spoken with at the national level were the Schweizer Bergführerverband

(SBV) (Swiss Mountain Guide Association) and Seilbahn Schweiz (SBS) (Swiss Mountain Railways Association). Both organisations are national associations and therefore did not hold any responsibility for implementing adaptation measures of their own accord, but did fulfil a role in bringing together stakeholders from their associations in order to raise awareness about the issue of climate change.

The stakeholder from SBS commented that although SBS cannot itself implement anything, it can make recommendations, share knowledge, raise awareness and elevate the theme, which it does.

Seilbahn Schweiz has a number of projects and there is a lot going on with the Railway Companies.

(Public, Canton Bern)

The stakeholder from SBV commented on the work that the individual Mountain Guides do in repairing the paths, which is done in partnership with other collaborators. More is commented on this in the 'Local' section below. SBV also play a role in raising awareness for the issue of climate change. At the time of interview, a press release had just been published in order to raise awareness about the increasing dangers within the mountains as climate change develops, and the steps that are being taken in order to mitigate these increased risks.

<u>Cantonal Level</u>

The stakeholder from Canton Bern's Office for Environment and Energy (Amt for Umwelt und Energie - AUE) - referenced the FIF Report by Müller & Weber (2007), saying that they collaborated on it. It was clarified that the government is investing in measures to protect against natural disasters and he mentioned the Energy Strategy of the canton. At the AUE it was said the Government was focussed on measures to protect against natural hazards. In areas where the flood risks are, flood protection measures are being implemented by the canton. In other parts of the canton, avalanche protections are completed with the canton's financial support. It was also commented that although this is an increasing risk, it has already been a risk factor for decades. The canton also was presented as playing a role in

infrastructural measures against permafrost problems.

Similarly, when asked about adaptation measures, stakeholders from the Canton Valais said that the focus at cantonal level was on environmental and natural hazard protection, but that as yet nothing had been implemented except for the usual hazard precautions (Gafahraussetzung) re-naturalisation projects.

Destination Level

Stakeholders interviewed at the destination level were primarily focused on marketing and communication offers, which include offer diversification and tourist sensitization to the issue. This represents the role of the destination tourism offices as being focussed on raising the profile of their individual regions and ensuring their long-term development. The stakeholder from the Jungfrau Region office commented on the longevity that the climate change issue has had for them. It was commented that they have been making permafrost observations on the Jungfraujoch for the last 20 years.

Local Level

Concentration at the local level needs to be divided up by the different sectors of stakeholders. The cable car companies (Bergbahn/Seilbahn) sit within the private sector and from the interviews are recognised as the primary stakeholders involved in adaptation measures at both the local and destination level, due to their collaboration with other local railway companies. The stakeholders from the Tourist Offices, Tourism Verein and Local Communal Council representative were generally more engaged in potential adaptive responses than those from the private sector at the local level (Sports Shops, Ski Schools, and Hoteliers). The Hoteliers came across in both areas as those least engaged in the topic, although this could have been due to the sample, but a common thread in interview was that as yet climate change was not yet so important an issue for them.

From interview with the SBV it became apparent that one group of local stakeholders that fall through the gap are the local mountain guides. These guides play a significant role in the repair work and maintenance of the mountain paths and routes, as well as the mountain huts. Since these areas are perceived as being out in the 'wilderness', there is little assistance or

funding made available to the mountain guides who do the increasingly important repair work on the mountain huts and paths. Evidence from the number of fatal accidents this summer in the Swiss Alps highlights the increasing dangers that these guides face, and the need to ensure that they have the financial and training assistance to continue to minimise these dangers as best they can.

4.2: Climate Change Perceptions:

Public Knowledge and Reservations

At the Destination level, each respondent emphasised that they were not climatologists but in turn each referred to either the IPCC or the FIF reports, or indeed both, as their source of knowledge for climate scenarios. One commented on not having 'any expectations - but felt that they just needed to see what would happen'. The feeling that they needed to just 'wait and see' what would take effect, how and over which timescale was also expressed by some stakeholders.

Another respondent at the Destination level said that he was not a scientist, but had read the relevant reports, while the third pointed out how tricky it was to answer this question and to know how to answer this question, but again referred to climate science reports such as the IPCC. At the local level, some referred to having spoken to climate scientists (Public, Bettmeralp), while others, commented that they 'really couldn't say what would happen' (Private x2, Bettmeralp*)*.

At the local level, only one respondent mentioned the Müller & Weber (2007) report, while being asked questions about their expectations of climate change. However, representatives from beco, Wengen-Mürren-Lauterbrunnental Tourism (W-M-L Tourism) and the Jungfraubahn all alluded to this report and commented on their involvement in its making (Table 6). Since the report was focussed on Berner Oberland Tourism, there were no expectations that interviewees from the Canton Valais side should be aware of it. At the cantonal level, one public stakeholder mentioned that 'r*ecommendations from the FIF report are being discussed at the canton level*', showing a positive and proactive use of the report.

Table 7: Reports mentioned within Interview by the different stakeholders.				
Reports Mentioned	**Institutions/Stakeholder Groups**			
The Bernese Oberland and Climate (Müller & Weber, 2007)	*Beco*	*W-M-L Tourism*	*Jungfraubahn*	*Private, Mürren*
IPCC	*AUE*	*ProNatura*		
Klimaänderung und die Schweiz 2050	*BAFU*			
Klimawandel in Canton Bern	*AUE*			
OECD, 2007	*BAFU*			
Expert Studies (ETH, Uni ZH)	*SBS*	*Bahn, Bettmeralp Region*		
Schweizer Gletscher Kommission	*ProNatura*			

Understanding and Expectations

Table 8: Summer and winter impacts on tourism from climate change, which different stakeholder levels mentioned as being the most important in Interview. The number in the bracket is the number of stakeholders interviewed within that stakeholder level. The category 'Natural Hazards' encompasses the flowing events: Rock Falls, flooding and landslides. Avalanches have been categorised separately.
Number of stakeholders interviewed at each level: Federal / National: 3 Canton: 4 Destination: 3 Local: 19

Winter Impacts	***F&N***	***C***	***D***	***L***	***Summer Impacts***	***F&N***	***C***	***D***	***L***
Reduced Snow Security	1	2		14	Unsightly Landscape Changes	1		3	
Increased Precipitation	1				Increased Dangers on Walking routes		1		
Unsightly Landscape Change	1				High(er) Temperatures		1		
Glacial Retreat	2				Infrastructural Issues		1		
Permafrost Melting	2			2	Extreme Precipitation / Weather Events		2		1
Increased Storminess	1				Natural Hazards		1	1	2
General Warming	1			1	Permafrost Degradation			1	
Natural Hazards	1		1		Drought				1
Avalanche Danger				1	Unpredictable weather/seasons				2
Environmental Damage & Pollution				1	Glacial Retreat				2

Table 8 details how stakeholders from the different levels comprehended climate change had and would manifest itself depending on season. At the local level most were worried about reduced snow fall, while within the public sector stakeholder groups at cantonal and federal level, there was more concern with increased natural hazards. It was noted that landscape change was seen as a product of glacial retreat, and was always seen as a negative change by stakeholders.

Concepts of Snow Security

A number of stakeholders from both areas made reference to the relative snow security of their region, while others referred to the fact that without artificial snow, there would be no skiing at Christmas and New Year time. In Bettmeralp, the majority of stakeholders commented that last winter had been an ‘optimal’ one (Public, Bettmeralp) for both Bettmeralp and the Valais in general. Some believed that although the snow was coming later, they still had a snow secure region, while others focussed more on the fact that they could benefit because the village was higher than other ski areas. A cross section of stakeholders felt that tourists would look for more snow secure areas, which would benefit them in Bettmeralp. Similarly in Mürren, many stakeholders commented that at the moment the height of the Schiltorn is seen as a benefit, and that last winter, they had had record visitor numbers there.

Although artificial snowmaking was the most prioritized adaptation measure, not every respondent mentioned it in interview as an adaptation measure to climate change. Almost two thirds (19/29), of stakeholders mentioned artificial snow making as an adaptation measure that would be or has been implemented in their region. But there were a number of stakeholders at the local level who commented that artificial snow making was a priority for them, with some saying that it was the only real issue for them in terms of climate change adaptation.

Others (mainly from the hotel sector) commented that in winter, so long as there was enough snow, not much would necessarily change for them. Some recognised that the 'height' would only be a benefit for them in the short to medium term, or just for their generation. Within the interviewees where it was commented that Bettmeralp or Mürren were snow secure, these stakeholders would often add in response to another question, that the lack of snow was worrying for them, and would have effects on tourism in the long term. However, the idea that both villages are high enough to consider themselves snow secure was prevalent throughout interviews at the local level.

However, there were a few stakeholders from both villages who alluded to the how dependent the perceived 'snow security' of both villages are on the production of artificial

snow. In Mürren, one stakeholder said that without the snow canons there would be no Christmas and New Year skiing. While in Bettmeralp, a couple of stakeholders said that the snow canons now have to come out at the end of October, in order to ensure that tourists can ski at Christmas.

A stakeholder from Canton Bern did feel that snow security would be a bigger problem for the Berner Oberland region than for areas such as Graubünden and the Valais. Likewise, both stakeholders from Canton Valais commented that climate change could be an advantage for the higher stations of the canton, such as Saas Fee and Zermatt; one adding that the region's future development looks good. Within the Jungfrau Destination, one stakeholder commented that the Schiltorn (2,970m) was at a high enough altitude to ensure that the region could remain snow secure. The Eggishorn measures in at 2,926m while the Bettmerhorn is 2,906m.

Weather versus Climate & the Idea of Natural Variation

At the moment, we really aren't that affected, so CC is not such a pressing issue since we are at 2000 metres, and Betten is at 1200 metres, so we are OK. So, we have had a bit less snow, but this happened 20 years ago as well. And then last year was more optimal than the previous 10.

(Public, Bettmeralp)

8 Stakeholders from the local level and 2 from the Destination Level (both from the Jungfrau Destination) elucidated a differentiation between the climate and weather signals, and made comments on natural variation of the weather and climate. 4 were from Mürren and 4 from Bettmeralp. Figure 7 below details the different responses on variability and climate change from the local and destination level.

Concepts of Climate Change and Natural Weather Variation in Interview

•Climate Change has always been happening, there is a question over weather it is human influenced. (*Mürren*)

•There were signs of climate change, but also signs that can not be attributed to climate change, but to natural variation, though something extra did seem to be happening on top of natural variation. (*Mürren*)

•Not so sure that Climate Change is totally to blame for the recent lack of snow. (*Mürren*)

•I would not call it climate change, but climate cycles - as a global warming skeptic. If it was Climate change then I would expect it to stay hot. But this year, we had a very hot April and May, and then a cold and rainy June. It seems that it is more changeable and one offs, rather than an actual trend. (*Mürren*).

•I'm not so sure if it climate change but there is less snow (*Bettmeralp*).

•I hope it will stabilize – as in previous years we have had bad winters, but it got better – but this is more of a hope than a belief. (*Bettmeralp*)

•Most important for us is is how will the weather plays out, it is not absolutely to do with climate change. (*Bettmeralp*).

•At the moment, way too much is spoken about in terms of climate change. Against the fact that everything is blamed on climate change, when the natural variability also plays a big role. For instance there have been times when March has been warmer or colder than it is now, that is natural variability. You can't just blame it all on climate change, although it does play a role. Up until now, it hasn't been such a big thing. What has been noticed the most though is that the Aletsch glacier has been receding. but we need to consider that there were times like that before. (*Bettmeralp*).

•Hard to say if glacial reduction is just to do with climate change. She commented that the last winter was due to weather rather than climate. When this continues for a long time, then you can say that it is climate rather than winter. (*Jungfrau Destination*)

•There is the natural variation, but the overall trend goes upwards in terms of temperature, so last winter was extreme, and the next one might get better (*Jungfrau Destination*)

Figure 7: Concepts of Climate Change and Natural Weather Variation in Interview

Additionally, 4 stakeholders at the local level commented about the negative effects inaccurate weather reporting had on tourism within their area. 2 were from Mürren and 2 from Bettmeralp. Both those from Bettmeralp made further comment that they were engaging with the media and weather stations, in order to counteract the negative effects of inaccurate weather reporting.

Expressions of Hope

In both Bettmeralp and Mürren, sentiments of hope were expressed by a number of stakeholders. Some hoped that the snow would start to come earlier next year, while others expressed hope that it would not be so warm, and that the extreme weather events would start to subsist and weather patterns would return to what they once were. Stakeholders did not report on what they perceived as normal, but did tend to refer to 'when they were younger' or between 10 -20 years ago as a benchmark for the changes. These opinions were expressed more uniformly in the two villages and in the private National and Destination stakeholders and did not appear amongst the public officials at the federal or canton level. One stakeholder from Bettmeralp commented that those who still say 'Snow and Taxes come every year' are the optimists, while others still think that it is just natural variation.

4.3: Preparedness for the impacts of Climate Change

Apathy

'I have noticed the increasing lack of snow. But we have a big advantage because of the height. But for the next generation - there will be problems. Things will be harder for the next generation'.

(Private, Mürren)

I don't have any expectations. We just have to wait and see what happens'

(Wengen-Mürren-Lauterbrunnental Tourism)

A number of stakeholders commented on the fact that climate change would be a greater issue for the next generation, but not theirs. Equally other short-term issues were considered

a much greater worry than the long-term problems that climate change raises. The complexity of the climate change issue also was listed as a factor in determining its lesser importance that simple day-to-day issues (refer to Table A10 for more detail). At the local level, aside from the cable car companies, there was a distinct lack of ownership over the implementation of concrete measures, with many asserting that they were not that affected by climate change yet.

Concerns within Tourism

But there are no real alternatives to Tourism within the Mountain area. Other industries will stay in the urban centres – they won't move them to the mountains.

(Private, Mürren)

Virtually all stakeholders raised different worries from the effects of climate change in summer to those in winter. Additionally, most also expressed concern about increased natural hazards within mountain regions as an issue for both summer and winter tourism. At all levels in Canton Bern, stakeholders commented on the balance between summer and winter tourism that has been achieved in the region, which can be seen as a necessity since Bern's ski areas are less snow secure than those of the Valais.

A number of stakeholders within the Bern region (across all sectors and levels) commented on the balance that the region had maintained between summer and winter tourism. Outside analysis (OcCC, 2007) (OECD, 2007) shows that the Canton Bern will suffer more severely from reduced snow security than Canton Valais ski regions, therefore the more balanced ratio between winter and summer tourism is a wise strategic move.

4.4: Adaptation Measures

The following data sets represent the different ways stakeholders prioritised and spoke about adaptation measures to reduce negative consequences of climate change on alpine tourism. These data sets are in response to questions 2(a), 2(b) and 4 as feature in Section A3. These questions aimed to elicit concepts of the importance of implementing adaptation measures, firstly through open-ended discussion, and then through a priority-ranking sheet.

Stakeholders were presented with the priority-scoring sheet after the main structured interview had taken place. This was to ensure that the stakeholders were not led into mentioning the adaptation measures listed on the priority-scoring chart. Figures 8 – 11 detail the priorities given by the different stakeholder levels.

The majority of stakeholders felt that it was highly important to implement some form of adaptation measure to the negative effects of tourism within their Alpine area. 13 stakeholders rated its importance as 'High', 2 as 'Medium' and 4 as 'Low'. All of those stakeholders who did comment that it was a low priority were from the local level.

