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Climate change in the Swiss National Park region: Impacts of climate change on the tourism business in winter season in the Swiss National Park region

- Master thesis -

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Abbreviations

CO2 – Carbon dioxide
DMO – Destination Marketing Organization
HTW - Hochschule für Technik und Wirtschaft, University of Applied Sciences
MASL – Meters above Sea Level
SNP – Swiss National Park

Abstract

Climate change is currently a central issue for Swiss winter tourism, as the mountain destinations are and will be for sure affected in different modalities by this global phenomenon. This issue is even more pressing for those destinations that rely mainly on the revenues obtained from this type of tourism. This study investigates the climate change impacts on tourism business in the Swiss National Park (SNP) region during the winter time and also the tourism providers' behaviors with regards to this phenomenon. With the help of literature review, interviews with tourism experts and with tourism providers of the area, aspects such as physical impacts, effects on tourism business, adaptation measures, drivers, barriers, and consequences are treated. The results of this research can represent a starting point for further studies but it is also useful for the practitioners who are interested how climate change can influence winter tourism businesses in the SNP region during winter season.

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1 Introduction

1.1 Background

Climate change is currently a central issue for Swiss winter tourism sector, as the mountain destinations are and will be for sure affected in different modalities by this global phenomenon (Matasci, 2012; Gonseth, 2013). Additionally, tourism represents an essential pillar of Switzerland's economy as this sector is a great job creator and revenue generator (Swiss Tourism Federation, 2015; WTTC, 2015). Shifting from the national to a regional scale, it is acknowledged that several mountain destinations rely mainly on winter tourism and winter sports as their main source of income (Bürki et al. 2003, December).

One can argue that this is also the case of Swiss National Park (SNP) region, an area situated in the canton of Graubünden which is placed on the second position (after Zurich region) in terms of tourists' overnight stays (Swiss Federal Statistical Office, 2015). The fact that in the SNP region tourism plays a crucial role can be seen from the considerable number of touristic establishments and winter sport facilities.

Several studies have already analyzed the impacts of climate change on winter tourism destinations such as those of Koenig and Abegg (1997), Elsasser and Bürki (2002), Bürki et al. (2003, December), Hoffmann et al. (2009), Pütz et al. (2011), Matasci (2012), Gonseth (2013) or Matasci et al. (2014) who developed wonderful papers about this topic. Most of them treated the subject on a national scale, providing great results about climate change impacts on tourism businesses, about adaptation measures and about barriers and drivers for implementing such measures with the focus being set on Swiss Alps. To the author's knowledge, no research treated specifically the issue of climate change impacts on tourism businesses in the SNP area during winter season. Therefore, having into consideration that Wyss et al. (2014) acknowledge that there are still numerous uncertainties on how climate change will affect diverse regions and communities, it is important to analyze in more details the impacts of climate change on tourism in the SNP region and to identify the actions taken by tourism providers with regards to this phenomenon. For this reason, the current master thesis discusses the climate change impacts on tourism businesses in the SNP region during the winter season and also presents which is the current situation of tourism providers regarding their reactions to this global phenomenon.

1.2 Research problem, aim, objectives and questions

The **research problem** that this master thesis intends to resolve is given by the lack of (at least English) literature which investigates the possible impacts of climate change on the tourism business in the SNP region in the winter season and the tourism businesses' behaviors with regards to these impacts. As the author of this master thesis is only competent with English language, the studies in German (which is the main language of the canton where SNP is located) could not be assessed.

The author has decided to write about climate change in the SNP region because of the following reasons:

- Climate change is a very popular topic nowadays and the author desires to contribute in a smaller or larger proportion to understanding this phenomenon
- Swiss National Park region is a special region in Switzerland, being located around the only national park of the country
- SNP region is located in a extremely important area for tourism, being on the territory of Graubünden, the second region (after Zurich region) in Switzerland regarding tourists' overnight stays (Swiss Federal Statistical Office, 2015)
- SNP region is a mountain region, and it is well known that these areas are extremely sensitive to climate variability (Scott et al. 2012)
- Studying climate change impacts is relevant for the whole tourism businesses operating in that area. As it can be seen in chapter 3.3.2.2 there are several actors involved in the tourism industry in the region.

As suggested by Wyss et al. (2014) there are still several uncertainties on what impacts will climate change have, especially due to geographical singularities and to individual aspects that local communities present.

The **aim** of this research is to understand the impacts of climate change on the tourism business in the winter season in the Swiss National Park region and to understand the behavior of tourism business in this area regarding the impacts of climate change.

This aim leads to the following **research question**:

What are the impacts of climate change on the tourism business in the winter season in the Swiss National Park region and how do tourism providers act in this direction (adaptation measures, drivers, barriers, consequences)?

This master thesis intends to accomplish the following **objectives**:

- To have a common understanding of terms and concepts such as: climate change, general impacts of climate change, impacts of climate change on tourism business during the winter season in the Swiss Alps, adaptation measures taken by tourism businesses, drivers, consequences and barriers of implementing adaptation measures, tourism business in Switzerland, delimitation of SNP region, tourism business in the SNP region
- To provide information about how climate change physically affects the studied area and what peculiarities does the region present
- To identify how are the tourism businesses affected by physical impacts of climate change
- To discover which types of actors operating in the tourism sector (such as accommodation, transportation, activities providers) in the SNP area are the most vulnerable
- To provide information about tourism businesses' behaviors with regards to climate change, meaning to provide details about their adaptation measures, their drivers for implementing such measures, barriers and consequences of these measures.

The current master thesis intends to provide answers to the following **research sub-questions**:

1. How can the following terms and structures be defined: climate change, general impacts of climate change, impacts of climate change on tourism business during the winter season in the Swiss Alps, adaptation measures taken by tourism businesses, drivers, consequences and barriers of implementing adaptation measures
2. How can Swiss National Park region be defined?
3. What is tourism business in Switzerland?
4. What is tourism business in the Swiss National Park region?
5. What are the physical impacts of climate change that affect SNP region in the winter season?
6. What are the peculiarities of SNP region with regards to climate change physical impacts?
7. How is the tourism business in the SNP region affected by the climate change impacts?
8. Which tourism sub-sector (accommodation, transportation, activities providers etc) is the most vulnerable to climate change impacts in the SNP region?
9. Are tourism providers in the Swiss National Park region aware of climate change?
10. Did tourism providers in the SNP region implement some adaptation measures?
11. What are the drivers, barriers and consequences for implementing such measures in the SNP region?

2 Methodology

2.1 Research strategy and research design

The research strategy followed in this paper is **qualitative** as the objective is to explore and interpret specific facts (Bryman & Bell, 2015), namely how tourism business is affected by climate change in the winter season in the SNP region. The author considers that qualitative approach is more suitable for this master thesis (than the quantitative one) because, being studied a relatively unknown region, it is very important to have a solid basis, which can be very well accomplished with the help of qualitative research methods.

The current research follows an **exploratory** approach. As already mentioned in the research problem, there is a gap in the literature – at least in the English written papers, with regards to climate change impacts on tourism business in the winter season in the Swiss National Park region. Therefore, this paper represents a first step into understanding a specific situation of a relatively unknown topic. The research can be the basis for further research papers, and also can create the basement for formulating research hypothesis (Bryman & Bell, 2015). Thus, the exploratory approach of this Master thesis is elucidated.

The reasoning of this paper is **inductive**, following a bottom-up direction, trying to formulate a new theory starting from the specific case of Swiss National Park region (Bryman & Bell, 2015). By answering the research questions formulated in Chapter 3 this paper will fill an existent gap in the literature and can represent a starting point for new research papers.

2.2 Research population and sampling strategies

Primary data has been collected by conducting semi-structured interviews with two groups of stakeholders: (1) the tourism experts (researchers, professors and persons who have knowledge and who are interested about tourism industry and climate change) and (2) representatives of tourism businesses from the SNP region.

For the **first group**, the tourism experts, it is difficult to assess the whole population. Of course there have been contacted the experts who have knowledge in the relation between climate change and tourism business, especially for the SNP region. It was used a **purposive, convenient sample**, and there have been contacted experts that were relatively easy to reach, such as HTW Chur lecturers or researchers recommended by the internal and external advisor. Using the **snowball** effect, the interviewees have been asked to recommend other researchers, if possible. A snowball sampling technique means that the researcher samples in the beginning a small group of persons and these people propose other participants with the relevant knowledge (Bryman & Bell, 2015). By gathering information from this first group it have been achieved a solid basis represented by the knowledge of the above mentioned experts.

The **second group** (tourism providers in the SNP region) has been interviewed, in order to see the practitioners' opinions and actions with regards to climate change. It was interesting to see the differences and similarities between the answers of climate change researchers and those of the tourism providers. The population of the second group is represented by all the tourism providers (accommodation providers, transportation providers, activities providers) in the SNP region – from Zernez to Scuol, in the Western part of the SNP and

from Tschierv to Müstair on the Eastern part of SNP. These providers have been contacted using their contact information available online and it was intended to have as much answers as possible. As for the first group, there will be used a **convenient sample**. Also for this second group the **snowball sampling** was be used, and persons interviewed have be asked to recommend other potential interviewees. For the population of tourism providers, it was also intended to use a **stratified sampling** technique as in this category, there can be distinguished other subcategories, such as accommodation providers, transportation providers, activities providers or food providers. Therefore, it was desired to have at least one interview from each category of providers. Moreover, as the focus of this study is spread over a geographical area where there are several winter resorts, with different characteristics regarding tourism (such as different altitudes for ski facilities, various options for winter sports and so on), it was desired to have interviewees which cover the whole area.