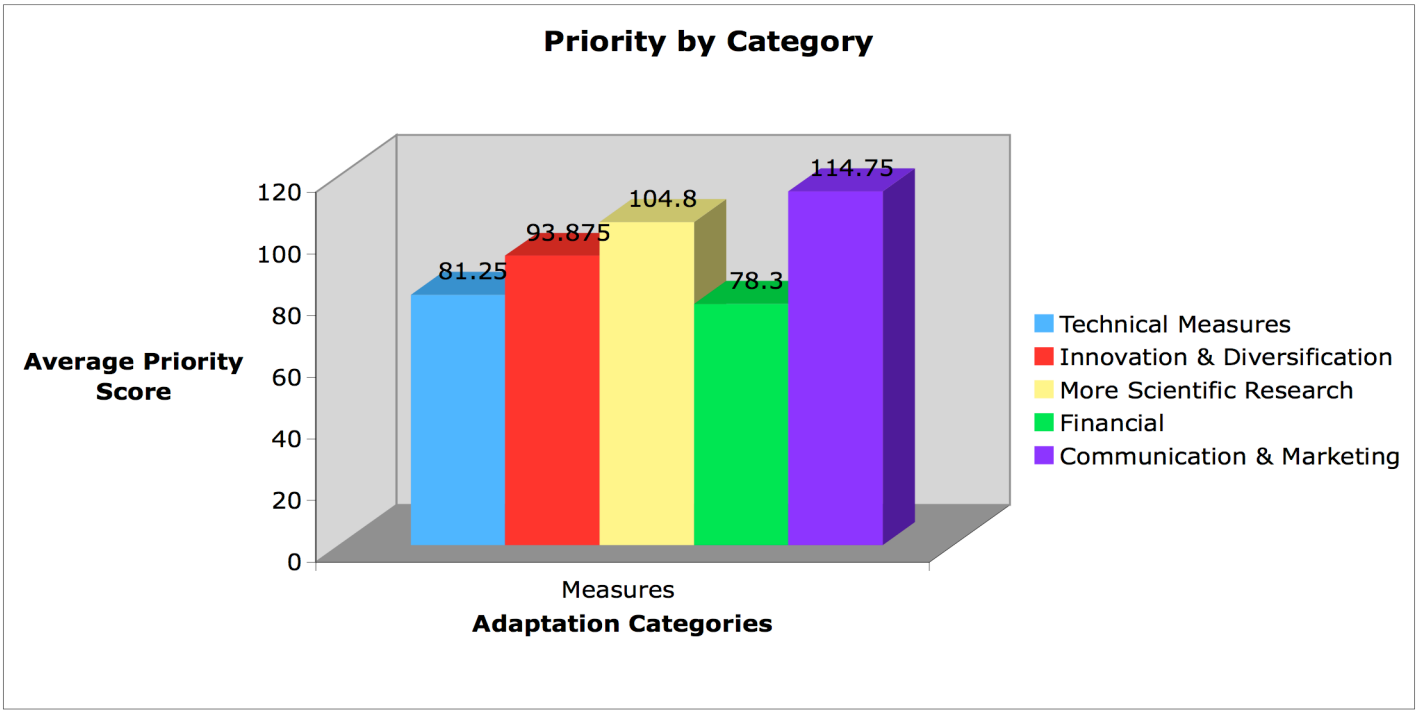

Figure 8: Priority Ratings aggregated for all stakeholders, showing the importance of technical measures versus behavioural/business measures.

Aggregated across the stakeholder groups, communication and marketing measures came out as the most prioritised adaptation measure to implement. Interestingly, technical measures came out as the second lowest priority rankings, yet as Figure 9, below, details, Artificial Snow Making was rated as the most prioritised adaptation measure by 10 scoring points. It

was the most widely recognised and mentioned adaptation priority as well, within the first stage of interview. Similarly, in the qualitative data from the open section of interview, artificial snow was also the most mentioned adaptation measure (Figure 11).

The call for more scientific research was seen in the context of improvements in technical research by the cable car companies, while public stakeholders tended to see it more in terms of the reports recently released by FIF (2007) for adaptation processes while others saw the need for a better understanding of how climate change will unfold.

The fact that technical measures came out so low can be partly explained by looking at which measures were scored the lowest priority in Figure 9, below. The lowest 3 scores were assigned to the technical measures of only having north facing slopes, using glacial covers and implementing artificial ski pistes (ski halls). The three measures did not have great relevance to the 2 case study areas, since their ski areas did not include glacier access and there was no real choice to only develop north-facing slopes. Additionally, the idea of relying on ski halls was deemed by many as farcical.

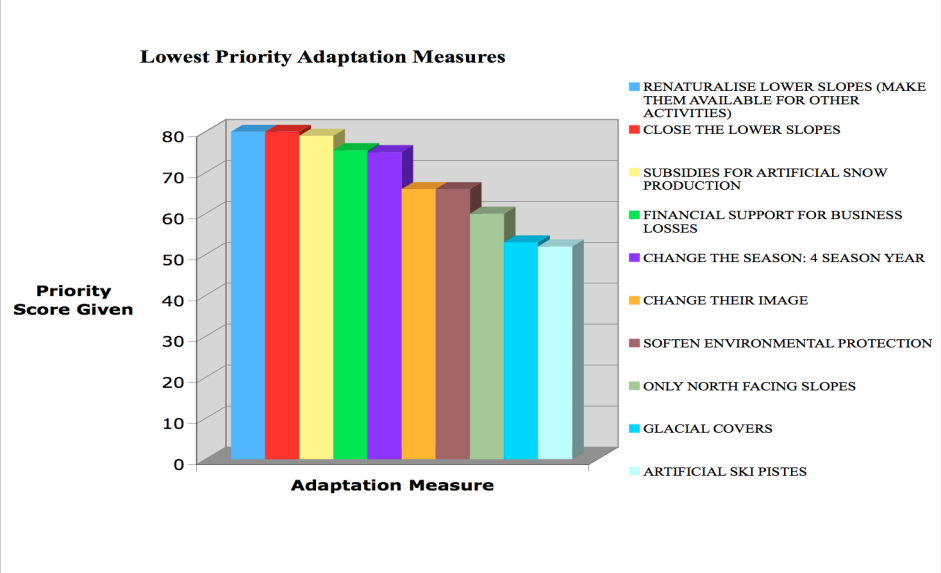

Figure 9: Least prioritized adaptation methods in response to Question 4 (Reference Section A3)

Figures 10 and 11 show the difference between the measures that stakeholders scored as high priority within the second section of the interview, in comparison to what they have mentioned as being important in the open section of the interview. Expanding offers for tourists, and thereby increasing dependency on non-snow and summer related offers was

noted as being of high importance in both sections of interview. Expanding alpine wellness offers was ranked in Question 4 as the highest priority. Tourist Sensitization also featured highly in both categories and across all stakeholders as can be seen in more detail in Table A9.

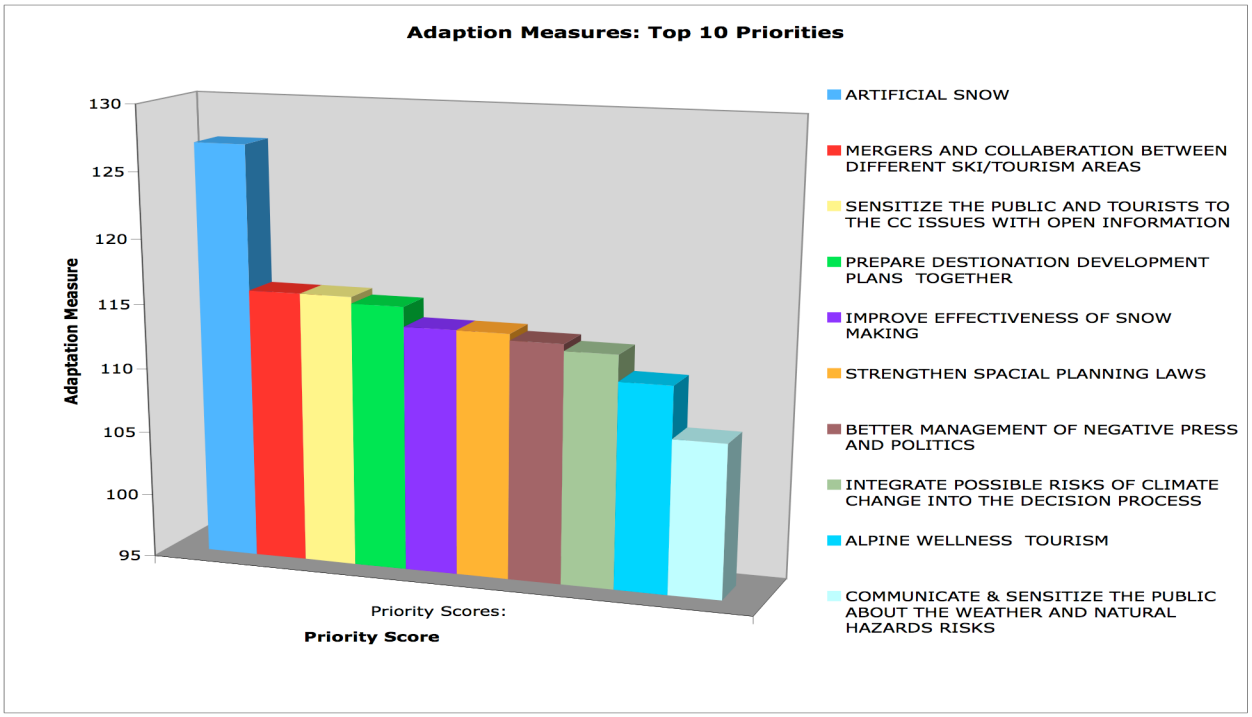

Figure 10: Top ten prioritized adaptation measures in response to Question 4 (reference Section A3 for full detail of the question and table X in the Section A2 for the full write up of the raw data)

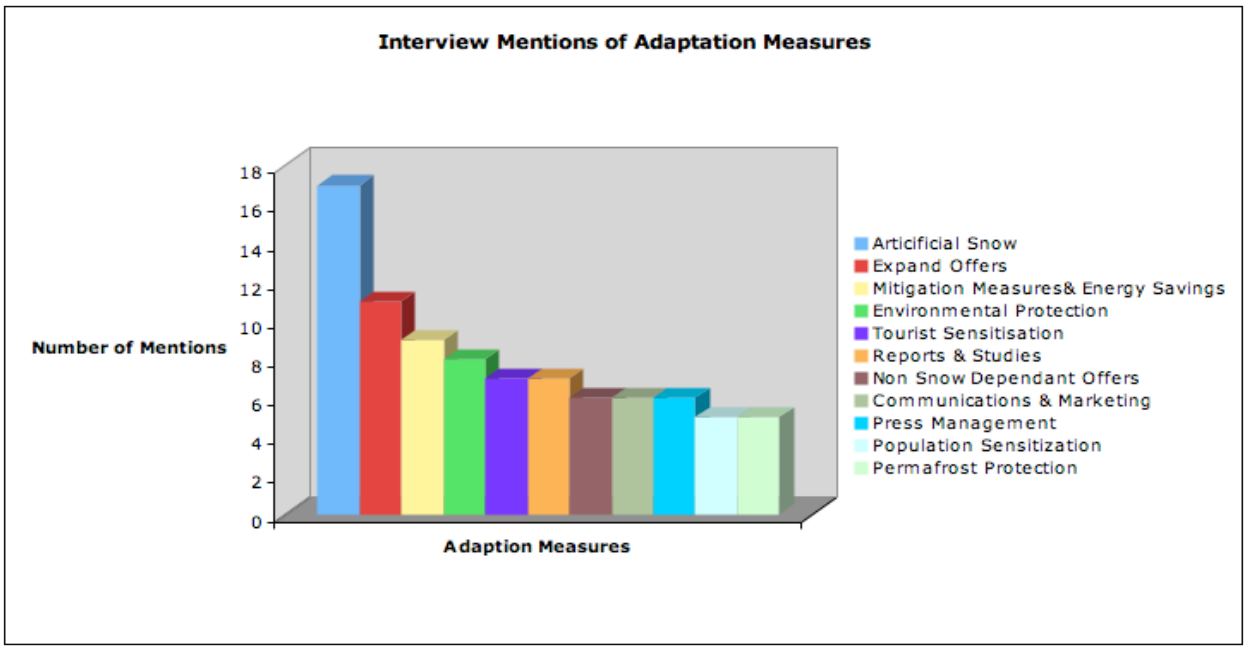

Figure 11: Top mentioned Adaptation Measures in response to Question 2 (reference Section A3 for full detail of the question and table X in the Section A2 for the full write up of the raw data)

4.5: Conflicts

Urban versus Rural & Lowland versus Highland

A number of stakeholders at the local level alluded to examples of the difference between their own traditional knowledge and understanding of nature in comparison to that of those who come to visit their villages. The quotes below highlight how locals felt about this conflict, and how increased communication to sensitize locals and guests to the issues was needed to combat it. Most of the local stakeholders interviewed, commented on how reliant their tourism livelihoods were on maintaining the intactness of their surrounding alpine environment. Some went on to add, most notably and in the most detail within the public sector local group that the increasing lack of understanding for nature's own needs and behaviour from the external tourists was a worrying development and one that had to be tackled in conjunction with the issue of climate change.

Concepts of Different Relationships with Nature

Nature will say what she wants and we need to live with nature. People think that they can dictate nature, but they need to stop thinking like this. They need to learn again how to save energy, water, turn off taps and lights… People need to help more and then nature will give back. We need to sensitize people and we need to start in school. (*Public, Bettmeralp*)

There is a certain relationship and understanding that long term locals have with nature, but that the tourists just don't have. Everything in the cities is possible and feasible, but this is just not the case up in the mountains. The tourists need to understand and accept this, just as the locals do. We need to pander to tourist demand, but within the boundaries of nature and not just follow demand completely. (*Public, Mürren*)

Figure 12: Stakeholder concepts of the conflict between local understanding of nature and that of urbanised tourists.

Some stakeholders gave examples of scenarios where tourists had not comprehended the true dangers that the alpine environment could pose, reacting against advice from locals with expert knowledge of the environmental extremes and natural hazards in mountainous areas. Yet, 'Nature' was repeatedly referred to as the decisive factor for people coming up here. Yet, the different levels of tourist and local understanding of nature was also consistently brought up at the local level as a major factor of tension in the development of alpine tourism. A sense that the guests need to be engaged with nature was also prevalent in a number of interviews at the local level. Concurrently, local stakeholders across the private and public sector spoke of the need to maintain the landscape in tact, and to keep nature in their interests. There was a sense that they needed to protect nature so that it could be used by tourists '*who want snow and sun in the winter and expect the weather to suit them'*

(Private, Mürren).

One stakeholder commented that the guests should instead better understand the weather patterns, and act accordingly, rather than the prevalent current lack of awareness for environmental and natural limits. Sensitizing tourists to the climate change issue and to environmental limits and patterns was depicted as a necessary measure to counteract these growing issues.

Other influencing factors

A number of interviewees commented on the fact that some of the measures in place, were not so because or not only because of climate change, but due to other influencing factors. For example in Mürren, a local government representative said that natural hazards protection is a major focus for them, but not just because of climate change. This has always been important. It was also felt that snow making and piste planning developments had not been done because of just climate change. This ties in with the fact that a number of interviewees did not mention artificial snow making as an adaptation measure, since it may be implemented but for apparently other reasons such as piste development or infrastructural improvement.

Even though the majority of local stakeholders rated the importance of implementing adaptation measures as 'high', the proportion that rated the importance of climate change as being high or important in comparison to other issues was less than half of that. Daily and short term issues were most often cited as being more significant and worrying for those at the local level, with climate change being viewed as too large and complex a problem for them at the moment. It was also perceived as being a problem that will be a greater issue in the future, and they were more worried about issues that were affecting them then and there. Table A9 in the Annex details the full set of data on these topics.