It can be argued that the intended sampling strategies have been reached for both target groups, and relevant aspects, such as necessity for stratified sampling have been considered. The persons interviewed are:

1. From the tourism experts group:
    a. Prof. Dr. Bruno Abegg, author of several studies about climate change impacts on tourism in the Swiss Alps
    b. Prof. Dr. Reto Rupf, author of studies about Swiss National Park and about the relation between climate change and winter tourism
    c. Dr. Therese Lehmann, author of studies about climate change and tourism
    d. Hans Lozza, Head of Communications and Public Relations at Swiss National Park
    e. Constanze Conradin, Project management Nature & Landscapes, Environmental Education and Research, Biosfera Val Müstair
2. From the tourism provider group:
    a. 4 **hotel** representatives from Scuol, from which 1 has also provided information about the hotel's **restaurant**
    b. 2 **ski schools** from Scuol
    c. 1 **ski school** from Zuoz
    d. 1 **cable car** company from Zuoz
    e. 1 representative of **destination marketing organization** Ferienregion Engadin Val Müstair

2.3 Data collection

For answering the research question and sub-questions named in Chapter 1.2 there have been used both primary and secondary data collection techniques.

The **primary** data has been collected using **semi-structured interviews.** This means that the researcher prepared in advance a list of questions so that the topic of interest has been covered. However, as the interview process was flexible, questions that are not included in the guideline have been asked, in order to clarify some aspects; or it can be the case that the order of the questions from the guideline was not followed ad litteram. As there are two groups of interviewees (tourism experts and tourism providers) there have also been designed two interview guidelines (see Appendix 1 & 2). The interview structure has been

determined mainly by the research sub-questions which have also determined the structure of the literature review.

In total there were conducted 14 interviews: 5 with tourism experts and 9 with representatives of tourism businesses.

Regarding the modality how the interviews have be conducted, the author of this thesis considered very important the existence of a direct contact between the interviewee and interviewer, in order to obtain spontaneous remarks and also to engage with the interviewees for receiving comprehensive answers (Bryman & Bell, 2015, p. 673). Therefore, **face to face** interviews have been preferred. However, to reduce some transportation costs, or to overcome long distances, most of the interviews (10) have been conducted by **telephone** and there was only one in person interview. Although phone interviews have many advantages, there are some evidences showing that the quality of data is inferior to the quality of in person interviews (Bryman & Bell, 2015, p. 217). Another option was **Skype** and there was one interview conducted this way. This is a very flexible option which is obviously less time and money consuming than a face to face interview or a telephone one. However, it can have its own challenges, like the occurrence of fluctuations in the quality of connection which can make the answers become unintelligible or even totally losing the connection (Bryman & Bell, 2015, p. 675). **E-mail** interviews represented another option used by the author, but it was offered only if the 3 other options above named were declined. With its numerous advantages (like flexibility in terms of time, no necessity for transcribing, no problems with mishearing or not hearing at all, more grammatically correct answers from the online interviewees) for an interview conducted via e-mail there are also some disadvantages, such as: lack of interaction, no possibility to notice the body language of other forms of non verbal data, less spontaneity in answers and even the risk that the person sending back the filled in interview guideline is not the one who they pretend to be (Bryman & Bell, 2015, pp. 673-674). However, only two interviews have been conducted by e-mail.

Both interview guidelines (for tourism experts and for tourism providers in the SNP region) have 8 questions and each interview lasted approximately 30-40 minutes.

It is important to be mentioned that, in general, all the interviewees, but especially the tourism experts, have been friendly and opened for the discussion and did not seem reluctant. However, in the case of one interview the respondents appeared to be under time pressure and tried to provide very quick answers and in another situation one tourism business representative considered that her business is not so appropriate for answer those questions and it would be better to try other providers. Nonetheless, both provided some answers and relevant information could be extracted. All the persons accepted that their answers can be used.

In the cases where interviews have been conducted face to face, over telephone or over Skype, these have been recorded using a telephone application for recording, of course, only after the interviewees agreed on this aspect. The situation of receiving a negative answer did not happen, only one representative of a ski school asked to not use her name in the master thesis.

The next step after conducting all the interviews was to transcribe all of them that have been recorded. The author decided to put into text all the interviews because having the transcripts permits a more meticulous and repeated examination of the interviewee's answers and it

also helps other researchers who want to evaluate the analysis (Bryman & Bell, 2015, p. 493).

Furthermore, the existing literature has been used. According to Denney & Tewksbury (2013) literature reviews are important primarily because they determine the writer to educate himself, by gathering a big amount of information about a specific topic. In the case of this thesis, the author has used literature review to become familiar with topics such as climate change, tourism business in the SNP region, adaptation measures of tourism providers and so on. In the same line Bless (2000) as cited by UNISA (n.d.) states that literature reviews help to sharpen and deepen the theoretical framework for the current research. He also mentions that by reviewing the literature, the author discovers potential gaps or weaknesses in previous studies. Discovering research gaps is a main aim of the literature review. Following the recommendations of Caulley (1992) the literature review of the current master thesis has identified and grouped authors who reach similar conclusions and has noted those who are in disagreement. There have been highlighted the exemplary studies and have also been identified variables which will be taken into consideration for the research, as recommended by Bless (2000) as cited by UNISA (n.d.).

Moreover, as one of the purposes of a literature review is to define an area of study (RMIT University, 2005), this has been done by describing the SNP region.

According to Denney & Tewksbury (2013), there are some differences between writing a literature review for a qualitative study and writing for a quantitative one. Therefore, this literature review has followed the recommendation of Denney & Tewksbury (2013, p. 222) regarding the literature review for qualitative works, which says that it "*needs to be an all inclusive approach to the general research topic".* This means that the literature review has treated the general topic of climate change and its impacts, narrowing slowly on the effects on tourism businesses in the Swiss Alps. This is also the opinion of Leedy (1989) as cited by UNISA (n.d.) who admits that the more knowledgeable a person is, the better he or she is able to understand the problem.

Regarding the sources used for establishing the literature review, the author had the advantage of having access to several online databases for books and scientific journals such as SienceDirect.com, Elsevier.com, and Tandfonline.com and so on. This is, in general, the main way of finding adequate sources (Denney & Tewksbury, 2013). Moreover, the author used the university's (HTW Chur) library and with the help of NEBIS.ch could order books or journals from around 140 libraries from Switzerland (NEBIS, 2016).

Other sources, such as newspapers articles or official websites of diverse institutions have been used, only if these presented a high degree of credibility.

For a facile visualization, Table 1 was provided and it shows which data collection technique was used for each question stated in Chapter 1.2:

Question	**Chosen method**
How can the following terms and structures be defined: climate change, general impacts of climate change, impacts of climate change on tourism business during the winter season in the Swiss Alps, adaptation measures taken by tourism businesses, drivers, consequences and barriers of implementing adaptation measures?	Literature

How can Swiss National Park region be defined?	Literature
What is tourism business in Switzerland?	Literature
What is tourism business in the Swiss National Park region?	Literature
What are the physical impacts of climate change that affect SNP region in the winter season?	Interviews
What are the peculiarities of SNP region with regards to climate change physical impacts?	Interviews
How is the tourism business in the SNP region affected by the climate change impacts?	Interviews
Which tourism sub-sector (accommodation, transportation, activities providers etc) is the most vulnerable to climate change impacts in the SNP region?	Interviews
Are tourism providers in the Swiss National Park region aware of climate change?	Interviews
Did tourism providers in the SNP region implement some adaptation measures?	Interviews
What are the drivers, barriers and consequences for implementing such measures in the SNP region?	Interviews

Table 1 Methods used for answering research sub-questions
Source: Own design

2.4 Data analysis

The current master thesis has followed a **deductive** approach for content analysis. This implies the creation of a **codebook** designed based on the information found in the literature (Nikitin, 2015a).

Codes can be defined as ‘‘*tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study”* and developing these codes represents the first step for analyzing interview data (Miles & Huberman, 1994, p. 56). Therefore, a **codebook** is a collection of codes, definitions and examples which are useful to guide the process of analyzing data (DeCuir-Gunby, Marshall, & McCulloch, 2011).

Climate change affecting tourism is a popular research issue nowadays. Therefore, there have been reviewed the studies made by other researchers, and based on this review, the codebook have be designed. As there is a plethora of studies and information about the topic treated in this master thesis, the author considered that there is a more facile option of using the codebook developed from literature for analyzing the data. Therefore, according to classification provided by DeCuir-Gunby et al. (2011), who mention that codes can be developed (1) before analyzing data (from theory and concepts, also known as theory driven codes), (2) they can be created from the raw data, or (3) they can emerge from the research goals and questions of a project, the codes for this master thesis have been developed in a **theory driven** manner. For creating the final codebook the theory has frequently been revised and new codes have been constantly added, as it is also suggested by DeCuir-Gunby et al. (2011). The final codebook can be seen in the Appendix 3.

The interviews have then been **transcribed** keeping all the information which is related to the respective questions, or to the general topic. An example of an interview transcript can be visualized in Appendices 4-18.

As the categories in the codebook correspond to the questions that have been asked, **the answers to every question has been analyzed separately**, in a table such as the one included in Appendices 19-33.

For creating the theory driven codebook but also while assigning the codes to the raw data, techniques of reduction, explaining and scaling have been used, as suggested by Nikitin (2015b).

The author has used the technique of **reduction** while creating the theory driven **codebook,** in order to develop a simplified and easy to work with version. For example, in the case of code *3.2 snow making*, the initial codes *producing snow* and *artificial snow making* have been merged because they have the same meaning. The same happened with the code *3.3.1 sport events* which was created after comprising the codes *winter sport competitions* and *organize sport events*. The code called *6.14 water resources* present in the category of barriers has also been developed after merging other codes with the same meaning: *access to water, more water is needed, reduced water level* or *water availability.* Reduction was also used when assigning the codes to the raw data (interview text) because many of the statements were used with the same meanings. For example, in the category physical impacts, the code *water scarcity* has been assigned to the statements *they have less water*, *impact on water availability* and *they are struggling to have enough water* because the interviewee expressed the same idea with different structures and words.