Traditional versus Pioneer & Local Autonomy

I am very keen to work together with other communes, but it will take time to get local support for this, and the pressure to do this should not be financial. We need to ask what we could do better if we would work together. We already have good cooperation with a ticket

that works for all areas, have joint offers (Autumn Sun) (mid September – 20 October) to come up to the plateau and enjoy the sports and food offerings.

(Public, Bettmeralp)

One stakeholder from Mürren spoke at length about the difficulty of implementing change in such a traditional village as Mürren. He commented that it always meets with a lot of opposition and challenge. It is as expected for rural small communities and businesses to be more risk –averse than their larger urban counterparts due to a number of factors (Furtado, Conversation, 2007), including less exposure to outside influences, traditional technology and procedures, lack of disposable capital, meaning that they tend to be 'followers' and not leaders of innovation / adaptation. One stakeholder from Bettmeralp commented on her eagerness to implement measures and ideas learnt from other areas to which she has travelled, a sentiment shared by another stakeholder in Mürren and which ascribes to Mühlinghaus' (2001) theory about the importance of the '*Returnee*' in promoting development within Alpine communities.

The collaboration started 8 years ago with Wengen-Mürren-Lauterbrunnental Tourism - and then with the Jungfraubahn mostly for marketing purposes. It takes a very long process to improve this.

(Private, Mürren)

Each locale is very very different. Distance wise, they are not that far from each other, but as a region or locale they are very different. You can't just generalise. Also with climate, can't generalise with resorts over 1200 metres, each one will be different and will need different adaptation measure. For example, in BA the forest boundary is very high – much higher than other places.

(Public, Bettmeralp)

These comments reveal how local actors recognise the need to establish new modes of business practise in order to develop their resorts, but how traditional mind sets must be brought along in the process, slowing it down somewhat but in turn ensuring that development does not become out of control.

Conflicts with the Media

Many public and private stakeholders across all levels referred to the ongoing conflict between their localised weather situations, and how the national and international media report on the general Alpine situation (reference Figure 13, below). Additionally 'inaccurate weather reporting' was felt to be an issue, in that it puts guests off making day trips to the mountains, specifically in summer, when in fact it may be a perfect day in the local area.

Concepts of Conflicts with the Media

•Last winter, the media kept reporting about the lack of snow. We did notice that the negative press discouraged the tourists. The media should give positive messages not negative. *(Private, Bettmeralp)*

•In Bettmeralp we are at an optimal height, therefore as yet we haven't had to think about adaptation strategies with regard to reduced snow security. Everything that is about 1800 metres at the moment is fine. We live at 2000 metres, and the pistes go to 2700. We are trying to think about how to combat negative press. *(Public, Bettmeralp)*

•The media is a big problem. Canton Valais had optimal snow last winter, but every evening there was negative press about the lack of snow. I did call Schweizer Fernsehn and Meteo Schweiz, but only resolved the issue in the short term. However, it did not have a major effect on the numbers that were coming to the resort. Valais Tourism and SBS have been trying to tackle the issue of bad weather reports, since they have a major effect on the day tourism traffic. Often the reports are wrong, inciting less people to come up to the mountains. (*Private, Bettmeralp)*

•Inaccurate weather reporting is a major issue. The weather forecast (Meteo) predicts weather that just doesn't happen and therefore guests are put off coming up for the day, even if it is good weather up in Mürren. *(Private, Mürren)*

•It is clear that the whole of last winter the media increasingly reported on the theme - was a shame when they had good piste coverage - but that is how it goes. The national and international media are always extreme, especially around the time of the Lauberhorn race. There was very bad press and they just put the whole of Switzerland into the same basket. We have been trying to be actively engaged with the press, attempting to be more proactive, rather than just reacting to negative media articles. But this will be our major task for the future. *(Private, Jungfrau Destination)*

•Main thing is that public awareness has grown in the last couple of years – so there has had to be a lot of public campaigning along the actual work they have been doing for years. There is a lot more in the news these days (e.g. Grindelwald) It is important at the moment, primarily because the media focus on it has made it such. *(National Level)*

Figure 13: Stakeholders' view and concepts of conflicts with media reporting and the actual situation within their local area.

With some stakeholders there was a sense of apathy towards how to counteract negative press articles, with the feeling that the media will just do as they please, while others had innovative ideas for how to tackle this issue, such as implementing cameras and pictures on the web and in train stations in order to give a '*true picture of what conditions are like'* (Public, Bettmeralp).

4.6: Implementation

Three common adaptation measures were detailed by a number of stakeholders as already being implemented.

1) Artificial Snow
2) Permafrost Measurement & Infrastructural Protection
3) Natural Hazard protective measures

In general, artificial snow was stated as having been prevalent since the 1990s, when the lack of snow in winter started to become a problem, with some interviewees commenting that Christmas/New Year skiing could not take place without snow canons assisting to lay down the base. Within the Jungfrau region, permafrost observations were stated as having taken place on the Jungfraujoch since 20 years. It was commented that this was not a new theme, but just that the public awareness of it was new. The measures of artificial snow and permafrost monitoring and protection are both the main responsibility of the Mountain railways, while natural hazard protective measures are implemented and financed in general by the canton. The exception to this was the work reportedly done by the mountain guides in stabilising the paths and huts in the mountains.

The concentration on technical measures to retain snow security can be assigned to the sentiment that ' *there are no real alternatives to Tourism within the Mountain areas. Other industries will stay in the urban centres – they won't move to the mountains'* as stated by one public stakeholder from Mürren. However, at the cantonal level in Bern, there was more interest in finding alternatives to ski tourism in winter, which was mirrored by some stakeholders at the local level. However, some stakeholders at the local level specifically commented on the fact that there was not much choice in how to adapt to the changes that climate change would bring. There was a feeling that tourists came for skiing in winter, and the beautiful scenery in summer, and that other offers would not satisfy tourist demand.

Financing

In the medium term, 43% of the ski areas in Canton Bern are in danger, which will require a significant amount of investment to concentrate winter sports in higher, more snow secure

areas, but the canton itself raises the question of whether these investments will actually be made (Public, Canton Bern). However, the adaptation measures that came out amongst the lowest were those that involved financial support for business losses and subsidies for snowmaking. These measures came in the lower half of the prioritised measures, consistently across all stakeholder levels and most seemed to be unimpressed with the idea of state subsidies, unemployment help within private and public stakeholder groups.

Among the stakeholders from the Mountain Railway sector, a common theme in interview was the need for greater equity in sharing the costs of increased infrastructural investments (such as snow canons) amongst all those who benefit from these investments. Stakeholders felt that while the mountain railway/gondola companies were expected to pay for most of the investments into ensuring the region was snow secure since direct costs from the piste passes and journeys go to them, those in the hotels, shops etc also benefited from these costly investments, yet were in effect 'free riders' to the millions of Swiss Francs invested.

A number of stakeholders, in both areas, spoke positively about the assistance, mainly financial, that the cantons bring to the implementation of protective measure against natural hazards such as avalanche barriers and flood protection. It was said by some, that without this assistance, the local authorities could not afford to implement the protective barriers needed.

The Bettmeralpbahn and the other mountain railways are mainly financing these measures – the communes don't have the finances to do this. Plus – it is the mountain railways that earn the money from the winter ski industry. From the communal level there is practically no support nor from the public.

(Public, Bettmeralp)

The most common thread within the area of financing adaptation measures was that the mountain cable car companies are responsible for the financing of technical measures of artificial snow investment and protective measures against melting permafrost. This requires a '*heavy investment, which needs to be met by a growth in turnover. These increasing costs are a major problem for the Bahns, (requiring) revenue to grow in order to cover this. The*

big problem when the revenue doesn't also grow parallel to the costs' (Bahn, Bettmeralp). Others felt that there should be 'more collaborative investment into infrastructure' in terms of a proper CBA into infrastructure investment so that all those (hotels, shops etc) who benefit from the investments should also share the costs (Bahn, Bettmeralp).

Collaboration

Additionally, a private sector stakeholder from Mürren commented that the Jungfraubahn and Schilthornbahn work together on ski passes, directives, and lift developments. The interview with a stakeholder from the Schilthornbahn confirmed that there is collaboration with other cable car companies on a technical level and with Wengen-Mürren-Lauterbrunnental Tourism on marketing. Additionally, there was comment that the '*World Cable Car Association is increasing knowledge of what is happening elsewhere in this field and enhancing international collaboration in order to share experiences with snow making, and learn about the different problems in different areas*.'

Concepts of Collaboration

•We work together with the other Aletsch Bahns on operative (computer network, personnel development) and marketing areas. Strategic collaboration with the other Bahns is a trickier issue because of the varying share that the different Gemeinde have in the companies. *(Bahn, Bettmeralp)*

•In the Railway sector they are looking at future scenarios and options for them, e.g. mergers, more collaboration. Public-Private partnerships in this area are common in Switzerland, where projects are co-financed between mountain railways and the canton/federal level, for instance like in Saas Fee. I also work with other Cantonal Tourism Directors on Tourism Politics. *(Public, Canton Bern)*

• The merger between Mürren and Grindelwald- Wengen -Lauterbrunnental is planned in 2008, in addition to the present collaboration on marketing. Additionally all 9 Berner Oberland Destinations did the Climate Change destination report with the University of Bern. We have worked with Hansrüdi Müller from FIF and Urs Wiesmann, CDE Uni Bern. We also work with Schweiz Tourismus on marketing. *(Tourism Office, Destination)*

Figure 14: Stakeholder responses to the importance of collaboration within Alpine tourism.

Additionally, public sector and Tourism office stakeholders from Bettmeralp and Mürren both rated increased collaboration as an important element in adapting to the changing environment, both natural and human, in their villages. One public stakeholder from Mürren commented that while he would like to see more collaboration and support from the canton and federal level, he did add that it was important to expect support only within reason and be 'objective' about it. Within the private sector, harmonisation was seen as a good idea across businesses, such as outsourcing hotel services such as dish washing and clothes washing, which could save energy and money.

5: DISCUSSION

Measures of Adaptive Capacity

5.1: Regional Adaptation Processes

The Alps and its inhabitants are currently undergoing a stage of both social and environmental change, which affects the different types of capital available for the economic livelihoods of local actors, including those at the Communal and Destination level. The actions and decisions of administrative and governmental officials at the canton, national and federal level directly impacts the ability of the local actors to adapt. According to Brugger et al (1984), how these mountain regions adapt to change is affected by the demands of different actors, such as households, private firms and public bodies, the disparities in the regional living conditions and the development opportunities, which are based on resources and infrastructure (Figure 15).

This study focussed on interviewing stakeholders that represented private firms and public bodies, at different stakeholder levels (Local, Regional and National) in order to map how they are/will respond to the effects of climate change. In doing so, respondents revealed a number of trends which affected how they have already reacted to changes influenced by climate and how they would act in the future in the face of ongoing environmental change.

The main resource that local actors spoke about was ‘nature’, which encompassed the snowy scenery in winter, and the agricultural and glacial landscape in the summer. It is the ‘cultural landscape’ that is recognised as the ‘essential capital of the tourist industry’ (Brugger et al, 1984). It was also recognised that the degradation of this landscape had for a long time that the ‘creeping destruction of the landscape has not produced a shock great enough to raise consciousness (Brugger et al, 1984). Climate change was noted by some respondents as exasperating the increasing socio-cultural and economic pressures in their lives.

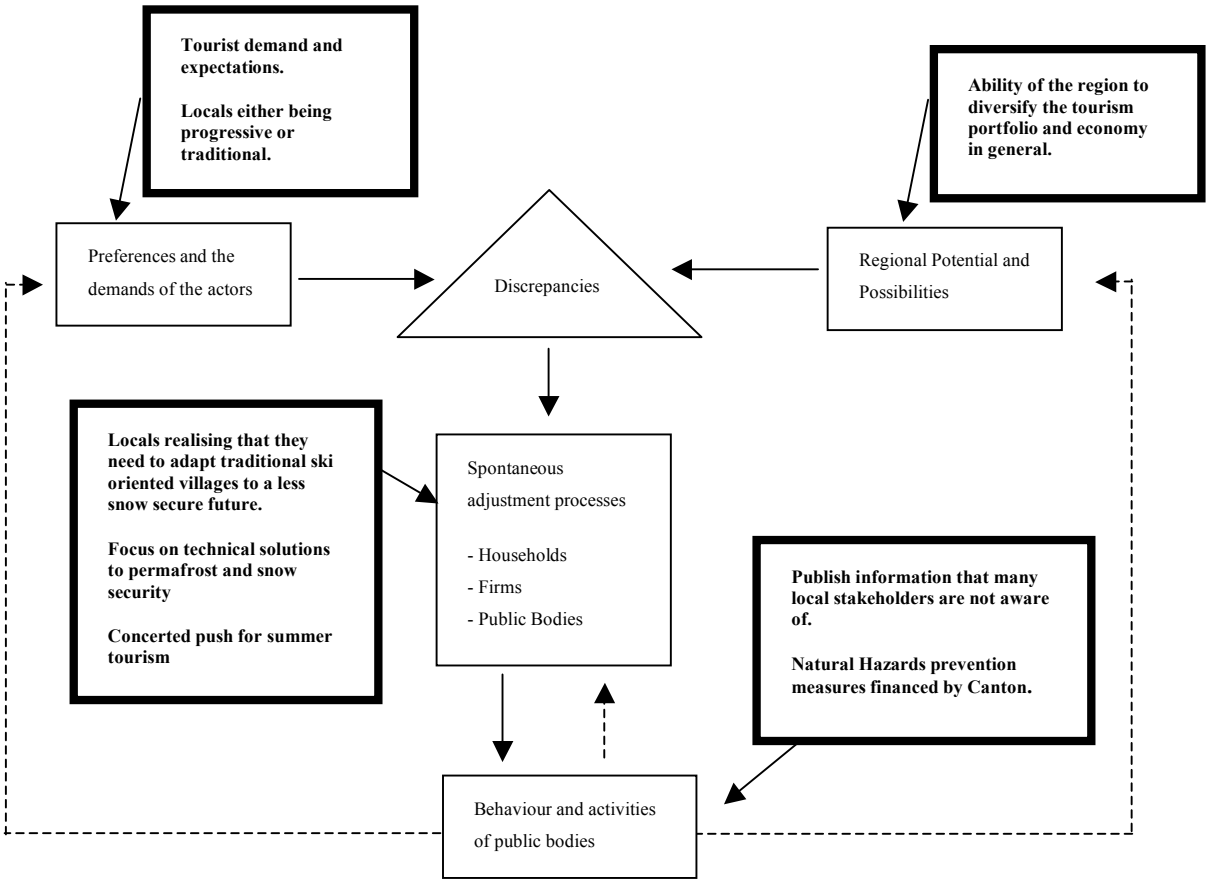

Figure 15: 'Regional adaptation processes' Source: Brugger et al (1984). Text in the bold boxes shows the overlay of findings from this study's results in the context of Brugger et al's analysis.

However, in the past few years, one has seen the rise of organisations such as 'Respect the Mountain' of the Ski Club of Great Britain, Bart's 'Respect the Mountains', 2041.com, Summit Foundation and Save our Snow amongst others and other initiatives by individual resorts and private organisations within Switzerland itself (as shall be detailed later). These organisations show that the degradation of the Alpine environment is moving further up the agenda of exogenous international or European actors. Interestingly, none of the stakeholders spoken to mentioned the work of such exogenous organisation, but this result could have been very different if the study took place in France or another less decentralised country.

5.2: Stakeholder Differences

The data sets presented in Section 4 and the Section A2, show that more distinct differences in attitude and action can be revealed between the stakeholder levels, than across the private and public stakeholder groups. However, some of this can be accounted for in the sample size and technique. But the aim was to portray a snap shot of different stakeholders rather than a conclusive view of how the different sector players are responding to the threat.

Table 7 shows how the concerns differ across the different stakeholder levels, while Table 5 shows how this is then translated into what the individual levels are then focused on in terms of adaptation measures. A link can be seen in terms of the finances available at the different levels, their concerns, and the adaptation measures then implemented or projected to be implemented.

Financial ability to implement measures was seen to reside with canton actors in terms of protection against natural hazards (outside of permafrost issues), or with the local mountain cable car companies (Seilbahns), who held responsibility for the financing and implementation of infrastructural measures such as artificial snow making capacity and permafrost protection. National and federal organisations can be seen to provide an important network for knowledge and experience sharing, as well as a vital role in disseminating the relevant information to stakeholders at different levels on the subjects of climate change and its impacts, whether through academic reports collaboratively produced, workshops or government information packs.

Differences between the private and public sector are seen more clearly at the regional (local & destination) level, where public sector stakeholders (Tourism office and commune Officials) interviewed had a heightened engagement with the issue than those who worked for local businesses, outside of the railway firms.

5.3: Understanding and Awareness

Public Awareness, Research and Education

Although there has been a significant amount of literature published in the field of tourism

adaptation measures to climate change, it was notable how few stakeholders at the local level were aware of reports such as the OECD (2007), OcCC (2007) and Müller & Weber (2007) as well as the reports published by the cantons or federal government on the subject of climate change. More could be done to ensure that local actors felt more involved in the dissemination of this information. With reference to Figure 14 (Brugger et al, 1984) one can infer that if information was better disseminated from the research activities of public bodies (including funded university reports) this might have direct effects on perceptions of adaptation and concepts of weather, climate and concepts of natural variation.

The expressions of hope from some local stakeholders, which in turn induce a more apathetic response to adaptation, might also be tackled by a better dissemination of information to the local level. Although it is vital to build and retain a potential for diversification within alpine tourism in order to respond to 'unpredictable changes in the demands and attitudes of tourists' (Wiesmann, 1999), at the local level there is a certain apathy to what can actually be done, or what needs to be done, even though this is recognised as truth by most.

However, it is also worth noting, that all stakeholders at all levels reported cogently on the changes in, as they saw it either weather or climate, which shows the level of awareness around the issue of climate change, even if they expressed reservations about how much impact this has so far had on tourism in their area.

Concept of Snow Security

The conflicting ideas of snow security as detailed in Figure 7 raises the question of what exactly is meant by snow security. Questions came out of the interview whether stakeholders were referring to natural snow cover or artificial snow cover, as well as how confident the interviewees should really be in their belief that their regions are snow secure. While interviewees in both areas expressed these feelings of being snow secure, this notion is more warranted in the Valais than in the Berner Oberland, even in Mürren, which has the highest access in the region.

Region	Anzahl Skigebiete	Schneesicherheit			
		heute	+1°C[a)]	+2 °C[a)]	+4 °C[a)]
Alpen VD+FR	17	100%	65%	53%	6%
Berner Oberland	26	96%	85%	62%	12%
Zentralschweiz	20	90%	75%	55%	20%
Ostschweiz	12	83%	58%	58%	8%
Graubünden	36	100%	97%	97%	83%
Wallis	49	100%	100%	100%	80%
Tessin	4	100%	75%	50%	0%
Schweiz	164	97%	87%	79%	49%

a) Zeithorizont: +1°C: ca. 2020er Jahre; +2°C: ca. 2050; +4°C: gegen Ende des Jahrhunderts

Figure 16: Reduction in snow security from today's (2007) mean temperature to an increase of 1oC, 2oC, 3oC, and 4oC per region in the Swiss Alps. Source: OcCC (2007)

According to a number of recent reports from the OECD, OCCD, and the University of Bern, while Canton Valais and Graubünden will be able to enjoy relative snow security, the Berner Oberland will experience a dramatic drop in snow secure areas from today's 96% to 12% with a 4 degree C increase in temperature (Figure 16). Mürren is the highest ski area within the region. This raises the question of what people actually mean when they refer to the 'snow security' of a location. What is clear is that at Christmas time, snow security may have come to represent the areas that are now cold enough to support artificial snow making as opposed to those areas, which are guaranteed sufficient levels of snow fall from mid December to the end of the season.

5.4: Preparedness

Retaining snow security through means of artificial snow making or improving its effectiveness was consistently the highest ranked and mentioned adaptation measures. The exception being at cantonal level, where it ranked as the 5th most important measure. While one could comment that preparedness was high, since this is also the measure that is implemented most effectively within the case study areas, one can equally argue that the focus on this measure represents a lack of preparedness for when temperatures will require truly snow independent offers.

Both Mürren and Bettmeralp have limited ability to expand and extend the pistes to higher altitude. However, it was noted by a number of stakeholders that expanding onto glaciers and into higher terrain, was unreasonable on environmental, economic and geographic grounds. The higher the lifts go, the less turnover is generated, but the more costly they are to build and maintain. Offer diversification, tourist sensitization represented more long term effective adaptation measures, but there was less sign of these having been so far implemented, or consensus on their potential success.

Apathy & Generational Discounting

Competing issues to climate change at the local level in particular mean that climate change is pushed further down the scale, inducing further apathy towards it as a problem. The feeling from some stakeholders at the local level that this would an issue for the next generation to tackle is a sentiment at the heart of the argument in the report on the Economics of Climate Change (Stern, 2006) to take this equation out of discount rates. Beniston (2005) also noted in facing the importance of environmental change, humans would need to think about it in terms of decades and centuries. The results from this study has shown that for many local level stakeholders, this very sentiment is a major impediment to realising adaptive capacity, since it enhances the idea that the issue can be left for future generations, rather than dealt with sooner.

Within the context of responsibility in the confederation, Brugger et al (1984) note that the 'responsibility for the care and maintenance of life space for future generations' is just as important as the freedom of decision making for the federal principle to enable and support. Within Switzerland therefore, increasing effort needs to be made at the federal level to enhance understanding and action for environmental issues. This can be seen to happening this year, as Switzerland prepares to go to the polls for the Swiss Federal Elections, and environmental protection is one of the issues at the top of the agenda for all parties (Eckert, 2007).

Summer and Winter Tourism

It is only since the seventies that winter tourism became so dominant in areas such as Bettmeralp (Public, Bettmeralp) and within the Bern region, summer and winter tourism

have remained more evenly balanced (Private, Jungfrau Destination). However, for some of the local stakeholders, reliance on winter tourism and the fear of what they would do without enough snow came through clearly in interview (reference the private interviews in Bettmeralp & Mürren). However, there was a clear awareness that climate change would bring in turn benefits for summer tourism, as long as the natural hazards did not increase too significantly. This in turn requires those who currently rely heavily on winter sports as their main source of income to learn new skills and establish new means for a summer based livelihood. However, there was little recognition or action that this would in fact need to be done, from those who worked within the snow sports sector.

Summer Tourism in the Alps has a much less harmful effect on the fragile environment (ProNatura, Destination Aletsch) and the increasing focus on growing summer tourism once more is therefore welcomed as less environmentally damaging. However, the way summer tourism develops may change this current 'more environmentally friendly' status that it holds, as discussed by Messerli (1999) and Siegrist (1999). For instance, developers should not be erecting more lifts for summer walking and biking, and too many more tourists in summer would also have negative effects for the fragile eco-systems, particularly as they are more stressed by climate warming. Maintaining the low environmental impact of summer tourism therefore does need to gain some more focus at the local and destination level, while stakeholders at the cantonal level confirmed their focus on environmental protection at the regional level.

5.5: Conflicts

Conflicts between different types and levels of stakeholders have typified many of the problems that mountain communities face, whether it is with lowland centres of political and economic power, or between tourism and agriculture or between locals and the tourists that are relied upon for economic sustainability. Conflicts between the 'large scale market economy' and the 'ecological stability in mountain areas' have been recognised by Brugger et al (1984). Climate change and its effects however add an extra dimension to the local effects of tourism, by incorporating an extra layer of environmental damage that is more complex to address at the local level.

Maintaining Rural Knowledge & Practices

Concern about the tensions of matching tourist expectations and demands from nature, with nature's own boundaries within the alpine environment are typical of the tensions between lowland/urban and upland/rural communities. The strong awareness at the local level as well as the National and Federal level of the importance of supporting alpine agriculture for the alpine cultural landscape is reflected in mountain agricultural subsidies and other incentives. In recent years in Mürren, there has been the appearance of a small market stall, selling local farm produce in the winter season. Such initiatives help local agriculture to benefit from winter, while providing farmers with a non-subsidy based income throughout the difficult winter months. In other areas of the Swiss Alps, such as Schamserberg, Canton Grisons, similar initiatives such as a cooperative of organic farmers have proved very effective in providing additional economic opportunities to tourism (Mühlinghaus, 2001).

Understanding of Nature

The dependency on nature and its role for many as the 'decisive factor' (Public, Mürren) for people to visit their villages reflects academic discussion about the 'pull' of the mountains for tourists (Price et al, 1999). Additionally, this is reflected in stakeholders' assessments that 'environmental protection' should be considered an adaptation measure aside from other measures mentioned such as technical measures for increased natural hazards and extreme weather events.

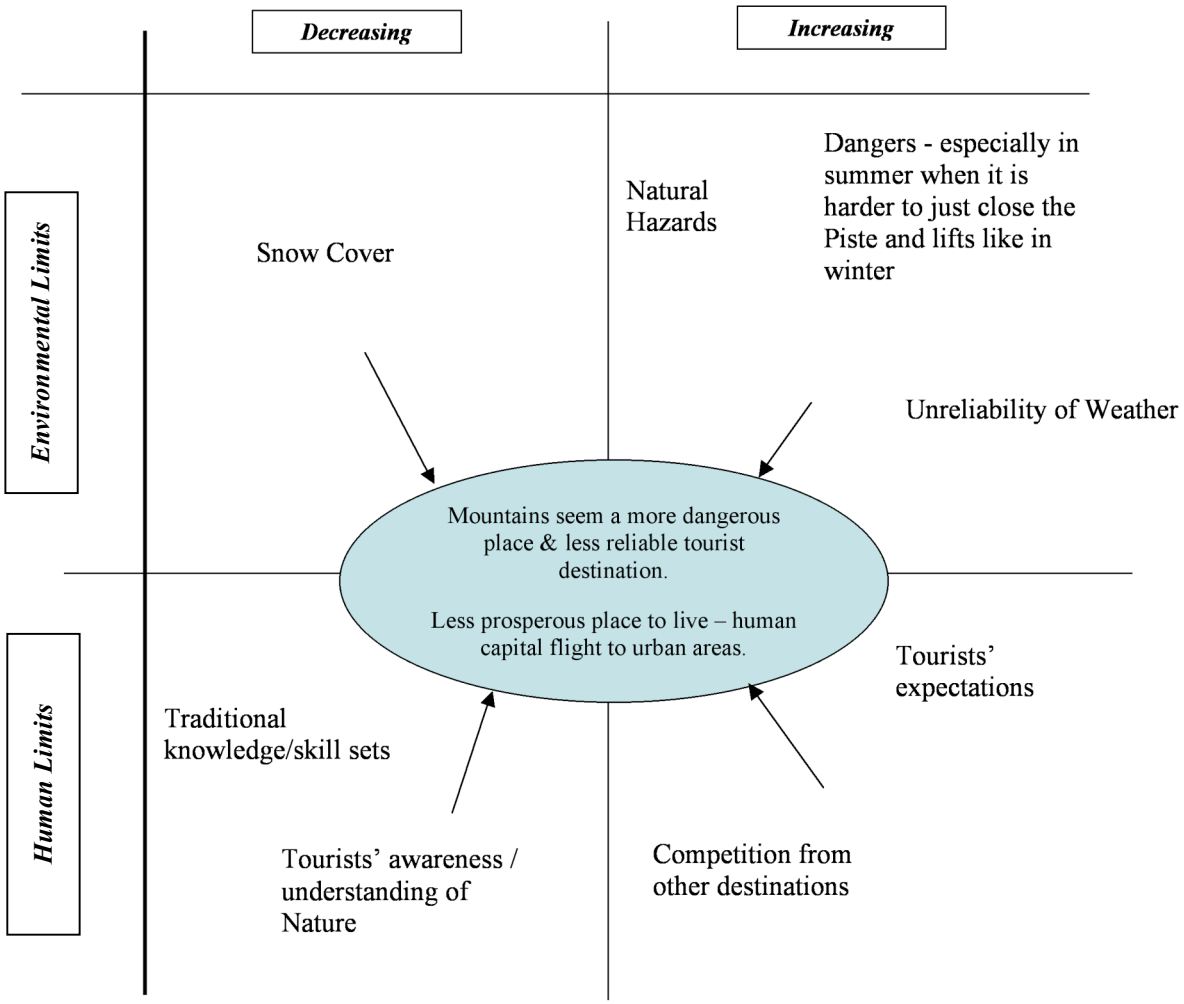

Figure 17: Alpine Futures: A more dangerous image? Increased Natural Hazards & Societal Changes will lead to heightened dangers in Alpine Tourism. Summary of how different increasing and decreasing environmental and human factors are affecting the safety of tourism in the Alps.

Figure 17 details how with decreasing understanding of nature (as mentioned by a number of stakeholders) and increasing hazards and weather events, the mountains may be 'seen' as a more dangerous and less desirable tourist destination. It is vital that measures are taken in order to ensure that the Alps remain a safe and productive cultural and environmental landscape for those who both live and holiday there. While, there has been a long history of technical measures to ensure safety in the face of natural hazards, more effort should be placed on educative measures such as those mentioned by the SBV stakeholder. Increased and more focussed training for those who work within the Alpine landscape is key, as is a concerted effort to improve tourist recognition and appreciation for the dangers and limits within the unique alpine environment.

Traditional versus Pioneer

A number of stakeholders within both Mürren and Bettmeralp commented that it was particularly difficult to implement new ideas and measures within such traditional villages. There was a strong awareness of the fact this very tradition was a major attraction for tourists, but at the same time a recognition that the village needed to move forward as well to adapt to the future scenarios that climate change might bring. Local actors need to be exposed to new ideas in order to comprehend how to move beyond the current status quo. Public stakeholders from both Mürren and Bettmeralp alluded to this concept, when they reported how, unlike others; they travel in order to bring back new ideas for tourism in their village.

Dealing with the Media

There is a need to find a way to move to a more positive relationship with the media, one where the local stakeholders have more input into what is reported about their own region. The media need to become more responsible and informed in the way that they report on climate change issues, particularly within alpine regions, where livelihoods are so narrowly dependant. The media need to learn to have more respect for these fragile livelihoods.

International Press – There were a number of stories published throughout the winter of 06/07 highlighting how 'Ski resorts [were] depressed by snowfall' (Cove, 2007) or rather the lack of it. Comments that 'in the Alps the start of winter in 2006/07 will be remembered by

many as one of the worst on record' by journalists (Cove, 2007) and a number of other negative and generalising articles are exemplary of the type of journalism that many of the local stakeholders were concerned about.

5.6: Implementation

Table 5 details the different areas of focus for the different stakeholders interviewed, which were in line with the findings of the OECD (2007) report. Table A8 reveals that there is a clear division of labour between the public and private sector in terms of what measures are being implemented by whom, in order to reduce the negative impacts of the threats mentioned in interview. Compounded with the division of tasks at the different levels detailed in Section 2 and Table A5, one can conclude that while the different sets of stakeholders have revealed that they intend to implement these different tasks, few have as yet felt the need to do so, outside of the technical measures with regards to artificial snow, permafrost degradation and natural hazard protection and prevention.

Collaboration & Networks to combat issues of Financing

Collaboration is a vital means to capitalising 'social capital', defined as defined as the 'institutions and networks of relationships between people, and the associated norms and values' (Grootaert, 2002). The role of social capital is recognised by Grootaert (2002) as having an increasingly prominent role to play in development and poverty alleviation. The increasing recognition of partnerships within the destinations and across the traditional communal structures is a positive step in development, even though stakeholders recognised the process to be a slow one.