While creating the theory driven codebook, some **structures which may not be self explanatory have been clarified**. For example, for the structure *cloud seeding* from the category of adaptation measures there was provided a short clarification about its meaning. This also happened while assessing the codes to the interview text. When the meaning of the structure was unclear, there was delivered a short explanation. For example, when discussing the physical impacts, B. Abegg mentions that *the most important impact is on snow cover* with the intention to say that the snow cover becomes less.

The last techniques used while developing the codebook was **scaling**. For example the same code received different values, like the case of code called *Changes in scenic beauty* which can be positive or negative. Therefore there have been created subcodes with these values. While assigning the codes to raw data, scaling was used for example in the case of code named *Dryness*, present in the physical impacts category. Here, one interviewee mentioned that it will become drier while another mentioned that the situation is uncertain and it can be more humid or drier. Therefore, there have been two subcodes created under the code *Dryness*, called *it will become drier* and *uncertainty.*

These actions of reducing, explaining and scaling can be better seen in the theory driven codebook (Appendix3) and in the table where codes have been assigned to interview texts (Appendices 19-33).

As a final aspect of the codebook conception it can be seen in Appendix 3 that the set of codes is very specific, mostly with codes that are easy to understand and to assign to raw data. According to DeCuir-Gunby et al. (2011), this is a positive aspect when referring to a codebook, because the more specific and the more detailed the set of codes is, the easier and the more consistency there will be when using it for coding the interviews.

3 Literature review

The aim of this literature review is firstly to familiarize the author of this thesis with relevant terms and concepts and also to provide the reader the opportunity to understand key aspects which will be used throughout the whole study. Therefore, terms and concepts such as climate change, climate change general impacts, impacts of climate change tourism, impacts of climate change on winter tourism in the Swiss Alps, adaptation measures, drivers and barriers for adaptation measures are presented and exemplified through the perspective of several researchers. Moreover, this literature review helps the reader to have a clear vision about the geographical focus of this master thesis.

3.1 Tourism business in Switzerland

The tourism industry is extremely important in Switzerland, the whole country's economy being highly dependent on this sector (Koenig & Abegg, 1997). Although the statement mentioned above cites a source which is almost 20 years old, the statistics show that it is still current.

Tourism has great contributions with regards to Swiss workforce, exports, gross domestic products (GDP) and investments.

Table 2 provides the most important aspects referring to tourism's contribution to Swiss economic system.

Total number of employees in tourism	209'800
Total revenue generated by Swiss tourism	CHF 38.5 billion
Revenue from foreign tourists in Switzerland	CHF 16 billion (more than Swiss tourists abroad outlays – CHF 15 billion)
Number of hotels and health resorts	5'129
Share in total export revenue	4.6%
Share in total investments	2.6% (US$ 3.35 billion)

Table 2 Major contributions of tourism to Swiss economy
Source: Swiss Tourism Federation (2015) and WTTC (2015)

It can be concluded from the information presented in Table 2 that tourism is a key source of total Swiss income (Swissinfo.ch, 2015).

The most attractive region for tourists is the Zurich region who registered in the period 2011-2014 the highest number of overnight stays in hotels and health establishments. This region is followed by cantons Graubünden and Valais (Swiss Federal Statistical Office, 2015).

Regarding the nationality of the foreign tourists, the most important for Swiss tourism are those coming from Germany followed by those coming from the UK. They are the foreign tourists who register the highest number of overnight stays among other nationalities (Swiss Federal Statistical Office, 2015).

Being a country with predominantly mountainous relief, for many Swiss alpine areas, the tourism represents the most important source of income (Koenig & Abegg, 1997). Also notable, is that the canton of Graubünden, a canton with high altitudes and worldwide known resorts (such as St. Moritz or Davos), presents a decrease of tourists' overnight stays (Swiss Federal Statistical Office, 2015).

3.2 Tourism business in the Swiss National Park region

The Swiss National Park is located in South-East of Switzerland, in the canton Graubünden. This canton is placed on the second position (after Zurich region) among other Swiss regions in terms of tourists' overnight stays and the first with regards to the number of establishments open in hotels and health establishments and distribution in 2014 (Swiss Federal Statistical Office, 2015).It also has the highest average stay duration, both for Swiss (2.58 nights) and foreign (3.46 nights) tourists. However, the same report shows that Graubünden faces a decrease in the number of overnight stays, from 2011 to 2014.

On the Swiss National Park official website (SNP, 2015a), there can be found useful information about the park history, localization, facilities and so on. The most interesting aspects are summarized in the next paragraph. The Swiss National Park has been established in 1914, being the first national park in the Alps and the only national park of Switzerland. It has an area of over 170 km2 and represents the largest protected area of the country, its territory overlapping the communities of Zernez, S-chanf, Scuol, Val Müstair and Lavin. The diversity of alpine animals (chamois, deer, and marmots) and the variety of alpine plants make the SNP to be highly appreciated and visited, attracting annually approximate 150'000 tourists. Tourists willing to accommodate within the park have two options: Cluozza hut, Hotel Park Naziunal Il Fuorn.

Around SNP boundaries there are some small resorts such as Zuoz, Zernez, Scuol or Val Müstair region. The region around SNP is a typical alpine region, where the tourism industry consists of numeric small-scale businesses which offer limited ranges of services (Wyss, Abegg, & Luthe, 2014).

Some of the above mentioned resorts provide facilities and infrastructure for winter sports tourists, such as Scuol ski area with 80 km of ski slopes or Val Müstair area with 25. Therefore, it can be argued that the main motivation of visitors is to practice such kind of sports. However, since in the SNP there are only 2 accommodation establishments, one can deduce that tourists willing to visit the SNP are also spending their nights in the region around the protected area. The relation between the SNP and the region around is clear also on the website of the region the park belongs to, namely Engadin. There is presented the SNP as a main attraction and the tourists are invited to stay overnight in the so called National Park hotels, located in Scuol, Tarasp, Zernez, Valchava and Zuoz (Engadin.com, 2015). Another modality how the SNP and the region around interact is given by the fact that, according to the official website, within the park camping is forbidden. Therefore, there are recommended the campsites around the SNP (SNP, 2015a).

The presence of touristic phenomenon in the SNP region can be remarked through the relative high number of accommodation facilities (hotels and holiday apartments and houses), especially having into consideration the low population existent in the localities. Moreover, according to Pütz et al. (2011) when asking some tourists about their motivation to come in Scuol, skiing was an essential factor when choosing this destination, with high requirements for skiing infrastructure.

On the official website of the destination, Engadine.com, the whole region is divided into other small areas. These are Engadine Scuol, which includes municipalities such as Scuol, Ftan or Taras; Engadine Val Müstair including municipalities such as Müstair or Tschierv and Engadine Samnaun. However among these 3 subdivisions only the first two (Engadine Scuol

and Engadine Val Müstair) are presented as being part of the National Park Region. Moreover, another subdivision of the entire valley of Engadine is represented by the Engadine Sankt Moritz which includes the municipality of Zernez, where the National Park Center is located. Therefore, also parts of this region (Engadine St. Moritz) will be included in the focus of this master thesis, as it can be easily seen the interaction between it and the SNP. From this region, the area selected is up to the municipality of Zuoz.

Table 3 presents the number of touristic facilities from the main municipalities situated around the SNP boundaries. The most important area in terms of accommodation and winter sports facilities is Engadine Scuol, with its main municipality of Scuol (situated in the North of SNP). Moreover, Scuol is also known for its spa facilities (Pütz et al, 2011). This is followed by followed by Zuoz (situated in the South-West of SNP) and Val Müstair (situated in the East of SNP). The municipality of Zernez is also important in terms of accommodation facilities and it also offer possibility for cross country skiing.

Area	**Hotels**	**Holiday apartments& houses**	**Ski area**
Engadine Val Müstair	22	62	Yes, ski area Minschuns, 25 km, lowest/highest point: 1'670/2'700m + Possibility for cross country skiing
Engadine Scuol	57	326	Yes, ski area Motta Naluns, 80 km, lowest/highest point 1'250/2'785m + Possibility for cross country skiing
Zernez	13	59	Possibility for cross country skiing
Zuoz	6	153	Yes, ski area Zuoz, 5 facilities, 10 slopes, highest point 2'465m + Possibility for cross country skiing

Table 3 Overview regarding touristic facilities in the SNP area
Source: Engadin.com (2015)

Having into consideration the above described situation, when assessing the impacts of climate change on the tourism business in the SNP region, the following area will be referred to:

- Localities situated on the Western part of SNP, from Zuoz to Scuol
- Localities situated on the Western part of SNP, from Val Müstair region

For a facile visualization of the area this study will focus on, Figure 1 is provided. The green area represents the SNP. The two circles with blue in the South-West and in the North of the SNP are Zuoz and respectively Scuol. The big blue circle in the East of SNP is the Val Müstair region.