Interestingly, no one mentioned collaboration across UNESCO sites, as a potential idea, but one stakeholder from the regional level did comment on knowledge sharing across the different sites. Collaboration was mainly discussed within the context of marketing, technical and business contexts, rather than the idea of strategic collaboration, which proved to be a sticking point for many stakeholders at the local level, due to notions of local autonomy and traditional individualism.

Almost all stakeholders across the different sectors and levels alluded to an increased focus towards collaboration and working with other stakeholders, areas, or other international actors. This represents a gradual move away from traditional autonomous villages, most notably in the realm of marketing and promotion. Although, in Switzerland, the nature of the direct democracy does slow down the public decision making process, at the Business Level, communities need to incentivise companies to outperform another also being small (Bieger, 1999).

Collaboration will prove vital for dealing with increased competition too. The popularity of sport-orientated mountain tourism has increased greatly in the past 30 years and is spreading from traditional areas such as the Rockies and Alps now to more untouched regions such as the Himalayas, Karakorum, Caucasus, Andes and even Antarctica (Siegrist, 1999).

UNESCO

A handful of stakeholders spoke about the benefits of association with the UNESCO World Heritage label, and commented on the role that the organisation had to play in establishing and promoting environmental protection as a high priority in the region. In general these comments came from stakeholders from the Tourist Office, Communal Council (Gemeindesrat) or from those at the Destination level. Stakeholders from the private sector local level did not comment on what UNESCO has brought to the area.

UNESCO is a big issue for us and we benefit from the awareness and recognition that it brings. It brings awareness to the local area and increases the focus on the topic, and provides and experience exchange.

(Tourism Office, Destination)

The Riederalp and Bettmeralp tourism brochures play heavily on the relationship with UNESCO, brandishing the UNESCO WHS logo for the Jungfrau-Aletsch-Bietschorn area on the front of brochures, on the car park and throughout the villages. Private companies' brochures also utilised the logo. Within the actual brochure of Riederalp, diverse offerings for summer mountain activities are offered with a focus on the benefits of the clean air, unique fauna and flora, glacier views and family fun in a car free resort. However, it is worth

noting that within the ‘getting there’ section – the most detailed information is devoted to how long it takes to reach the ‘Aletschegebiet’ by car from 5 different cities.

Mitigation

Often the interviewees spoke about mitigation as part of their vision of which adaptation measures they will take (reference Appendix raw data). A number of stakeholders, across all levels commented that, while they felt they did need to play their part in the mitigation cause, there was little impact they themselves (and the region or country as a whole) could have in the global fight against climate change. While some expressed opinions that ‘Climate change is not man made and therefore we can't affect it’, others felt that it ‘doesn't matter what we do, we are just a small area - it is the big nations such as China and US that need to address this problem’.

6: CONCLUSION

In the initial meetings of this study, many of the academics conferred with had suggested that there were few adaptation strategies and plans in existence and fewer still have been implemented. This study has shown that some stakeholder groups have been engaged with this topic for many years, though perhaps not under the guise of 'climate change' or with efforts that address establishing new tourism possibilities, but to protect the old. Additionally, ideas for adaptation strategies were found to be evenly segmented across the different sectors and levels. While these also focused almost entirely on maintaining winter tourism, through technical or marketing measures, marketing measures tended to concentrate on increasing the summer tourism market share.

Tourism is also a vulnerable industry, with a high volatility of demand (Messerli, 1999), which can be seen significant market risk. Therefore it is a high-risk strategy to focus efforts on maintaining the status quo. Furthermore, since questions continue to be raised over whether mountains likely to become ever more attractive sanctuaries of escape in the rapidly urbanising world, or if pressures from climate change amongst other stresses (Price et al, 1999) and changes in seasonality increase competition from other destinations (Messerli, 1999).

6.1: Recommendations

In order to thoroughly address the socio-economic consequences of climate change on Alpine tourism (and therefore Alpine livelihoods) the different sectoral and levels of actors must take action to significantly diversify the alpine economy outside the realms of winter tourism, increase the understanding of nature and the climate change issue within the alpine region, and improve the dissemination of information across the research, administrative, local and tourist communities. Additionally, it is vital that local actors understand the importance of taking action and responsibility earlier rather than later, despite the long-term character of the environmental changes afoot (Beniston, 2005). In order to achieve the aims

listed above there are different challenges at each level. The following recommendations, some directly from the existing literature, others indirectly seek to address how to combat these challenges.

Measures in Tourism

Alpine tourism needs to find a new vision with creative ideas, one where the current obstinacy of winter ski tourism no longer holds sway (CIPRA, 2007). Additionally, it should begin to be characterised by a participatory planning process, efficiency, environmental friendliness, authenticity, slow development, high quality and humanistic philosophy and management (Müller, 1996).

- Develop summer tourism in a responsible and sustainable way.
- Innovate with marketing techniques to promote the destinations in new markets.
- Develop low impacts eco - tourism in the form of non-consumptive recreation, as is becoming increasingly popular in North America (Nepal, 2002).
- Set up organisations to promote sustainable winter sports, such as snow shoeing, Nordic walking, winter trekking. For example the 'Compagnia del Buon Cammino' was set up to promote hiking tourism, particularly trekking and winter snow shoe touring in the Cuneo Province, Italy (CIPRA, 2007)
- Further develop and promote other long term viable alternative non-deep snow dependant offers.

Local Level

Local initiatives that take place under local control and for the benefit of the local population, innovative and collaborative activities, where local are the actors and initiators of the projects (Mühlinghaus, 2001). The main priority at the local level, is to support autonomous growth, outside of the tourism sector, as well as diversifying alpine tourism itself, so that local communities can continue to sustain livelihoods in the mountains,

Supporting local entrepreneurialism

- Improve competitiveness of small local enterprises in comparison to that of larger regional or national ones.

In Malaysia, the Rural Industries Smallholders Development Authority provides the same level of managerial and technological support as large corporations have. RISDA buys the products of these enterprises, pays them half and banks half their monies, provides them with extension services, processing and marketing facilities and so on. In Switzerland, umbrella organisations such as RegioPlus and the Swiss Syndicate for Mountain Areas (Schweizer Arbeitsgemeinschaft für die Berggebiete) exist to implement projects that aim to enhance economic development at the local alpine level. However, perhaps more could be done to implement initiatives that help increase competiveness at the local level. For instance, local agriculture through cooperative organic market stalls, such as the cooperative of organic farmers that have proved effective in providing additional economic opportunities to tourism in areas such as Schamserberg, Canton Grisons (Mühlinghaus, 2001).

Promote external experiences to generate fresh ideas at the local level.

Some stakeholders had mentioned the importance of their travels for generating new ideas that could be implemented within the local area, a sentiment shared by Mühlinghaus' notion of the 'Returnee'. Exposing more stakeholders at the local level to exogenous factors listed in Table A12 through exchange programmes (perhaps sponsored through the UNESCO WHS framework) could further reduce barriers to adaptive capacity.

Maintain Social, Economic, Political Autonomy

It is vital to reduce dependency and increase diversity (Napal, 2007) within local communities. Local people need to maintain a 'high degree of socio-political and economic autonomy in order to achieve sustainable community based mass tourism' (Wiesmann, 1999). Within Switzerland, this is assisted through the de-centralised political system. However, more can be done in order to sustain communities in the Swiss Alps, as they face increasing pressures from environmental and economic change. A widening of economic alternatives, maintaining of schools, broadening of the tourism sector etc would all go some way to ensuring that population flight does not diminish the currently good example of local alpine autonomy that Switzerland prospers in.

Education & Training

More educational centres within the mountains themselves (such as ProNatura) would ensure

that visitors to the Alps regain/retain a connection with nature that will change behaviour patterns. Such centres could also play a role in the increased assistance and training for the mountain guides as more training is needed as the landscape changes more to ensure that the standard is maintained. This is further needed since, alpine skiing is in decline, and mountain guides have to be expert skiers, rather than snow boarders.

- Promote affordable skiing and other alpine winter sports amongst the mountain communities that are no longer snow secure, and therefore do not have their 'local' lifts available winter long. Promote snow and other alpine winter sports amongst
- Maintain environmental protection at the local level

Financial Measures

At the local financial assistance in addition to the cantonal support for natural hazard protection could reduce commercial risk and sustain some of the repair and protective work that is not captured by the local or cantonal authorities.

- Financial assistance to the guides (in different forms e.g. collaborations, charities, sponsorship etc) for the work that they do on repairing huts and paths
- Establish a form of commercial insurance through diversifying economic strategies (Greenwood, 2005).

Regional & Cantonal Level

Local initiatives however cannot be separated from national and global context, and tend to evolve 'as a continuous interplay between internal and external factors' (Mühlinghaus, 2001). Therefore it is requisite that Regional Policies, either from the public or private sector, should also look to promoting 'endogenous development' by promoting 'participation, local initiative and social capital' (Mühlinghaus & Wälty, 2001). Additionally, regional conflicts must be reduced. Brugger et al (1984) notes different methods to reduce the potential for conflicts between different stakeholder levels in order to reduce out migration can include; adapting individual preferences and aims to the regional situation; and changing the regional situation to conform to individual preferences. Although Switzerland provides better prerequisite than other alpine communities, regional policy could still better:

- Diversify economic strategies (Greenwood, 2005)

- Support local initiatives with funding and advice.
- Enhance exchange of information, collaboration and communication.
- Institute a mechanism for communicating to exogenous stakeholders about the weather. Methods such as institution Live Cams in major train stations and airports could be an option.
- Regionalise direct agricultural payments, to reduce negative feelings of dependence on federal subsidies, while assisting in maintaining some form of regional economic diversity, especially since mountain agriculture is recognised as provider of identity (Soliva, 2007).
- Improve marketing of regional products
- Ensure that any negative externalities of adaptation strategies within the winter tourism sector are identified and accounted for.

National/Federal Level

Decentralised and participatory decision-making is needed to recognise the specific constraints of mountain conditions. As mountain tourism is intricately linked to many other economic sectors, consistent sectoral and regional policies are required to address it (Price et al, 1999). Federal policy must 'enable and support regional decision making and that the regional control over resources in the essential areas of life' (Brugger et al, 1984). Therefore the federal principle in Switzerland must continue to support autonomous development at the local and regional level.

- Improve Dissemination of Information to the local level of academic / government reports.
- Increase education in schools to retain local traditional knowledge of environmentally sound behaviour.
- Address the growing problems of lack of understanding of nature amongst the urbanized - the growing gap between urbanized and rural and upland and lowland.
- Instigate 'reward scheme' to encourage private sector involvement in diversifying local tourism initiatives and
- Increased research programmes in understanding climate change effects in mountain environments – reduces uncertainty in the estimation of impacts, thereby allowing a more appropriate level of the relevant method of insurance (Greenwood, 2005).

- The science community need to 'move from asserting the existence of climate change to describing the future climate in terms relevant to policy and decision makers' (Greenwood, 2005).
- Increase number of mountain agencies that operate for the benefit of mountain communities rather than for distant urban or lowland populations so that economic benefits of the alpine environment are better retained within the local economy.
- Enhance interaction between research, investment, policy and local communities – so that research respond more to the needs of the investment and policy stakeholders and communities seek the counsel of scientists in their adaptation plans.
- National Organisations need to continue to actively engage in knowledge and experience exchange programmes in the realm of climate change –playing a larger role at the local level in terms of dissemination of information.
- At the research level, it is vital that local stakeholders feel that they are more involved in adaptation possibilities. Therefore more targeted and stakeholder influenced research programmes could be established.

European Level

Even though Switzerland is not a member of the European Union, it is still involved in CIPRA: International Commission for the Protection of the Alps has been working in support of sustainable development in the Alps. CIPRA's motto is 'Getting Knowledge Across - Networking People', which is work that is sorely needed to be disseminated out of the European Research community and down to the local stakeholder level. Similarly, the Alpine Convention is an international agreement to protect nature and to promote sustainable development in the Alps (Alpine Convention, 2007).

- Increase knowledge exchange, perhaps through an online platform, across the European local communities within the above frameworks to provide more impetus for actors to implement tried and tested solutions from other areas to enhance economic diversification.

International Level

There is a multitude of international organisation working under and outside of the framework of the UN Mountain Agenda such as the UN Food and Agricultural Organisation

(FAO) Mountain Programme, (ICIMOD), Swiss Development Cooperation (SDC), Mountain Research Initiative (MRI), the Mountain Forum, The Mountain Partnership, The Mountain Institute and The Alpine Convention. Increased cooperation and leadership among this international mountain community to set standards and indicators for sustainable economic development could then

Outside of the realms of tourism, organisations such as the SDC support actions in the area of adaptation to climate change by helping local level stakeholders in developing countries understand their vulnerability to climate change, support adaptation programs and capacity building in areas of vulnerability assessment and planning for adaptation (Dubois, 2005).

International mountain events such as the Winter Olympics could be better utilised to exemplify sustainable mountain development, and raise awareness for the issues mountain communities face, and how climate change is exasperating these.

Additionally, in the planning of these events short-term profit and long-term environmental loss should be avoided (unlike in Nagano and Albertville) by implementing Environmental Impact Assessments (Müller & Kohler, 1999), including social and economic impacts as implemented at the Vancouver 2010 through their 'Environmental Stewardship and Impact Reduction' (Vancouver 2010, 2007). The games recognise that *'Winter sports and Games depend on snow and ice, and they are particularly vulnerable to the effects of global warming. The Olympic and Paralympic Winter Games also use considerable energy to heat buildings, make snow, freeze ice sheets and sliding tracks, power equipment, and transport people and goods. These actions all generate GHG emissions. This challenges the Olympic and Paralympic Movements to minimize GHG emissions and leverage the Games to raise awareness among athletes and international audiences'.*

- Utilise the UNESCO partnership as a means to increased knowledge and experience sharing across different world heritage sites.
- Extend the remit of reports such as 'Case Studies on Climate Change & World Heritage' (UNESCO, 2007), in order to help increase communication of knowledge across the different UNESCO World Heritage Sites, by sharing experience across the

different areas amongst the communities themselves.

- Establish a framework to support an international UNESCO Knowledge and Experience Exchange in which local stakeholders can participate.

Napal (2007) suggests the mountain eco-tourism could greatly benefit from a system of designation similar to the UNESCO WHS designation system, involving stakeholders from the eco-tourism industry (policy makers, practitioners and local communities) who would develop a set of criteria and check points to designate and maintain eco-tourism sites. Offer distinct benefits to those that adhere to the scheme to engage the private sector more comprehensively. Such a scheme could be implemented at the Destination level, but its effects would be felt from the local to the international.

Collaboration & Networks:

Within the tourism sector increased collaboration and mergers to combat negative socio-economic consequences of climate change is trend that is set to continue, and must gain more support at the local level which within the case study site was seen to be happening. Increase the role and remit of tourism networks in sensitizing the public to the issue, such as ECLAT, UN World Tourism Organisation (UNWTO). *'UNWTO has initiated a series of pilot projects to assist selected SIDS, in order to develop and demonstrate adaptation policies and techniques at beach destinations and coastal ecosystems. Initial proposals on climate change adaptation in tourism has been approved by the Global Environmental Facility (GEF)'* (UNWTO, 2007). It's cooperation with the World Meteorological Organization, since 1992 to produce Handbook on Natural Disaster Reduction in Tourist Areas (WMO & UNWTO, 1998) or UNWTO's contribution to the 27th edition of the World Climate News that deals with climate and tourism issues.