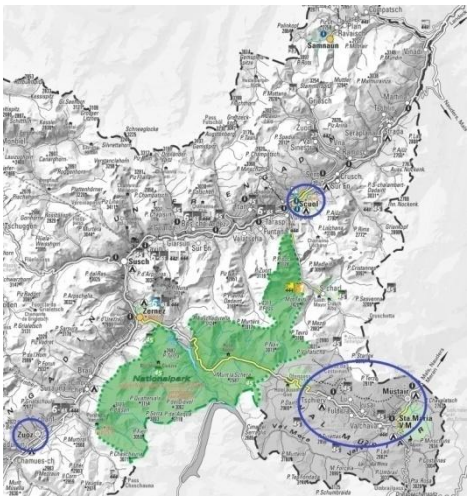

Figure 1 SNP region delimitation
Source: Own design based on the map retrieved from Engadin.com (2015b)

3.3 Climate change – general information

Climate change is nowadays one of the most popular topics, often brought into the public attention through basically all media channels.

The researchers' attention has dramatically increased in the last 15 years with regards to climate change, as it can be seen in Figure 2. Furthermore, many forums, conferences and programs have been established in order to better understand what climate change is, and more important what are its impacts. For example, the U.S. Global Change Research Program has been established in 1989 with the aim of assessing, predicting and responding the human-induced and natural processes of global change (GlobalChange.gov, n.d.). A more recent example is the establishment of World Climate Summit, in 2010, with the aim of being an international platform helping to find solutions to climate change (World Climate, 2013).

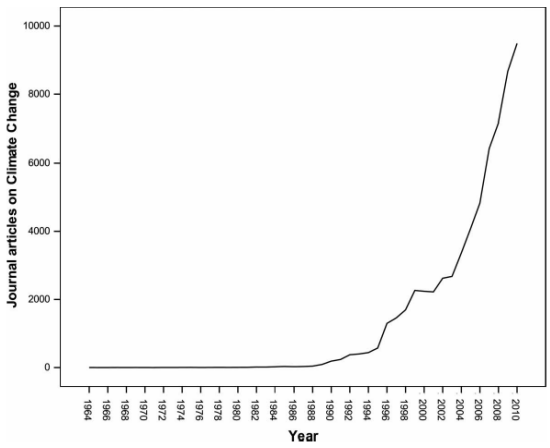

Figure 2 Number of Journal Articles on Climate Change per Year
Source: Pang, McKercher and Prideaux (2013)

However, climate change is not discussed only by scientists from this field, but many other persons and entities involve in this discussion. A good example is Pope's Francis call for action assigned to the whole world, in order to diminish the global warming (Burke, 2015).

Because the climate change is almost unanimously seen as a threat to humanity, important business actors are committed to reduce their impacts on global warming. DHL, for example, intends to reduce its carbon emissions by 30% by 2020 and with this purpose, the company invested in the US between 2014 and 2015 more than $50 million in new environmental-friendly vehicles (Green Lodging News, 2015).

In order to define what climate change is there are some aspects that have to be clarified. First of all, the term *climate* represents the average or the typical weather of a place, including patterns of temperature, precipitation, humidity, wind and seasons (Departament of Ecology, 2015).

It is also important to know that the Earth's climate is always changing due to natural or to human influenced causes (NASA, 2011). Over time, the Earth's climate faced both warmer and cooler intervals, but the observations show that nowadays the climate has been warming. The natural causes of climate change include modifications in Earth's orbit and in the volume of energy received from the sun (ibid).

On the other hand, there are human activities that can be named as causes of the recent warming, mostly related to the burning of fuels such as coal, oil or gas. By this, gases that trap heat in the atmosphere are emitted (USEPA, 2015). There are several types of greenhouse gases (carbon dioxide, methane, nitrous oxide, fluorinated gases) but the carbon dioxide (CO2) in present in the largest amount among the others, with a share of approximate 77% (USEPA, 2015).

The structures *climate change* and *global warming* are currently very often used, and although they might look like having a similar meaning, there is a slight difference between the two. While *global warming* indicates the long term **increase** in Earth's average temperature, *climate change* points out to **any** long term change in Earth's climate, **including warming** or cooling **temperature** (NASA, 2011). However, in nowadays context, through the expression *climate change* it is referred the strict phenomenon of *global warming*. Therefore, in this paper, the two structures will be used as having identical understandings.

Climate change can be, therefore defined as a change in the Earth's overall climate, change that can refer to a modification of, for example, the average temperature or of the amount of precipitation.

The question that can rise from the above mentioned statements is why the whole world is concerned about the climate change, when this is a natural phenomenon, which was faced by our planet many times in the history. Well, according to Shani and Arad (2014) there are 3 main arguments that explain the attention received by the climate change and global warming: 1) Earth is becoming warmer with an unusual speed rate, in a destructive manner; 2) The cause for the statement mentioned as the first reason is mainly the human activity, through the emission of greenhouse gases, especially CO2; and 3) The process is reversible through a significant change in human values and lifestyle – for example having sustainability as one major principle for human development.

Statistics regarding the fast rate the Earth is warming with are easy accessible and definitely support the first argument of the above mentioned authors. The global temperature has increased with approximate 0.77 degrees Celsius (1.4 degrees Fahrenheit) compared with

the global temperature in 1880 (NASA, 2015a). Moreover, nine of the 10 warmest years on record have occurred since 2000 (ibid). This growth of the global temperature is related with the growth of carbon dioxide levels present in the air. The concentration of CO2 has increased dramatically after the industrial revolution reaching nowadays the value of 401 ppm (parts per million) (ibid) while the pre-industrial level was about 280 ppm (Climate Change Conference, 2010).

Despite the plethora of evidences which present that accelerated global warming is caused by the human activities, there are many persons who still negate climate change or at least some aspects related to this (Häkkinen & Akrami, 2014). For example, Shani and Arad (2014) are skeptical to the fact that climate change is human induced. They present some periods from the history when, although the CO2 concentration increased, the temperature remained constant, or even decreased. Other counter arguments to the statement that climate change, through an accelerated global warming happens due to human activities are:

- Natural factors, such as diverse solar activity and modifications in the galactic environment induce climate variations (Vahrenholt, 2012);
- El Niño activity has a significant role the global warming, way more important than the CO2 emissions (Spencer & Braswell, 2013)

Shani and Arad (2014, p. 84) mention in their conclusions that: *the theory of anthropogenic global warming is highly controversial among climate scientists*. However, other sources clearly mention that 97% or even more of the climate experts agree that human activities are the main cause of the unusual global warming (NASA, 2015b).

As a conclusion to this part, it can be stated that the structure “climate change” has received deeper nuances in the nowadays context. It is strictly referring to the warming Earth’s climate and it is mostly seen as a threat to humanity. People do not see this phenomenon as a normal one (although it is to some extents) but, in the most contexts this term usually calls for peoples action in order to stabilize or to reduce the speed rate the Earth is warming with. People see the climate change mainly through the perspective of what negative impacts it brings.

Most of the effects had by the global warming present negative scenarios and that it is why people who accept that human activities cause Earth’s climate to increase, try to find the best options for reducing the human impact, by reducing the CO2 emissions. The most important effects of climate change will be presented in the following chapter.

3.3.1 General impacts of climate change

When it comes to the possible impacts of climate change, many scenarios have been envisioned.

Maybe one of the most threatening and most publicized impacts is represented by the sea level rise. This is a real issue in the nowadays context, and statistics show that the global average sea level has raised with approximate 17.8 centimeters (7 inches) in the last 100 years (NASA, 2015a). This aspect is crucial, having into consideration that approximate 40% of the world’s population lives within 100 kilometers of the coast (United Nations, n.d.). Moreover, 6.6% of the total world’s population is living in areas where elevation is below 5

meters (World Bank, 2015). In the actual context, with a total world population of more than 7.2 billion (United Nations, 2014), for about 475 million people every centimeter gained by the sea level is a real threat. Projections provided by NASA show that the sea level can rise between 30 centimeters and 1.2 meters (1 to 4 feet) by 2100 (NASA, 2015c).

The rise of the sea level is caused by the huge masses of ice melting both at North and South Pole. In 2012, Arctic sea ice registered the lowest extent on record, while the ice mass of Greenland decreases with 287 billion metric tons per year, since 2002 (NASA, 2015a). At the South Pole, Antarctica is also losing ice mass with a rate of 134 billion metric tons per year, since 2002 (ibid). Moreover, the mountain glaciers are also melting (Tranos & Davoudi, 2014) while the snow cover is less and less (Rosselló-Nadal, 2014).

Extreme weather events, such as hurricanes will become more powerful and more intense (NASA, 2015c). Presence of heavy rainfall, more violent storms and heat-waves are other impacts that climate change will have (BBC, 2014).

The increasing frequency of extreme weather events has an impact on the ecosystem and also on the quality and quantity of water resources in many parts of the world (Arain, 2011). The global warming can cause some species to move to higher latitudes and altitudes in order to find the proper environment to survive (BBC, 2014).

Global warming will have an impact on food supplies, meaning that it is possible for crop yields to increase at higher latitudes and to reduce at lower ones (BBC, 2014). Another impact is that, due to rising temperatures, more droughts and heat weaves will occur with a direct influence on agricultural production (NASA, 2015c). Scientists also suggest that the global warming will affect the distribution, species structure and productivity of forests (Irland, et al., 2001). Moreover, fishing industry will be affected by the climate change, expecting both positive and negative impacts (GBRMPA, n.d.). Wine industry is also threatened by the climate change because of the aspects such as changes in grape chemistry and quality of oak (wood used for keeping wine in barrels) due to rising temperatures and CO2 emissions and even loss of vineyard acreage due to rising sea level (Mozell & Thach, 2014).

It can be concluded until now that due to environmental changes (rising sea level, increasing temperatures, melting ice etc) the majority of industries will be more or less affected. It is obvious that for some industries the global warming represents a bigger threat than for others, and, because of that, a top of the most likely to be affected industries by climate change has been elaborated (Williams, 2014):

- **Businesses depending on water**, specifically recreational boating industry and companies that depend on commercial shipping in rivers and lakes. Such businesses have already been affected in the US in the year 2012, when there were very low precipitation and extreme high temperatures, causing droughts and low water levels on the Great Lakes.
- **Commodity-based businesses**. Businesses depending on a commodity (such as food, minerals, oil) will be affected due to price fluctuations (mainly price increasing). It is given the example when a drought occurs in Brazil, then the prices of coffee will increase.
- **Tourism**. There are presented both positive (for example coastal tourism could increase due to warmer summer time) and negative (such as areas affected by the

rising sea levels) impacts that climate change could have on tourism businesses. A detailed description of what impacts could global warming have on tourism industry will follow in the next subchapter.

While the above mentioned impacts of climate change mostly have a negative connotation, there are some authors that were able to identify some benefits of global warming.

Shani and Arad (2014) identify as main benefits of global warming the followings:

- Fewer winter deaths (winter deaths exceed summer deaths)
- Lower energy costs
- Improved agricultural yields
- Decline of famines
- Fewer droughts
- Richer biodiversity

Although some of the arguments are very pragmatic and realistic (for example, when the temperature is higher, heating expenses are lower, so energy costs decrease or when the temperature is higher in winters, people will not suffer as much due to cold as before) others are in contradiction with the impacts mentioned in the first part of this subchapter (for example, amount of droughts).

In this chapter there were mentioned the most important general impacts that climate change has. It was clarified that effects are diverse and numerous, and the industries which are affected nowadays and will also be in the future are varying too. From the fishing industry to the wine industry, it looks like in a bigger or smaller proportion, direct or indirect; almost all the sectors are influenced by one of the most important phenomenon of the 21st century: the climate change. In the next chapter, will be described the ways in which tourism, one of the most significant industries, is affected.

3.3.2 Impacts of climate change in tourism

Climate change and tourism industry is a relation that has been discussed and considered in tourism research for a relatively long time (Kaján & Saarinen, 2013).

Tourism is one of the economic sectors directly affected by climate change (Tranos & Davoudi, 2014). This industry is placed in a unique but delicate position, with regards to climate change: it is one of the important contributors of greenhouse gases emissions, but in the same time is a major victim of global warming (Pang, McKercher, & Prideaux, 2013).

One peculiarity of tourism, named in many scientific papers says that the industry is a climate-sensitive one (UNWTO, 2008) (Soboll & Dingeldey, 2012) (Pang, McKercher, & Prideaux, 2013). It is emphasized that climate and natural resources represent, for many regions, the main tourists' interests and even constitute a solid base for the regional economies (Kaján & Saarinen, 2013). Therefore, any changes in the climate or in the natural resources can have significant effects on the specific region, with the possibility of creating opportunities but also threats.

The impacts that climate change has on tourism are variable and depend on the location or on the interests that tourists have.

For example, visits to natural reservations and parks, cycling tourism, golf tourism, beach tourism, city tourism or ski tourism definitely require specific weather conditions (Rosselló-Nadal, 2014). On the other side can be positioned wellness tourism which is rather climate independent (Soboll & Dingeldey, 2012). For the tourism activities that need certain weather conditions there is necessary an assessment of tourists perception with respect to the *optimal conditions*, followed by an evaluation of *future climate quality* (Rosselló-Nadal, 2014). While finding what the optimal conditions are in the tourists' vision can be relatively easily researched, assessing how the climatic conditions will modify over time is a task way more challenging. Still, according to Rosselló-Nadal (2014) this is a relevant modality to determine if a destination will diminish or will improve its attractiveness for tourists.

As mentioned above, the impacts of climate change differ from one destination to another, meaning that, for example, in a coastal resort effects are different to what an Alpine destination could face due to the same factor: global warming. In the followings will be described the diverse impacts that climate change have in different destination locations.

Winter sports destinations. These areas are extremely sensitive to climate variability and that is why this is the most studied aspect of climate change in tourism (Scott, Gössling, & Hall, International tourism and climate change., 2012). Implications of climate change in the mountain areas are expressed through less snow, retreat of the glaciers, melting permafrost and landslides (Bürki, Elsasser, & Abegg, 2003, April). These impacts are very significant, taking into consideration that for many mountain resorts, winter sports are the main source of income, and of course, snow is a pillar for these resorts' attractiveness (Bürki, Elsasser, & Abegg, 2003, December). More about how climate change influences mountain destinations, focusing on Swiss Alps, will be presented in the next chapter.

Coastal destinations. Sea level rising is the main concern present in this type of destinations. Touristic islands which are situated at very low altitudes might be inundated (Pang, McKercher, & Prideaux, 2013). A research done in the Caribbean Sea shows that 25% of major resorts would be defenseless to partial or full inundation by a 1 meter rise of the sea level (Scott, Gössling, & Hall, International tourism and climate change., 2012). Other impact of climate change for this type of destinations is represented by the increase in temperature in the summer season in resorts situated at the Mediterranean Sea, is such a manner that will be exceeded the comfortable levels (Pang, McKercher, & Prideaux, 2013). Furthermore, destinations which depend on coral-reef will probably be less attractive to tourists due to coral bleaching. The corals become white, and therefore do not present such massive interests for tourists, when they face modifications of ocean temperature, light or nutrients, and pollution (NOAA, n.d.). From a survey made in the Caribbean, it resulted that 76% of diver tourists would not return for the same price in the eventuality of coral bleaching (Scott, Gössling, & Hall, International tourism and climate change., 2012).

Impacts of climate change in mountain and coastal areas are easy visible and often discussed in scientific papers. However, there are other touristic destinations where the impacts of climate change are also noticeable. For example, the golf destinations depend on abundant water quantities and might be seriously affected when there is a decline in rainfall

(UNTWO-UNEP-WMO, 2008). Australian destinations face a higher risk of fire due to extremely increasing temperatures and due to less amounts of precipitation (Pang, McKercher, & Prideaux, 2013). In Italy, flood waters determined landslides which in their turn have damaged cultural heritage sites (ibid). A last example is the Chan Chan Archaeological zone from Peru where the intense rainfall damaged the base of the structures (Climatechangenews.com, 2012).

With the help of the above stated examples, it can be concluded that touristic operators from the climate sensitive destinations are very affected by the global warming. In most of the cases, the change of climate along with its consequences (areas with less snow, too hot temperatures, too many rainfall), has diminished the attractiveness of the destinations for the tourists. Hence, the impacts of climate change determine the tourists to not find attractive a certain destination anymore.

However, while some touristic providers are facing very tough times, trying to find solutions and adaptation measures, others use climate change in their advantage and make profit out of it. Eijgelaar, Thaper and Peeters (2010) discuss in their paper about “last-chance tourism”, specifically about Arctic and Antarctic cruise tourism. Operators who provide such cruises promote their packages as one of the only occasion to see ice masses and polar bears before they will disappear. These operators found a way of exploiting the popularity hold by climate change nowadays. Unlike the other touristic providers who are struggling to attract tourists, these cruises seem very demanded since the number of Antarctic cruise ship passengers has tripled from 2000 to 2007. However, the paradox presented by Eijgelaar et al (2010) is that while visiting the endangered area, the cruise ships produce a very high level of greenhouse gases, thus contributing to the environmental damage.

As resulted from the aspects mentioned in this chapter, it is obvious that along with the global warming, tourism industry is affected, mostly in the very sensitive areas, such as mountain and coastal tourism. The climate which becomes warmer determine some destinations’ attractiveness to decrease, giving, lastly very difficult time for touristic providers. Climate change has also some positive impacts on some touristic suppliers, such as those operating Arctic and Antarctic cruises, whose success is a clear fact. In the next chapter the impacts of climate change on winter tourism will be presented, focusing on Swiss Alps.

3.3.2.1 Climate change and winter tourism in the Swiss Alps

Many industries operating in the mountains such as mountain agriculture, mountain hydropower and mountain tourism are affected by climate change impacts and will also be in the future (Bürki, Elsasser, & Abegg, 2003, December).

Climate change in considered to be a real threat for several mountain tourism destinations in the Alps (Wyss, Abegg, & Luthe, 2014). Mountain areas are very sensitive to climate change, and the effects are easy visible manifesting through less snow, retreating glaciers, melting permafrost and other events such as landslides (Bürki, Elsasser, & Abegg, 2003, April).

It is obvious that winter tourism depends on favorable snow conditions and therefore the financial activity of mountain destinations is highly dependent on supportive snow conditions (Rosselló-Nadal, 2014). This is a really pressing issue, especially for those alpine destinations which rely mainly on winter activities as their main source of income (Bürki,

Elsasser, & Abegg, 2003, December). Tourists who are enjoying winter sports definitely need enough snow for ski or snowboard. Obtaining profit out of ski tourism without enough snow it is rarely acquirable (ibid).

According to the report of OECD (2007), among 666 Alpine ski areas in Austria, France, Germany, Italy and Switzerland, 9% are already operating under marginal conditions. From the same source is mentioned that if the average temperature will increase with 1ºC the number of snow reliable[1] areas will decrease to 500. Moreover, 404 snow reliable areas will remain if the average temperature increases with 2 ºC and only 202 under a warming of climate with 4 ºC. The same study mentions Germany as being the most vulnerable winter destination among the other countries, which will have no more naturally snow reliable ski areas if the temperature increases with 4 ºC. On the opposite pole is Switzerland, which will still have 50% of its snow reliable ski areas at a increasing with 4 ºC in the global temperature.

Swiss alpine areas are in the situation where the winter tourism is the most important source of income (Koenig & Abegg, 1997). Therefore, if the attractiveness of such destinations diminishes for tourists, the economical situation of these will decrease as well.