Further cross sector, trans-boundary collaboration could be established through an active network for all mountain stakeholders. This network could actively engage the research, policy, private, and community level stakeholders in the same way that the Small Island Developing States (SIDS) partnership has so effectively raised awareness for the issues that their nations face with climate change. . This network could:

- Official partnership organisation with interested parties from the private sector

- Help mountain focussed businesses understand the associated risks and corresponding mitigation or adaptation measures
- Offer mountain destinations a platform for raising their profiles at an international level

6.1: Further Research

Further work could be done to compare these results to lower level resorts, or to resorts outside of the Swiss Alps, with a different political system, such as in Italy, Austria or France, especially since Switzerland was found by the OECD (2007) study to be the least sensitive to climate change out of the five Alpine countries in the study. Additionally, since it is noted by OECD (2007) that the European Alps have a 'high adaptive capacity' it would be worthwhile using findings from this and similar studies and applying them to other mountain systems in developed and developing countries.

Further research could also be done to assess how what has been said in this study relates to other studies on tourist behaviour and demand for snow sports and alpine tourism in relation to climate change. Finally, according to Greg Greenwood (2005), Executive Director, Mountain Research Initiative there is currently insufficient 'understanding of climate change and its impacts in mountain regions to predict outcomes and plan accordingly'. More research is therefore called for to better understand 'how biophysical and economic systems respond to climate change in order to evaluate adaptation options'.

6.3: Beyond the Alps

Feelings of reservation, apathy, the general implementation of technical quick fixes, such as snow making, are typical of the global dialogue of climate change. Such public indifference needs to be tackled though concerted international governmental and agency effort to move people beyond the apathetic stage with the issue of climate change. Similarly, the sense that this was an issue that could be left for other generations to deal with alludes to the conclusions of the Stern Report (2006). Namely, that it is time for this generation to feel the

monetary costs of the externalities in order for a significant behaviour change to take place.

How alpine communities and the interested/surrounding private or public bodies react to these changes will shape the construction of the Alpine Future. There is a need to build up an image of this future as one that can move beyond the winter sport and ski dominated image of the past 50 years. This will need to incorporate factors from increased globalisation, such as the emergence of amplified competition not only from other mountain destinations such as the Himalayas, but also non-alpine destinations. While mountain tourism is fundamental to the overall concept of sustainable mountain development, diversifying the alpine economy to move away from such a one sided dependency, is vital to the creating social, economic and environmental benefits for the alpine future (Elsasser, 1999). However, as with climate change in the wider context, so often other daily issues usurp the focus away from longer term adaptive planning.

7: REFERENCES

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8: ANNEX

Section A1: Academic Interviews/Meetings

In preparation for the case study interviews, a number of informal meetings with academics took place. These meetings generated a deeper understanding of the areas of current research and knowledge within the field of Alpine climate change in Switzerland. A clearer picture of the Swiss policy and political framework was developed, namely which programmes are directed and controlled at Federal level, and which at canton or communal level. The meetings also provided direction as to which themes and sectors should be focused on, within the time limit of the MSc project, as well as developing the research methodology, interview protocol and structure.

Meetings took place with:

- Dr. Astrid Wallner (Co-Supervisor), CDE Bern University / NCCR North South
- Prof. Dr. Jaboury Ghazoul (Co-Supervisor), ETH, Zürich
- Prof. Dr. Urs Wiessman, CDE Bern University / NCCR North South
- Prof. Dr. Gertrude Hirsch, ETH, Zürich
- Prof. Dr. Willi Zimmerman, ETH, Zürich
- Dr. Fabian Weber, FIF, Bern University
- Dr. Matthias Bürgi, WSL
- Prof. Dr. Hans Elsasser, Geography Department, Zürich University
- Prof. Dr. Jürg Fuhrer, ART, Reckenholz
- Prof. Dr. Martin Beniston, University of Geneva / NCCR Climate
- Dipl. Geogr. Ursula Shüpbach, UNESCO JAB, Management Centre

Section A2: Tables and Figures

Table A1: Adaptation measures mentioned within interview, before the priority-scoring sheet, by stakeholder level. The numbers represent the number of stakeholders at that level that mentioned the particular adaptation response.
Federal - no real implementation duties except for their expertise in the field of education and environmental protection
National stakeholders SBS, SBV are mainly representative bodies -with no implementation duty - but tend to play a role in marketing, media relations, knowledge awareness and disseminating information to their members and the public.

Adaptation Measures	*Federal*	*National*	*Canton*	*Destination*	*Local*
Educative	1				
Reports/Studies			2	2	2
Training/Specialisation (Mountain Guides)		1			
Population Sensitization		1	1	1	2
Tourist Sensitisation				2	5
Workshops		2			
Knowledge/Experience Sharing		2			
Promote Sustainable Development					
Technical Measures					
Glacial Covers		1	1		1
Artificial Snow		1		3	13
New technologies and energy use		1	1		2
Close ski areas					
Re-naturalise slopes			1		
Active monitoring of the climate			1	1	2
Infrastructure Investments					
Improved Snow making	1				
Marinating Mountain Agriculture	1				1
Protecting Infrastructure			1		3
Permafrost Protection	1				4
Slope development/optimisation					
Protective Measures					
Repairing mountain paths/routes					1
Repairing mountain huts					1
Environmental Protection			3	1	4
Flood Protection			2		
Avalanche Protection			1		
Other NH Protection					3
Water protection measures					1
Offer Diversification					
Expand the offers available/diversify			1	2	8
Non Snow Dependant				1	5
Climate Neutral Holiday					1
Growth in Summer Tourism			1	3	
Cheaper ski offers					2
Innovation					
Increased Collaboration			1	2	
Create new image			1		
Communications and Marketing				2	4
Press Management				1	5
Mitigation & Energy Savings		1	2		6
Integrate CC issues into investment decisions				1	
Unemployment benefits and subsidies					1

Table A2: Total priority scorings given to the adaptation measures, as listed from the literature review

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	ADAPTATION MEASURE	*TOTAL SCORE*
Technical Measures	ARTIFICIAL SNOW	123
	IMPROVE EFFECTIVENESS OF SNOW MAKING	113
	IMPROVE AND DEVELOP SKI PISTES	99.5
	DEVELOPING HIGHER SLOPES	92
	RENATURALISE LOWER SLOPES (MAKE THEM AVAILABLE FOR OTHER ACTIVITIES)	76
	ONLY NORTH FACING SLOPES	59
	MORE GLACIER SKIING	44
	GLACIAL COVERS	49
	ARTIFICIAL SKI PISTES	51
	SLOPE STABILISATION	78
Innovation & Diversification	CLOSE THE LOWER SLOPES	79
	CHANGE THE SEASON: 4 SEASON YEAR	74
	EXTEND THE SEASON	88
	DIVERSIFICATION OF WINTER & SUMMER OFFERINGS	98.5
	CONFERENCE TOURISM	85
	RETIREMENT OFFERS	101
	ALPINE WELLNESS TOURISM	110
	CULTURAL & EDUCATIONAL OFFERS	90
	PROMOTE TRADITIONAL CRAFTS & MOUNTAIN (TRADES) (WATCH MAKING, LOCAL PRODUCE, HERBAL AGRICULTURE FOR MEDICINAL PURPOSES)	101
	SPECIALISE IN PARTICULAR MARKET SEGMENTS	92
	CHANGE THEIR IMAGE	62
	MERGERS AND COLLABERATION BETWEEN DIFFERENT SKI/TOURISM AREAS	112
Scientific Research	INTENSIFY RESEARCH	89
	COMMUNICATE & SENSITIZE THE PUBLIC ABOUT THE WEATHER AND NATURAL HAZARDS RISKS	106
	BETTER INTEGRATE SCIENTIFIC RESEARCH INTO THE DECISION PROCESS	97
	INTEGRATE POSSIBLE RISKS OF CLIMATE CHANGE INTO THE DECISION PROCESS	110
	STRENGTHEN SPACIAL PLANNING LAWS	109
Communication & Marketing	BETTER MANAGEMENT OF NEGATIVE PRESS AND POLITICS	109.5
	PREPARE DESTIONATION DEVELOPMENT PLANS TOGETHER	110.5
	SENSITIZE THE PUBLIC AND TOURISTS TO THE CC ISSUES WITH OPEN INFORMATION	115
Financial Measures	SUBSIDIES FOR ARTIFICIAL SNOW PRODUCTION	76
	FINANCIAL SUPPORT FOR BUSINESS LOSSES	74.5
	INSURANCE FOR FINANCIAL LOSSES DUE TO LACK OF SNOW	78
	LINK PREVENTION WITH INSURANCE COSTS	86
	SOFTEN ENVIRONMENTAL PROTECTION	66

Table A3: Overview of the ranked priority ratings of adaptation measures in order of top to lowest ranking.

ADAPTATION MEASURES	PRIORITY SCORE
ARTIFICIAL SNOW	**123**
SENSITIZE THE PUBLIC AND TOURISTS TO THE CC ISSUES WITH OPEN INFORMATION	**115**
IMPROVE EFFECTIVENESS OF SNOW MAKING	**113**
MERGERS AND COLLABERATION BETWEEN DIFFERENT SKI/TOURISM AREAS	**112**
PREPARE DESTIONATION DEVELOPMENT PLANS TOGETHER	**110.5**
ALPINE WELLNESS TOURISM	**110**
INTEGRATE POSSIBLE RISKS OF CLIMATE CHANGE INTO THE DECISION PROCESS	**110**
BETTER MANAGEMENT OF NEGATIVE PRESS AND POLITICS	**109.5**
STRENGTHEN SPACIAL PLANNING LAWS	**109**
COMMUNICATE & SENSITIZE THE PUBLIC ABOUT THE WEATHER AND NATURAL HAZARDS RISKS	**106**
RETIREMENT OFFERS	**101**
PROMOTE TRADITIONAL CRAFTS & MOUNTAIN (TRADES) (WATCH MAKING, LOCAL PRODUCE, HERBAL AGRICULTURE FOR MEDICINAL PURPOSES)	**101**
IMPROVE AND DEVELOP SKI PISTES	**99.5**
DIVERSIFICATION OF WINTER & SUMMER OFFERINGS	**98.5**
BETTER INTEGRATE SCIENTIFIC RESEARCH INTO THE DECISION PROCESS	**97**
DEVELOPING HIGHER SLOPES	**92**
SPECIALISE IN PARTICULAR MARKET SEGMENTS	**92**
CULTURAL & EDUCATIONAL OFFERS	**90**
INTENSIFY RESEARCH	**89**
EXTEND THE SEASON	**88**
LINK PREVENTION WITH INSURANCE COSTS	**86**
CONFERENCE TOURISM	**85**
CLOSE THE LOWER SLOPES	**79**
SLOPE STABILISATION	**78**
INSURANCE FOR FINANCIAL LOSSES DUE TO LACK OF SNOW	**78**
RENATURALISE LOWER SLOPES (MAKE THEM AVAILABLE FOR OTHER ACTIVITIES)	**76**
SUBSIDIES FOR ARTIFICIAL SNOW PRODUCTION	**76**
FINANCIAL SUPPORT FOR BUSINESS LOSSES	**74.5**
CHANGE THE SEASON: 4 SEASON YEAR	**74**
SOFTEN ENVIRONMENTAL PROTECTION	**66**
CHANGE THEIR IMAGE	**62**
ONLY NORTH FACING SLOPES	**59**
ARTIFICIAL SKI PISTES	**51**
GLACIAL COVERS	**49**
MORE GLACIER SKIING	**44**

Table A4: Overview of the ranked priority ratings of adaptation measures in order of top to lowest ranking as ranked at the Federal/National stakeholder level.

ADAPTATION MEASURES	***Total Values***
ARTIFICIAL SNOW	127
MERGERS AND COLLABERATION BETWEEN DIFFERENT SKI/TOURISM AREAS	116
SENSITIZE THE PUBLIC AND TOURISTS TO THE CC ISSUES WITH OPEN INFORMATION	116
PREPARE DESTIONATION DEVELOPMENT PLANS TOGETHER	115.5
IMPROVE EFFECTIVENESS OF SNOW MAKING	114
STRENGTHEN SPACIAL PLANNING LAWS	114
BETTER MANAGEMENT OF NEGATIVE PRESS AND POLITICS	113.5
INTEGRATE POSSIBLE RISKS OF CLIMATE CHANGE INTO THE DECISION PROCESS	113
ALPINE WELLNESS TOURISM	111
COMMUNICATE & SENSITIZE THE PUBLIC ABOUT THE WEATHER AND NATURAL HAZARDS RISKS	107
RETIREMENT OFFERS	104
IMPROVE AND DEVELOP SKI PISTES	103.5
PROMOTE TRADITIONAL CRAFTS & MOUNTAIN (TRADES) (WATCH MAKING, LOCAL PRODUCE, HERBAL AGRICULTURE FOR MEDICINAL PURPOSES)	102
DIVERSIFICATION OF WINTER & SUMMER OFFERINGS	101.5
BETTER INTEGRATE SCIENTIFIC RESEARCH INTO THE DECISION PROCESS	100
SPECIALISE IN PARTICULAR MARKET SEGMENTS	96
DEVELOPING HIGHER SLOPES	95
CULTURAL & EDUCATIONAL OFFERS	94
EXTEND THE SEASON	91
CONFERENCE TOURISM	90
INTENSIFY RESEARCH	90
LINK PREVENTION WITH INSURANCE COSTS	90
SLOPE STABILISATION	82
INSURANCE FOR FINANCIAL LOSSES DUE TO LACK OF SNOW	81
RENATURALISE LOWER SLOPES (MAKE THEM AVAILABLE FOR OTHER ACTIVITIES)	80
CLOSE THE LOWER SLOPES	80
SUBSIDIES FOR ARTIFICIAL SNOW PRODUCTION	79
FINANCIAL SUPPORT FOR BUSINESS LOSSES	75.5
CHANGE THE SEASON: 4 SEASON YEAR	75
CHANGE THEIR IMAGE	66
SOFTEN ENVIRONMENTAL PROTECTION	66
ONLY NORTH FACING SLOPES	60
GLACIAL COVERS	53
ARTIFICIAL SKI PISTES	52
MORE GLACIER SKIING	46

Table A5: Overview of the ranked priority ratings of adaptation measures in order of top to lowest ranking as ranked at the Destination stakeholder level.

ADAPTATION MEASURES	***Total Values***
IMPROVE EFFECTIVENESS OF SNOW MAKING	15
EXTEND THE SEASON	15
PREPARE DESTIONATION DEVELOPMENT PLAN TOGETHER	15
INTEGRATE POSSIBLE RISKS OF CLIMATE CHANGE INTO THE DECISION PROCESS	14
BETTER MANAGEMENT OF NEGATIVE PRESS AND POLITICS	14
MERGERS AND COLLABERATION BETWEEN DIFFERENT SKI/TOURISM AREAS	13.5
ARTIFICIAL SNOW	13
CHANGE THE SEASON: 4 SEASON YEAR	13
INTENSIFY RESEARCH	13
BETTER INTEGRATE SCIENTIFIC RESEARCH INTO THE DECISION PROCESS	13
SENSITIZE THE PUBLIC AND TOURISTS TO THE CC ISSUES WITH OPEN INFORMATION	13
LINK PREVENTION WITH INSURANCE COSTS	13
COMMUNICATE & SENSITIZE THE PUBLIC ABOUT THE WEATHER AND NATURAL HAZARDS RISKS	12
CLOSE THE LOWER SLOPES	11
RETIREMENT OFFERS	11
STRENGTHEN SPACIAL PLANNING LAWS	11
INSURANCE FOR FINANCIAL LOSSES DUE TO LACK OF SNOW	11
RENATURALISE LOWER SLOPES (MAKE THEM AVAILABLE FOR OTHER ACTIVITIES)	10
DIVERSIFICATION OF WINTER & SUMMER OFFERINGS	10
ALPINE WELLNESS TOURISM	10
CONFERENCE TOURISM	9
CULTURAL & EDUCATIONAL OFFERS	9
PROMOTE TRADITIONAL CRAFTS & MOUNTAIN (TRADES) (WATCH MAKING, LOCAL PRODUCE, HERBAL AGRICULTURE FOR MEDICINAL PURPOSES)	9
SPECIALISE IN PARTICULAR MARKET SEGMENTS	9
FINANCIAL SUPPORT FOR BUSINESS LOSSES	9
IMPROVE AND DEVELOP SKI PISTES	7
SLOPE STABILISATION	7
CHANGE THEIR IMAGE	7
SUBSIDIES FOR ARTIFICIAL SNOW PRODUCTION	7
SOFTEN ENVIRONMENTAL PROTECTION	7
DEVELOPING HIGHER SLOPES	6
ONLY NORTH FACING SLOPES	6
MORE GLACIER SKIING	6
GLACIAL COVERS	4
ARTIFICIAL SKI PISTES	3

Table A6: Overview of the ranked priority ratings of adaptation measures in order of top to lowest ranking as ranked at the canton stakeholder level.