Snow-reliability is high ranked in the top 10 requirements of tourists coming in Switzerland (Elsasser & Bürki, 2002). In another survey, ski tourists in Switzerland were asked what their reaction would be in the case that "the next five winters would have very little natural snow". The results of this research also show how important is the presence of snow in appropriate quantities for winter activities tourists: 30% would not change their skiing behavior, 11% would come at the same location but less often, 49% would ski at a more snow reliable resort and 4% would not practice skiing anymore (Scott, Gössling, & Hall, International tourism and climate change., 2012). Therefore, it is clear that if winter resorts in Switzerland become less snow reliable it will automatically determine less tourists coming to those destinations.

The awareness of winter sports tourists regarding possible impacts of climate change is very high, 83% of the respondents of a survey done by Rolf Bürki (researcher at the University of Zurich) agreed that climate change could negatively influence the ski tourism (Bürki 2000, as cited in Yang & Wan (2010)).

However, although for some mountain destinations in the Swiss Alps their degree of attractiveness might decrease during winter season, due to climate change, a study of Serquet and Rebetez (2011) shows that during the summer season, the touristic Alpine region may benefit from the high temperatures that will occur at lower altitudes. The study confirms that domestic tourists spend more nights in the mountain hotels during summer time, due to hot temperatures. Although this is an interesting result, which presents a positive impact of climate change for resorts in the Swiss Alps, the aim of this master thesis is to discuss the impacts during winter season; therefore, the aspects related to summer tourism or impacts during summer season will not be discussed.

Potential impacts of climate change on winter tourism in the Swiss Alps are well summarized by Bürki et al. (2003, December) who describe the followings aspects about:

[1] Natural snow relability is by the "100-days-rule" which states that a regions is natural snow reliable if there is sufficient snow cover of at least 30 cm for skiing on minimum 100 days between 16 December and 15 April in 7 of 10 years (Abegg 1996 and Bürki 2000, as cited by Pütz et al. 2011)

- Snow – the most important link between global warming and mountain tourism results from the less amounts of snow, which in the end determine less incomes for ski tourism operators
- Glaciers – according to a very dramatic prevision, by 2030, 20 to 70% of Swiss glaciers will disappear. This is supported by the fact that since 1850, more than 25% of glaciers' surfaces in Switzerland have been lost. In addition, the melting of the glaciers is also remarked by the Head of Slope Preparations, from Titlis Cableways, one of the key stakeholders for winter tourism in Engelberg, a touristic village situated in central Switzerland. The person mentions: "*Twenty years ago, it was normal to have seven to eight meters of accumulated snow on top of the Titlis Mountain. Three years ago it was down to 2.5 meters*" (Wyss, Abegg, & Luthe, 2014, p. 72).
- Permafrost – the melting of permafrost increases the areas' vulnerability to landslides. Moreover, constructions built in permafrost (such as mountain cableways) are in danger if the soil is not stable anymore.
- Changing weather conditions – evidences show that climate is warmer but also its patterns have changed such as more rainfall or higher fog level. The Managing Director of Mountain Guiding Bureau in Engelberg remarks: "*In summer, the precipitation up on the mountain does not fall as snow any more, but as rain. This is especially problematic on the glacier, where the rain additionally enforces melting processes*" (Wyss, Abegg, & Luthe, 2014, p. 72).

Although the quotations presented above may give the impression that touristic operators are aware on the effects of climate change, there are authors mentioning that the majority of Swiss ski operators have the intention to discount the risks of global warming impacts (Yang & Wan, 2010). Moreover, they believe that climate change is too advertised by media, scientists and politicians (ibid).

In addition to the four impacts of climate change on winter tourism in the Swiss Alps presented above, Matasci (2012) add four more, which are:

- Positive and negative changes of climate variability for tourism activities. Due to climate change the thermal comfort will be affected (through modifications of temperature, precipitations, wind speed, humidity and number of daylight hours) and therefore, the degree of attractiveness of destinations at lakes and in the Alps may increase in the summer time, even reaching the level to replace the tourism in the Mediterranean region.
- Increase in the frequency and intensity of floods, debris flows, landslides and falling rocks
- Water scarcity – droughts. In the study is mentioned that in approximately 50-70 years (2070-2099) the amount of available water in Switzerland will slightly decrease. The causes are the less abundant precipitation in the summer, combined with more intense evapotranspiration and also the melting glaciers could determine more droughts in the post summer periods. As the Swiss tourism depends on water availability in several ways (apart from basic needs, water is necessary for swimming pools and spas, irrigate golf areas, produce energy and it is also vital for snowmaking) its scarcity could lead to with other sectors, such as agriculture or energy production.

- Positive and negative changes in scenic beauty. Due to climate change several aspects of landscape (such as glaciers, soil, flora and fauna) will be affected. While some species will adapt to new conditions, others are expected to disappear. Non-native species will also make their occurrence to be felt, and even phenomenon such as desertification could take place in the inner Alpine dry valleys. These changes could increase but also decrease the attractiveness of some areas.

The negative impacts of climate change on winter tourism in Switzerland involve financial costs. The potential annual costs of climate change in Switzerland are calculated at CHF 2.3 to 3.2 billion by the year 2050 (Elsasser & Bürki, 2002).

Several computations and scenarios have been done, trying to assess the impact of global warming also for the future.

The starting point for one of the scenario is the fact that in the Swiss Alps the altitude where snow is in appropriate quantities for skiing is 1200 meters above sea level (masl) (Elsasser & Bürki, 2002). At the time when the article has been written 85% of the 230 Swiss ski resorts were considerate snow reliable. One assumption is that due to climate change, the minimum level of snow reliability will increase. In the eventuality of this level reaching 1500 masl the number of snow reliable ski resorts will fall to 63%. If the level will rise up to 1800, the percentage of snow reliable ski resorts will drop to 44% (Elsasser & Bürki, 2002).

Another scenario takes into account the possible increase in temperature. Under current conditions 159 (or 96%) out of 164 Swiss ski areas are snow reliable (Abegg, Bürki, & Elsasser, n.d.). If the temperature increases with 1ºC, the percentage of snow reliable ski areas will drop to 86% (ibid). This could happen in less than 20 years, because a warming of around 1.2ºC is projected to happen in Switzerland by 2035 (Wyss, Abegg, & Luthe, 2014). With a 2ºC rise of the temperature, the share of snow reliable ski areas will fall to 78% while for an increase of 4ºC, only 47% of ski areas will still be snow reliable (Abegg, Bürki, & Elsasser, n.d.).

Bavay, Grünewald and Lehning (2013) predicted another impact of the climate change, according to which the snow season would reduce by 5-9 weeks in the Eastern Switzerland (where the focus of the current master thesis is) for the period 2070-2095. This would be equivalent with an increase in the snow level with 400-800m.

The negative impacts of climate change on the Swiss winter tourism in the last decade could be one of the main factors explaining the decreasing number of ski tourists faced by Switzerland (Vanat, 2014). In the Figure 3 it can be seen that the skier visits in Switzerland decreased from almost 30 million in the season 2003-2004 to approximate 25 million in the season 2012-2013.

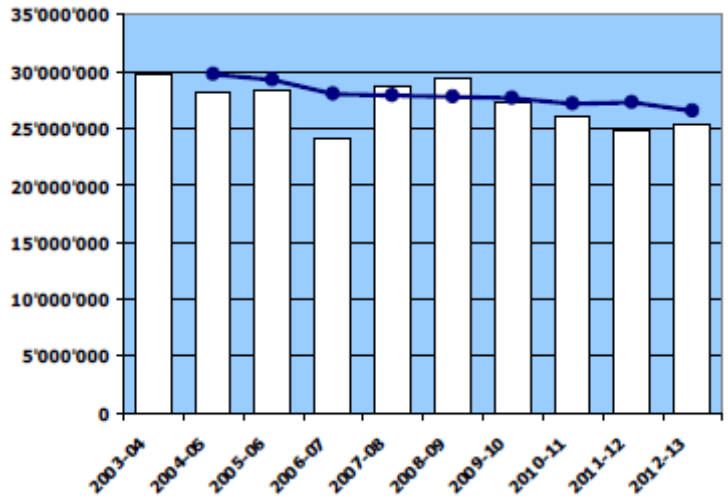

Figure 3 Evolution of skier visits in Switzerland
Source: Vanat (2014)

3.3.2.2 Target groups affected by climate change in the Swiss Alps

Based on what it has been presented in the previous chapter, it resulted that the following groups are affected by climate change in the Swiss Alps destination (see Figure 4).