ADAPTATION MEASURES	***Total Values***
STRENGTHEN SPACIAL PLANNING LAWS	17
RENATURALISE LOWER SLOPES (MAKE THEM AVAILABLE FOR OTHER ACTIVITIES)	16
CONFERENCE TOURISM	16
SPECIALISE IN PARTICULAR MARKET SEGMENTS	16
MERGERS AND COLLABERATION BETWEEN DIFFERENT SKI/TOURISM AREAS	16
ARTIFICIAL SNOW	15
CULTURAL & EDUCATIONAL OFFERS	15
INTEGRATE POSSIBLE RISKS OF CLIMATE CHANGE INTO THE DECISION PROCESS	15
IMPROVE AND DEVELOP SKI PISTES	14
EXTEND THE SEASON	14
RETIREMENT OFFERS	14
CHANGE THEIR IMAGE	14
PREPARE DESTIONATION DEVELOPMENT PLANS TOGETHER	14
SENSITIZE THE PUBLIC AND TOURISTS TO THE CC ISSUES WITH OPEN INFORMATION	14
SLOPE STABILISATION	13
ALPINE WELLNESS TOURISM	13
BETTER INTEGRATE SCIENTIFIC RESEARCH INTO THE DECISION PROCESS	13
IMPROVE EFFECTIVENESS OF SNOW MAKING	11
DEVELOPING HIGHER SLOPES	11
CLOSE THE LOWER SLOPES	11
CHANGE THE SEASON: 4 SEASON YEAR	11
DIVERSIFICATION OF WINTER & SUMMER OFFERINGS	11
COMMUNICATE & SENSITIZE THE PUBLIC ABOUT THE WEATHER AND NATURAL HAZARDS RISKS	11
LINK PREVENTION WITH INSURANCE COSTS	11
PROMOTE TRADITIONAL CRAFTS & MOUNTAIN (TRADES) (WATCH MAKING, LOCAL PRODUCE, HERBAL AGRICULTURE FOR MEDICINAL PURPOSES)	10
GLACIAL COVERS	9
INSURANCE FOR FINANCIAL LOSSES DUE TO LACK OF SNOW	9
ONLY NORTH FACING SLOPES	8
MORE GLACIER SKIING	8
INTENSIFY RESEARCH	8
BETTER MANAGEMENT OF NEGATIVE PRESS AND POLITICS	8
SUBSIDIES FOR ARTIFICIAL SNOW PRODUCTION	8
ARTIFICIAL SKI PISTES	5
FINANCIAL SUPPORT FOR BUSINESS LOSSES	5
SOFTEN ENVIRONMENTAL PROTECTION	3

Table A7: Overview of the ranked priority ratings of adaptation measures in order of top to lowest ranking as ranked at the Local stakeholder level.

ADAPTATION MEASURES	***Total Values***
ARTIFICIAL SNOW	91
IMPROVE EFFECTIVENESS OF SNOW MAKING	83
BETTER MANAGEMENT OF NEGATIVE PRESS AND POLITICS	82.5
ALPINE WELLNESS TOURISM	79
IMPROVE AND DEVELOP SKI PISTES	78.5
SENSITIZE THE PUBLIC AND TOURISTS TO THE CC ISSUES WITH OPEN INFORMATION	78
PREPARE DESTIONATION DEVELOPMENT PLANS TOGETHER	77.5
MERGERS AND COLLABERATION BETWEEN DIFFERENT SKI/TOURISM AREAS	76.5
STRENGTHEN SPACIAL PLANNING LAWS	75
PROMOTE TRADITIONAL CRAFTS & MOUNTAIN (TRADES) (WATCH MAKING, LOCAL PRODUCE, HERBAL AGRICULTURE FOR MEDICINAL PURPOSES)	74
DEVELOPING HIGHER SLOPES	73
COMMUNICATE & SENSITIZE THE PUBLIC ABOUT THE WEATHER AND NATURAL HAZARDS RISKS	73
DIVERSIFICATION OF WINTER & SUMMER OFFERINGS	71.5
INTEGRATE POSSIBLE RISKS OF CLIMATE CHANGE INTO THE DECISION PROCESS	71
RETIREMENT OFFERS	70
SPECIALISE IN PARTICULAR MARKET SEGMENTS	63
INTENSIFY RESEARCH	63
BETTER INTEGRATE SCIENTIFIC RESEARCH INTO THE DECISION PROCESS	62
CULTURAL & EDUCATIONAL OFFERS	61
LINK PREVENTION WITH INSURANCE COSTS	59
SUBSIDIES FOR ARTIFICIAL SNOW PRODUCTION	58
FINANCIAL SUPPORT FOR BUSINESS LOSSES	57.5
SLOPE STABILISATION	57
EXTEND THE SEASON	57
CONFERENCE TOURISM	56
INSURANCE FOR FINANCIAL LOSSES DUE TO LACK OF SNOW	55
SOFTEN ENVIRONMENTAL PROTECTION	52
CLOSE THE LOWER SLOPES	51
RENATURALISE LOWER SLOPES (MAKE THEM AVAILABLE FOR OTHER ACTIVITIES)	50
ONLY NORTH FACING SLOPES	44
CHANGE THE SEASON: 4 SEASON YEAR	44
CHANGE THEIR IMAGE	42
ARTIFICIAL SKI PISTES	41
GLACIAL COVERS	35
MORE GLACIER SKIING	28

Table A8: Adaptive measures implemented by private and public stakeholders in response to the different threats from climate change on tourism

THREATS MENTIONED	PRIVATE	PUBLIC
Lack of Snow Security	Artificial Snow Making, Offer Diversification	Awareness Raising
Increased Precipitation		Flood Protection
Landscape Change		
Glacier Recession	Glacier Covers (but not in case study areas)	
Permafrost Degradation	Infrastructure Protection	
Increased Storminess		
General Warming		
Increased Natural Hazards		Avalanche, Rock fall, landslide barriers/protection
Environmental Damage & Pollution		Land Use Planning Awareness Brochures, Environmental Protection

Table A9: Breakdown of how stakeholders spoke about the measures that they have said have been implemented in comparison to those that they will implement. In a number of cases stakeholders have commented that currently, they feel they do not need to implement any measures.

Stakeholder Group	***Adaptation Measures Implemented***	***Adaptation Measures to be Implemented***
Federal - BAFU	They are not responsible for implementing	Not their remit to implement – Refer to the Klima 2050 report for other issues and the BAFU point of view. – They are mainly focussed on the drought effect of CC rather than the heat for nature as well as agriculture
National - Schweizer Bergführer Verband (Swiss Mountain Guide Association)	The guides themselves, or the SAC, do a lot of work stabilise the paths, with little or no financial or logistical assistance from the communal, destination, cantonal, or federal level.	Look for new paths - the routes are fixed, because most accidents happen on the walking paths rather than the big mountain paths, because that is where most of the guests go. Diversification. Mountain guides will need to work at different altitudes at different times of year - these will probably need to adjust. Increased training for 100 mountain guides for working with natural dangers/hazards. Increased specialization within the role of mountain guide.
National - Seilbahn Schweiz (Swiss Cable Car Association)	Examples that he was aware of: Glacier Covers (e.g. Gamfstock, Andermatt) – 30-40,000 CHF to rebuild the piste every year, yet these are just local solutions and cannot cover a whole glacier. Snow Farming. Arosa – Climate Neutral Holidays (Arosa Tourism initiative, the Cable Car company is just a partner) – Mitigation	SBS cannot itself implement anything - it does make recommendations, share knowledge, raise awareness and elevate the theme. Some of the Seilbahns are experimenting with new technologies and alternative energies Increase in public awareness in the last couple of years, therefore there has had to be a lot of public campaigning along the actual work they have been doing for years. Their biggest challenge is the day guests who are more and more using their private cars are transport Lötschberg Tunnel is a great accomplishment towards getting national and international travellers off the road and the station at Flümserberg is an excellent example of good planning Zermatt is talking about strategies to reduce the traffic (even though it is only electric cars) – thinking of putting a Seilbahn over the village
Canton Bern		

Beco (Bern Office for Economics and Business) (Berner Wirtschaft Oeconomie)		Referred to the recommendations within the FIF report. Important to expect individuals to react as well Referred to mitigation as well.
AUE (Office for Environmental Coordination and Energy) (Amt für Umweltkoordination und Energie)	For them at the AUE the focus is on environmental protection. Referred to the FIF Report that they collaborated on. The Regierung is investing in measures to protect against natural disasters and he mentioned the Energy Strategy of the Canton. Important to recognise the change and lose dependence on old images and build up a new image (Bilder), should not look back, but start again with a clean sheet. Need to build infrastructural protection – which is expensive. In some places (Bern, Brienz, Thun - Aare) protective measures are already under way against natural hazards - flood protection is the major issue for them.	Canton is more involved with natural hazard protection. The natural hazards protection strategies – remit comes from the Canton while the plans come from the commune. Canton finances where they have given the requirement. Gave examples of the information packs that they are distributing, and the energy strategy and report on the Heat wave of 2003.
Canton Wallis		
Office for Economic Development (Dienstelle Wirschafts Entwicklung)	Protecting natural beauty. Glacial covers	Close ski areas if it becomes impossible to ski and implement other activities there. Need to put pressure on Bern and the federal government - and spoke about China (again Mitigation) Sustainable Development for businesses within the region Umweltkarte. Strategic developments - not just because of climate change.
Office for Environmental Protection (Dienstelle Umweltschutz)	Have not yet started to implement solutions at Canton Level. Tirone Corrections – already started Re-naturalisation – a lot more projects.	
Jungfrau		
Wengen-Mürren-Lauterbrunnental Tourism	None so far implemented because it is not yet a major problem. But do have a communications and marketing plan - attempting to be more proactive towards negative press. Offers: Summer Fresh Advertise the highness of the ski area. Need to increase marketing and	Have some ideas: Sensitizing the guests to the issue. Importance of Mürren and Wengen remaining car free, within the issue of climate change. Have a lot of hikers, who they should make aware of the problem, especially within the UNESCO area. Winter: Promote sports that don't need so

	communication in this area, for which there is a plan, but it was not concrete. More proactive management of negative press (but didn't see it as an adaptation measure).	much snow or so much ski piste preparation e.g. snow shoeing, winter walking. Raise awareness for the other snow sports that don't need so much snow. Prepared winter walking paths. Expand the offers.
Jungfraubahn	Permafrost observations have been taken on the Jungfraujoch since 20 years, therefore they have been dealing with this issue for a long time - but it is only recently that it has raised such great outside / media interest. Since 1980s, they have dealt with the issue, especially in terms of building projects. Investing more heavily in summer tourism - and pushing summer offers - they have been doing this for a long time, and therefore are better balanced than other areas. Winter: making the investments so that they can have snow for longer - i.e. Snow making to compensate for less snow. Balancing of summer: winter offers. Infrastructural protection against the storms that are becoming more frequent (have increased significantly in the last 3/4 years).	Need to observe and react to the changes in climate. Need to invest in the next 20 years (until 2030) in artificial snow. But need to think about whether this makes sense in the next 50/60 years. Summer adaptation is an ongoing process and is not time constrained and have already been investing for a long time in this area and will continue to. Those who react faster will be better positioned in the market. Partnerships: marketing measures in other areas such as India, Thailand, Australia to attract off season tourists there and actively selling in these markets. Since 10/12 years - temperature measurements and have it under control - because of technical measures taken. Most important for Grindelwald area because of the glacier melting and the natural hazards associated with it.
Aletsch		
ProNatura	Bettmeralpbahn is pushing for more summer tourism Building a gallery/exhibition on the Bettmerhorn station.	Important to show them the problems that tourism brings and the difficulty of working with it as well. More needs to be done about the effects of winter tourism - especially as pressure increases on smaller and smaller areas. Important to show the importance of these forests to the visitors.
Mürren		
Public	Protection measures against natural hazards - but that these were not necessarily tied in with Climate Change. As for adaptation measures nothing has so far been realised or agreed on except for Snow making and piste planning - however these were not done necessarily because of CC.	No real alternatives to tourism within the Mountain area. Other industries will stay in the urban centres - won't move them to the mountains. – People do not come up here for the add on offers (tennis courts, swimming pools) but for the nature and snow in winter. In winter 98-99 all emergency programmes were greeting with disinterest - they just

		want to experience the winter nature, not swimming pools, walking etc. They just want to ski and maybe skate - nothing else. At the moment - artificial snow is the priority, but its economic viability needs to be considered. – Protective measures are also important - but they need the financing for it. Need federal/cantonal financial support.
Public - Tourism Office	Have not implemented much yet - because they are a high area - and therefore still snow secure. Already starting to push summer offers more to readdress the winter heavy balance. Artificial snow making from the Schilthornbahn has been implemented to put the base down.	Need to look at what offers they have - that they are good offers and something that the guests want - plus that they are ready for the changes that CC will bring. If there is no snow - then they need to react to this. Spoke about the fact that due to the glaciers melting and disappearing - there might be scope to offer geology offers as they landscape changes. Need to discuss this process of creating new offers seriously, as it will take a lot of work to figure out what is attractive to the tourists.
Private - Cable car Company (Bahn)	The issue of permafrost (on north side of Schilthorn) was already being observed by Schilthornbahn in the 60s, so they have been monitoring and working on it since then. SBB- Winter Walking general pass. They have technologies which means that they can compensate for changes. There has been new investment in the upper slopes, but while Climate Change was one part of the reason for this, it was not done because of Climate Change.	Permafrost was always was a problem - just need to learn how to live with it- but issue is that the media makes such a big deal about it Develop winter walking offers - wellness, fitness offers. Offer diversification.
Private - Hotelier	First said no - then mentioned snowmaking. Investment in cable car from Grütschalp to Lauterbrunnen instead of old funicular train.	Protection again natural hazards/dangers. They need to work towards what the tourists want/demand but the tourists also need to realise the natural boundaries. Since Mürren is on a terrace - there is very little that in terms of expansion that it can do. In the next few winters - nothing is really needed.
Private - Hotelier	As yet they have not implemented anything concrete - but there will come a time when it will become more	If they are cut off - then they need to react – referred to the snowfall in June and so they need to think about how they can react to

	important - especially as there will be more issues about access and natural hazards/dangers	such situations. Marketing needs to adapt - reach more markets. More information to the tourists - especially on safety of the region and what will happen. Guests need to be made to feel safe. Artificial snow - but the problem is when the temperatures rise more.
Private - Hotelier	Nothing at all.	They do need to adapt when big changes happen. They offer peace and quiet - need to keep it that way. Marketing measures to get more guests Increase in the building/infrastructural measures being taken by the commune in terms of infrastructural protection (avalanche protection, rock fall protection).
Private - Tourism Verein & Sports Shop	There is currently not much talk about CC.	They will need to look at what will happen, but there are not so many options to expand the offers. People within tourism are thinking more about mitigation that adaptation.
Private - Sports Shop	Jungfrau region & Schilthornbahn have invested in Snow making machines - so that the infrastructure is set up to cope with less snow secure winters. Jungfrau region & Schilthornbahn have invested in Snow making machines - so that the infrastructure is set up to cope with less snow secure winters. Other lift developments	A winter resort needs snow - but at the same time, Mürren is a traditional resort, with regulars and therefore changing the offerings just might meet with confusion.
Bettmeralp		
Public	Have certain offers to families for weekend and day trips in January so that they can see how good the conditions are. At the moment the press is so negative, this rubs off on the tourists. Need 'einstimmung'. E.g. they have live cameras and live pictures on the web and in Bern Station – to give the true picture of what conditions are. Do a lot with children and schools, to ensure that they come up to ski with the schools, so they can see how well they feel up here. Important to have this experience instilled as children.	People think they can dictate nature, but they need to stop thinking like this, they need to learn how to live with it. Need to learn again how to save energy, water, turning off taps and lights, only use as much eating as you need, don't have windows open with the heating on. Need to 'sensitization' for people – and need to start in the school.