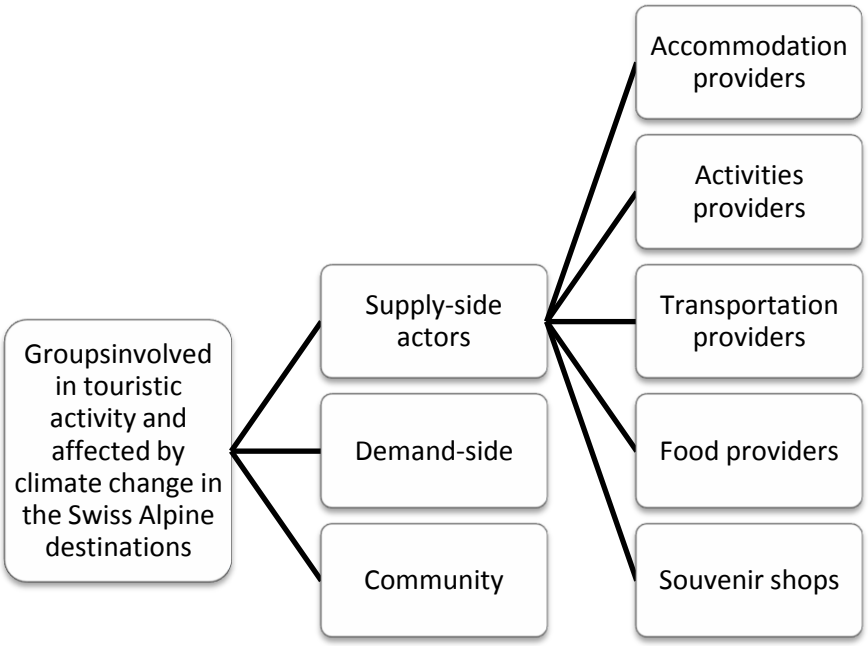

Figure 4 Groups involved in touristic activity and affected by climate change in the Swiss Alpine destinations
Source: own design based on: Wyss et al. (2014); Koenig & Abegg (1997); Bürki et al. (2003, December); MoE (2011)

The supply-side actors can be divided in:

- **Accommodation providers** situated at altitudes where climate change impacts are more intensive receive fewer tourists, due to a decrease of attractiveness of the destination. However, according to Koenig and Abegg (1997), who have analyzed the

impacts of three consecutive snow-deficient winters at the end of the 1980s on the winter tourism in Switzerland, accommodation providers were less affected by low demand, than the next category, the transportation providers.

- **Transportation providers** (cable-cars, T-bars, chair-lifts). Those located at lower altitudes face two main negative impacts: first, the fewer amounts of tourists using their infrastructure and secondly, the threat that their pillars can be not stable anymore, due to melting permafrost (Bürki, Elsasser, & Abegg, 2003, December). Consequently, the transportation providers situated on glaciers, present increases in the number of passenger, according to the study of Koenig and Abegg (1997).
- **Activities providers**, such as ski schools; **food providers**, such as restaurants; **souvenir shops** which can also face fewer clients because the region where they operate is not attractive anymore (Wyss, Abegg, & Luthe, 2014) (MoE, 2011)**.**

The tourists.

Often, tourists experience the entire portfolio of services and goods existent within a destination as a whole offer, and do not distinguish between the tourism businesses and elements (Bieger, 2008 as cited in Wyss et al, 2014). One component which influence the touristic perception is also the weather condition, especially for those who are willing to practice winter sports and therefore need adequate weather context – such as sufficient amounts of snow, low temperatures to keep the snow layer, lack of rainfalls (which hurry the snow melting) and so on. Therefore, if one piece of the whole touristic package is not satisfactory for tourists, it results from the statement of Bieger (2008 as cited in Wyss et al, 2014) that the whole tourists' experience is negatively affected.

Moreover, tourists will be affected in terms of less supply diversity (Koenig & Abegg, 1997). If some ski resorts will no longer be snow reliable, the tourists' options to choose among destinations will be diminished (ibid).

Community.

Climate change determines tourists to not go anymore to certain destinations, which will determine a decrease in the income of the respective local communities (MoE, 2011). Fewer amounts of tourists also mean a less contribution to the community budged – for example there are fewer parking taxes or city taxes paid.

It can also be assumed that the majority of the employees working for the above mentioned touristic providers are part of the community where the operators are based in. Therefore, if the economic agents face tough economic times, they can be forced to implement some cost reduction measures, such as personnel reduction. Therefore, the members of community who work for the touristic providers in a resort located at low altitude are threatened to lose their jobs. Moreover, those who do not necessarily work in a dedicated tourism business (such as groceries) will be negatively affected by the fewer tourists coming, because the latter can constitute a smaller or larger proportion of the customers.

It can be argued that **supply-side actors** are the most affected group, because, contrary to the tourists, or the community, they do not have the benefit of mobility. While the tourists can

easily go to the resorts which are more snow reliable, and the community members working for the touristic providers can be hired in other resorts or other fields, for a cable car company, for example, it will be much more difficult to move its infrastructure (cable cars, pillars, wires etc) to an altitude which is not affected by the warming temperatures. Moreover, compared with the tourists, the touristic providers but also the communities have a **very low adaptive capacity** to climate change (MoE, 2011). Among the touristic providers, **hotels** and **attraction operators** represent the lowest adaptive ability (ibid). This is also confirmed by Scott and McBoyle (2007, p. 12) who mention that skiers are "very adaptable to climate variability" and they can effortlessly change the destination or/and the time of their trip. Moreover they can even shift from the skiing activities to other recreational activities (ibid).

Therefore, **the target group of this research is represented by the supply-side actors** operating in the SNP region.

3.3.2.3 Adaptation measures taken by tourism providers in the Swiss Alps

A further increase is earth's surface temperature is considered to be imminent despite the successful activities which have the purpose of mitigating climate change (Hoffmann et al., 2009). Therefore, it has been concluded that nowadays societies around the world will need to adapt to some extents to the impacts of climate change (Scott & McBoyle, 2007). However, this does not mean that mitigation actions are not necessary anymore or that they are less important. Elsasser and Bürki (2002) mention that tourism industry needs to concentrate more on mitigation strategies. Therefore, as it is suggested by Matasci (2012), both adaptation measures and mitigation are necessary. Further on, adaptation measures implemented by tourism actors in Swiss Alps will be discussed.

Adaptation can be defined as the capacity of an entity (such as a touristic operator or a community) to transform its structure and operations in order to cope with changes which are challenging its existence and success (Kaján & Saarinen, 2013).

Almost 20 years ago, Koenig and Abegg (1997) considered the following adaptation strategies as being beneficial to be implemented:

- *Development of higher skiing areas*. Ski areas at higher altitudes have considerable advantages, when is about global warming.
- *Snow making*. It is a reasonable strategy for maintaining the snow cover, especially for the smaller areas of the ski slopes which are exposed to sunny conditions. This activity is the most preferred adaptation measure (Tranos & Davoudi, 2014).
- *Diversification*. Resorts focused on winter tourism can diversify into other activities like cultural sector or entertainment and sports events which can help to improve summer business.
- *Co-operation*. By business co-operation or fusion of companies there will be beneficial effects regarding the financial base and the investment strategies. This is also confirmed by Wyss et al. (2014) who emphasize on the aspect that cooperation among the actors along the tourism supply chain is a key element driving most of the adaptations measures to success in an alpine tourism context. Moreover, in a study focused on winter tourism, Swiss Alps and snowmaking, Pütz et al. (2011) call for immediate collaboration among all relevant stakeholder groups (such as mountain railways companies, communities, tourism organization and agencies for nature conservation) for handling the planning process with regards to snowmaking. Finally, a research conducted on the Swiss tourism sector revealed that the participants

frequently named cooperation among stakeholders as being one of the options for overcoming barriers that can obstruct the adaptation measures to be implemented (Matasci et al. 2014).

It can be seen that for some of the measures mentioned almost 20 years ago, their necessity or their practical implementation is confirmed by very recent studies such as those of Tranos and Davoudi (2014), Wyss et al. (2014), Pütz et al. (2011) or Matasci et al. (2014)

In 2002, the actions of tourism stakeholders and ski area operators are noticed by Elsasser and Bürki (2002) who remark that the above mentioned actors are not waiting to confront the negative impacts of the climate change, but they are already adapting their behaviors.

Abegg et al. (n.d.) classify the adaptation practices identified among ski area operators in two categories: **technological** and **behavioral**. **Technological** adaptations are further divided into four types: landscaping and slope development, moving to higher altitudes and to slopes which are facing north, glacier skiing and artificial snowmaking. Regarding the **behavioral** measures, the authors suggest that there is a diversity of such adaptations varying from operational proceedings (such as reducing the ski season) and financial tools to new business models and a shift to more diversified activities.

Scott and McBoyle (2007) also mention adaptation measures that can be implemented by the ski area operators, and classify these measures in **technological** practices and **business** practices. The options found in the category with technological practices are very similar with the case of Abegg et al. (n.d.). Scott and McBoyle (2007) mention in this category the following:

- Snowmaking
- Slope development and operational practices. These practices include slope contouring, landscaping and glaciers protection. For this category, activities such as removing rocks and shrub vegetation from the slopes, strategically tree cover planting will reduce snowmaking requirements and also the snowmelt. Moreover, it is mentioned the development of new ski areas, for example north facing slopes or extension to higher altitudes area.
- Cloud seeding – a technology used to produce additional precipitation.

The category with business practices includes the following measures:

- Ski conglomerates. It is give the example of companies which have acquired ski areas in several locations in North America. The main advantage of these ski conglomerates is that the access to capital and marketing resources in more facile than in the case of a company which has ski resorts in only a single region. The authors consider that this measure can be one of the most effective adaptations to future climate change.
- Revenue diversification. This measure involves that ski resorts make investments for offering alternative activities for visitors who do not practice skiing. Examples of such activities are: snowmobiling, skating, indoor pools, health and wellness spas, and fitness centers or games rooms. The authors mention that some resorts shifted from ski resorts to four season resorts by providing activities such as golf, rafting, mountain biking, horseback riding and other activities.

- Marketing incentives is the last option in this category. Through it, the ski companies try to ensure their clients that they will have proper snow conditions. In case the weather conditions are bad, the companies offer some discounts.

At the border between technological and business practices is situated the option of indoor ski areas. The authors mention that building such indoor ski domes can be a strategy for low elevation ski areas to continue to develop the ski industry.

Very similar to the adaptation strategies presented until now is the classification of Elsasser and Bürki (2002) who have also grouped the measures into 4 different categories. Along with the strategies for (1) **maintaining ski tourism**, (2) provide **alternatives to ski tourism** and (3) **subsidies**, categories which have already been indentified in similar form in other studies above discussed, the category number four, called ***fatalism***, comes into notice. The authors mention in this category the following measures:

- "Business as usual", which means that both supply and demand sides keep their actual behaviors without changing it, and
- Cancel ski tourism, which basically means to close down the facilities used for winter sports, without trying to promote or to consolidate other types of tourism.