Public - Tourism Office	Have invested heavily in artificial snow making in Bettmeralp (CHF 12-13 million). The snow canons now come out at the end of October, starting earlier.	At the moment not using chemicals in their snowmaking – but if the temperature rises 1 or 2 more degrees, then they will need to start doing so, and this is more expensive. Adaptation is always taking place – man is very adaptive – will need to look for different alternatives such as winter walking, artificial ice rinks, more wellness offers, need to find alternatives to snow sports.
Private - Sport Shop	Artificial snow is the most important issue for him.	Implementing more alternative energy – solar power in winter and summer
Private - Sport Shop	Snow Canons. Trying to move pistes higher - but not so much room for that in this area Mitigation/general environmental consciousness in terms of careful waste disposal etc.	Snow Making - people just want snow.
Private - Hotel	Until now, nothing has been implemented.	At the moment there is not that much done – but maybe not so much is really affecting the hoteliers at the moment. Collaboration – to work together to save energy, mitigation strategies – look at taking economic steps that will have ecological consequences. (E.g. signs in the hotel about towels, and washing, to save energy/water and therefore look after the environment). Individuals have to do their own part.
Private - Hotel	No - But then spoke about artificial snow production.	Little has been implemented…
Private - Hotel	No. - Hotel Verein has talked about how they can all reduce their CO2 emissions and other mitigation efforts - but that is the only thing.	Very important to implement something in terms of transport technical measures and protection against natural hazards. Increasing issues with permafrost will need to be dealt with. Spoke about Bretsch-Mörel - protection against rock falls. On his own he can look into energy savings
Private - Ski School	Other sports offerings: e.g. Nordic walking - but does not feel so positive about these.	Hopes that it will get better and at the moment doesn't know what she would do. So if next year, or the following years are bad, then she doesn't know what she will do.
Private - Ski School	No major plans.	Snow Canons: without the snowmaking - it would be impossible to ski at Christmas. Winter walking, alternative offers, but will have to see what happens with the climate/weather.
Private - Bahn	Permafrost is a major issue.	Increase summer tourism, building

	Have to redo the paths every year – to stabilise them. Push on summer tourism – to increase the share. Built the gallery on the Bettmerhorn to protect the walkers – cost CHF 300,000. Started to notice the problem after 2004. Financed by Bettmeralpbahn, but always in consultation with the commune and tourism office Have a video room showing history of the Aletsch Gletscher in the Bettmerhorn restaurant. UNESCO – combined projects such as the Lötschental, Grindelwald, Bettmeralp UNESCO Nordic walking (in its 2nd year)	protection v permafrost problems, and slope stabilisation to protect walkers. UNESCO combined products – Work closely with the mountain experience Working on joint products with other cable car companies. Doing their part in mitigation – encouraging people to come with public transport – new Lötschberg Tunnel opening on 19.Dec Intensify marketing to increase summer tourism share (at the moment 80%=Winter, 20%=Summer) & better planning to move more towards summer (Climbing, nature & culture offers, Nordic walking, half marathons, biking)
Private - Bahn	About CHF 10 million investment into snow canons (10 million in investment for the infrastructure for the snow making. 1 million for operational costs including capitalisation - this is just for Fiesch). Therefore need revenue to grow in order to cover this. Have already implemented a measurement campaign and stabilised the areas with problems on the Eggishorn area.	Stopped plans for a Valley descent because of snow security issues. Spoke about snow canons and technical measures for infrastructural safety against permafrost issues. ETH reports building on permafrost and natural hazard zones.

Table A10: Importance ratings that the different levels of stakeholder place on the need to implement adaptation measures; the issue of climate change; and detail on which other issues are currently of more importance than climate change.

Stakeholder	***Importance of Implementing Adaptation Measures***	***Importance of Climate Change***	***Other Issues of Importance***
Federal / National	High	Most Important Issue	Investment Issues & Structural Change
	High	Important	Financing/Mergers/Consolidation
	High		Development of the Destinations
Canton	High	Just as important as other issues	Increased global competition
	High	High	Competition with other Swiss commercial hubs
	High	High	Business & Industry
	High	Medium	
Destination	Medium	Important	Development of the Destination
	Dependant on Summer of Winter	Important	Financing, Marketing & Technology
	Important	High	Mid & Long term Investment Environmental Education Environmental Protection
Local	High (13)	Very Important (4)	Daily & Short Term Issues
	Medium (2)	Important (2)	Environmental Protection
	Low (4)	Not important enough	Financing & Marketing Issues
		Secondary Issue (2)	Travel Tax (Kurtax) & Sports Centre
		Not very important (7)	Inaccurate Weather Forecasting
		Mainly a summer issue	Traffic Issues (Vekehr)
		Weather is more important than climate	Local School
			Improving & Investing in the pistes
			Technical Infrastructure
			Hospitality & Hotel Standards
			Local Image
			Increasing Tourist numbers
			Access & Mobility
			Maintaining mountain agriculture
			Energy Savings

Table A11; An overview of the regional adjustment process. An attempt to systematize the relationship between the two main dimensions of regional adaptation processes. (Source: Brugger et al, The Transformation of Swiss Mountain Regions, 1984, pg 63)

Economic Field: Structure of the Firm, firms' ability to adapt, labour market processes
Socio-Cultural Field: Spread of urban living standards & ways of life, identification or processes which affect the goals and preferences of individual actors.
Political Change Field: Collective and Institutional measures to improve living conditions and further economic growth or maintain autonomous development, which rests on local and regional consciousness.
Ecological Field: Changes in the use of space, intensity of land use, and consequences of such changes on nature and landscape.

At the time of publication (1984), this framework was not so focussed on the effects of climate change, but the relevance for how it may be applied and extrapolated to the issues that mountain communities face in adapting to the impacts of climate change on tourism. For more discussion of this topic refer to Section X.

Sub-system source & / control	**Economic**	**Socio-Cultural**	**Political**	**Ecological**
Exogenous	Functional disassociation and the division of labour (cf. Muggli, Müller, Geilinger)	Penetration of values from outside the region (cf. Walter-Busch)	Division of tasks between levels of government (cf. Kienholz, Bussman/	Selective use of natural resources from outside the region (cf. Krippendorf, Mauch/Schwank)
Endogenous	Decision-making at the level of the firm and inter-firm linkages (cf. Arend, Abt)	Changes in value preferences among youth in the mountain areas (cf.Bassnad, Niederer)	Decision-making capacity and responsibility at the municipal level (cf. Schäfer, Vettiger-Galluser)	Large scale, self-reliant use of natural potential (cf Charles, Rieder, Meyer, Rey)

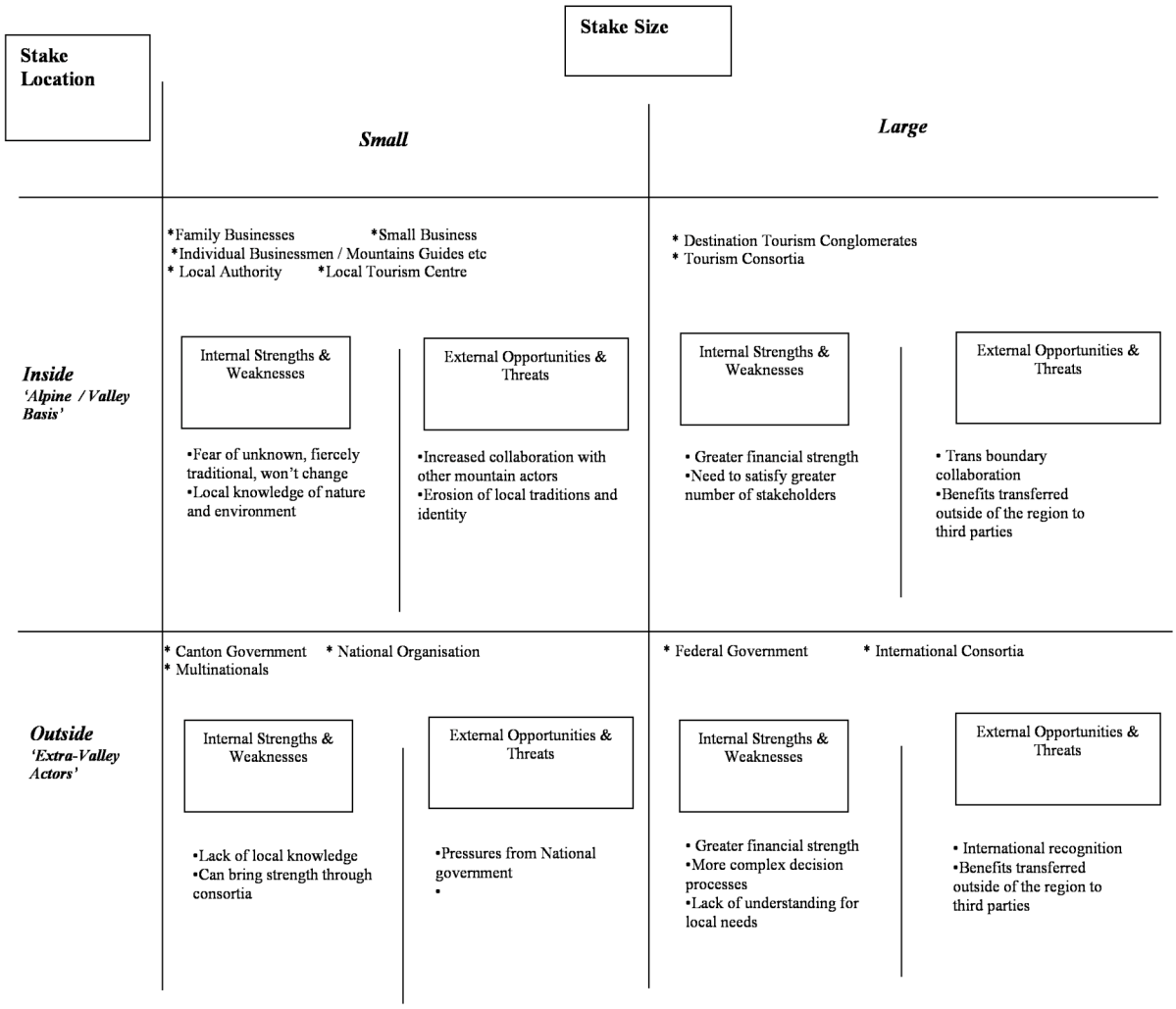

Figure A1: Identifying potential for linking stakeholders of different size and locations: Stake size: Small stakeholders (e.g. Family businesses (inside), canton government / multinationals (outside), large stakeholders (e.g. Area authorities or Middle men (inside), federal government / international consortia (outside). Stake location comprises of 'Insiders' (valley basis), 'Outsiders' (extra valley actors). Internal 'Strengths & Weaknesses' and external 'Opportunities & Threats' of each actor in the matrix cell reveals patterns for addressing emerging risks / uncertainties.

Section A3: Interview Format

Protocol

The interview began short introduction as follows:

Introduction:

I'm a Masters Student at Imperial College, London. At present, I am conducting my project in the Socio-Economic Consequences of Climate Change in the Swiss Alps. I shall be researching the adaptation strategies of different stakeholder groups in two case study areas, Mürren and Bettmeralp. Both are situated in the UNESCO World Heritage Site, but each in a different canton and on different size of the Alps. I am working in collaboration in ETH and University of Bern and am supported through the UNESCO World Heritage Jungfrau-Aletsch-Bietschhorn Management Centre.

In this Study I will be aiming to better understand:

- How you perceive the challenges of climate change in the tourism sector
- What are the pressures at the federal/canton/destination/communal (Gemeinde) level
- Observations and Expectations of Climate Change and the consequences for tourism
- Awareness and Knowledge of adaptation measures
- Adaptive capacity (Urgency to implement adaptation measures)
- Ability and possibility to act
- What have you decided to do
- Importance of the climate change issue in comparison to other issues for you

The interview will last about 30 minutes to an hour. If possible, I would like to record the interview – but you answers will be published anonymously in my final paper. I would like to take some demographic information, but again, this can remain confidential.

- Sex
- Age
- Hometown
- Occupation

We will need to agree for whom you are speaking, at the beginning of the interview – personally, or for you firm/department or for which group if you have more than one occupation? This needs to remain the same throughout. There are no right or wrong answers, just your own observations and views.

Questionnaire

The interview took place in 2 stages. Initially, a set of open ended questions were asked to instigate the interviewees to elucidate on their observations, expectations of climate change consequences within the case study areas. Questions then moved onto investigating their observations and expectations of the need for adaptation methods to these consequences, and which they were expecting to implement. The full set of questions in translation features below.

The second stage of the interview was a more closed questionnaire in which interviewees were asked to give defined priority rankings to a set of adaptations measures taken from the academic literature review. The measures were both technical and commercial/behavioural. The scale ranged from 5 -1.

5 – High

4 - Medium High

3 – Medium

2 - Medium Low

1 - Low

Section 1: Open Questions (30-45 minutes)

1a) Changes - Observation:

Have you already observed signs of climate change? Which signs? Over what timeline?

Which signs of climate change do you feel are the most important for tourism? Why?

Have you already experienced any effects on tourism? Which ones?

1b) Changes – Expectations:

What do you expect the short term and long term effects of climate change on the tourism sector?

Over the next 10 years? Over the next 25 years?

Which advantages and disadvantages do you expect from climate change?

On Winter/Summer tourism/Agriculture/other sectors?

2a) Adaptive Capacity – Observation:

Which adaptation measures have you already observed/discussed?

Did you hear about them from the media, academic or scientific reports, and regional/local information?

Have any measures already been implemented?

At which level? (Sector/communal/canton/national)? What was is decided? Was it implemented? What were the reasons for this?

Are there any recommendations or guidelines from the commune / canton / destination / federal level?

Or do you work with other businesses / communes / cantons/ destinations / countries?

When no: Why? Do you think this may be a problem? Or that this should happen?

When yes: Is this at all important? For whom? Or does it not play an important role in Switzerland?

2b) Adaptive Capacity – Expectations:

How important or urgent is it for tourism in this village/ region/ country to implement adaptation strategies? Very important (High)? Not important (Low)? Medium?

Which alternatives do you think, you could/would implement?

3) How important are the challenges or changes from climate change in comparison to the other challenges that you face? (I.e. your business/commune/canton/ tourism industry etc) faces? E.g.

Political

Economic

Environmental

4) Adaptive Capacity – Expectations: Priority Ranking (10 -15 mins)

For the following adaptation measures, can you please give a priority ranking (5-1) and comment where appropriate? (Ref Table 2)

5) Final Remarks: Any final comments? Would you like any further information?