Like its name says, this category is a really extreme one, and Elsasser and Bürki (2002) mention that although this *fatalistic* attitude is more likely to happen for small and isolated ski providers situated at low altitudes, these measures (business as usual and cancel ski tourism) should not be considered as true strategies when combating climate change.

In another study, Hoffmann et al. (2009) provide a list with adaptation measures taken by ski lift operators in Switzerland. These measures are classified by the strategic direction that they follow, namely to protect the affected business, to expand beyond the affected business or to share risks of financial impacts. The measures named in the respective study are found in Table 4:

Strategic directions	**Single adaptation measures**
Protect the affected business	• Extend artificial snow making • Landscaping and slope development to reduce the required snow cover (e.g. plane slopes) • Develop higher terrain for slope sports • Install blankets for snow conservation • Improve/professionalize slope support • Concentrate slope sports in higher terrains of the developed area • Introduce alternative slope activities • Organize winter sport competitions • Open slopes with less snow than usual
Expand beyond the affected business	• Establish/develop hiking trails • Offer theme hiking • Organize summer-events on the mountain (e.g. open-air concerts) • Develop bike/downhill routes • Offer adventure and fun sports (e.g. paragliding) • Develop gastronomy on the mountain • Build a summer toboggan-run

	• Establish/develop snowshoeing trails, winter hiking trails or winter toboggan runs • Organize winter events on the mountain (e.g. concerts)
Share risks of financial impacts	• Effect a snow insurance • Split costs (operating costs or investment costs) with local industry • Split costs with the local authority • Cooperate with local industry (e.g. joint offerings) • Cooperate with other ski lift operators (e.g. exchange of machines) • Merge with other ski lift operators

Table 4 Adaptation measures of ski lift operators classified by strategy direction
Source: Hoffmann et al. (2009)

Finally, it can be argued that these adaptation strategies have a crucial role in tourism, especially in the winter segment, and preparing for the impacts of climate change has become a key aspect for those having management position and for decision makers (Rosselló-Nadal, 2014).

3.3.2.4 Drivers for implementing adaptation measures

Hoffmann et al. (2009) realized an interesting study about what could determine the tourism operators to start the implementation of adaptation strategies. They decided to focus on Swiss ski lift operators and explained this through the fact the these companies are directly dependent on the amount of natural snow - in 2005, more than 80% of the ski lift operators' revenues came in the winter season Seilbahnen Schweiz (2006). The second reason is that these companies make considerably investments for their infrastructure. The third aspect of why the ski lift operators have been chosen is given by the fact that these companies represent the core of ski resorts, and other stakeholders depend on their operations.

The first finding of the above named study acknowledges that **the higher is the degree of a company's awareness** regarding possible climate change effects, the more adaptation measures it will attend.

The second aspect revealed by the study is the confirmation of the hypothesis which says that **the more dependent is a company on the affected business**, the more measures to protect that business it will initiate.

The next finding mentioned by the study of Hoffmann et al. (2009) confirms the hypothesis that **the higher is the company's ability to adapt**, the more measures it will implement for protecting the affected business and also to expand beyond that business.

An interesting result of the study is the fact that the hypothesis which states that the more vulnerable a company is, the more adaptation measures it will pursue, could not be confirmed.

Therefore, at least for one of the most important group of tourism providers in Switzerland, namely the ski lift operators, it can be conclude that in order for them to pursue adaptation measures it is important their awareness about possible climate change effects, their dependency of the affected business and also their ability to adapt. The bigger are these variables, the more measures the companies will implement for protecting their businesses.

In another study about climate change and Swiss tourism, Matasci (2012) identifies that factors that are triggering adaptation measures are not always only related to climate change. Some of the stakeholders interviewed in the above mentioned paper admitted that some diversification measures have been triggered by less amounts of snow, but an important role was also played by the economic situation of that time, by the situation in neighboring regions and also by the changes that occurred in the demand side.

3.3.2.5 Barriers for implementing adaptation measures

In the process of developing and implementing climate change adaptation measures, several barriers can emerge (Biesbroek, Klostermann, Termeer, & Kabat, 2013). Because nowadays the topic of climate change is a very popular one, of course, the academic interest for treating the subjects of adaptation and barriers has also increased in the last decade (Biesbroek, Klostermann, Termeer, & Kabat, 2013).

A general definition of barriers to adaptation is the one provided by The Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC), stating the barriers are: *obstacles to reaching a potential that can be overcome by a policy, program, or measure* (IPCC, 2007)**.**

A study of Matasci et al. (2014) assessed the barriers that can emerge among Swiss tourism sector stakeholders while considering adaptation measures. The study begins with a framework for barriers' classification, divided into five families of barriers, as follows:

- Barriers obstructing social feasibility, which include the difficulty to identify the changes that already happen or to identify the impacts of these changes.
- Barriers obstructing social acceptability, which may arise, for example, when the population is not willing to accept certain adaptation measures.
- Barriers obstructing institutional feasibility, which may occur when there is no political willingness to conduct some actions at different levels. Another case is when there is a lack of coordination and cooperation among tourism stakeholders in a region.
- Barriers obstructing economic feasibility, which can be represented by insufficient funds or disadvantageous cost-benefit proportion of the planned adapting measures.
- Barriers obstructing technological feasibility, which means that stakeholders may not have the know-how or the needed technologies for acting.

After providing this useful classification, Matasci et al. (2014) asked hundreds of stakeholders from the Swiss tourism sector questions about what types of barriers they face and what degree of importance each type has. The results are very interesting:

- All types of barriers are recognized as being important, but **in particular economic and institutional feasibility barriers**.
- **Lack of quality information** about climate change and its **effects represents an impediment** for stakeholders' actions to adapt.
- Stakeholders named other **possible barriers**, apart from those suggested by the authors of the study, which were: **lack of long-term perspective**, which can be determined by a pressure to obtain immediate results; **strong Swiss franc** (the time when this project has been done coincided with a appreciation of the currency by

30%); **lack of action at international level** and also the **concern that** if there would be changes in tourism, **the jobs and the incomes in that region would be affected**.

- Because Swiss inhabitants are in general aware of climate change and conscious that some adaptation measures are needed (Matasci, 2012), **the barriers related to social acceptability do not represent a threat** for the adaptation process.
- The **stakeholders were not worried about a potential lack of technical know-how** related to climate change adaptation measures.
- **Willingness to act among the stakeholder does not represent a barrier** to adaptation actions; the eagerness to adapt is similar between private and public sector stakeholders.

The author the current master thesis considers that the study of Matasci et al. (2014) extremely helpful, firstly for providing the theoretical framework of barriers but also for the results of the survey done among the Swiss tourism sector stakeholders. The current master thesis intends to discover what barriers face in implementing adaptation measures the tourism providers from the SNP region, therefore having a more focused area of study it can be the case that the results of the above named study will/will not be confirmed.

Moreover, as Matasci et al. (2014) acknowledges, the study did not include barriers considering environmental feasibility (such as some limits of natural resources). This can be an important category as several other author have discovered. Further, will be presented the barriers and constraints stated by other researchers.

In the article Climate Change in the European Alps there are named some limits or potential conflicts for each adaptation measure suggested (OECD, 2007). Also Scott and McBoyle (2007) name constraints for most of the measures identified. The main limits, potential conflicts or constraints are summarized in the Table 5.

Adaptation measure	Limits, potential conflicts, constraints
Landscaping and slope development	**OECD** (2007)**:** Environmental impacts; impacts on biodiversity and vegetation cover; may negatively impact summer tourism
Moving ski areas higher and north facing	**OECD** (2007): Opposition from environmental groups, because of the disturbance of high mountain environments and because of increase pollution (due to traffic associated to tourism) Limited or no options for expansions for some ski areas Costly measure (between CHF 40 and 49 million in Switzerland for moving ski operations to higher altitudes) North facing slopes might be unattractive to skiers Risk of avalanches **Scott and McBoyle** (2007)**:** Opposition from public and environmental groups because of disturbing environments
Glacier skiing	**OECD** (2007)**:** Unsustainable strategy in the long term; opposition from environmental groups
Use of white blankets to protect glaciers from melting	**OECD** (2007)**:** High costs; opposition from environmental groups such as Greenpeace and Pro Natura

Snowmaking	**OECD** (2007)**:** Increasing costs; More and more water and energy are needed; Ineffective at temperatures higher than -2 ºC; Can lead to cuts in the water supply system or reduce water levels; Negative impacts on Alpine vegetation; noise generated by snow cannons; **Scott and McBoyle** (2007)**:** Access to water can be a critical constraint; Infrastructure and energy costs which can lead to losses for providers; Environmental impacts (for example when water is withdrawn from natural lakes it can impact the life of aquatic species) and therefore opposition from communities and environmental organizations; Strict regulations of some jurisdictions regarding water withdrawals. **Pütz et al.** (2011)**:** Not so high acceptance of artificial snow from tourists, from this study resulted that 51% of the interviewed skiers supported the option of artificial snow. Some areas with dry climate, for example Scuol is well known for this (750 mm annual precipitation and 6 ºC mean annual temperature)
Operational practices (such as reducing the ski season)	**OECD** (2007)**:** Negative impact on the economy; Losses if the facilities are open for shorter periods.
Financial and Marketing Tools (such as marketing incentives or snow insurance)	**OECD** (2007)**:** Insurance premiums can be too costly for ski resorts. **Scott and McBoyle** (2007)**:** Marketing incentives can be countered by the trend of tourists of booking their holidays very close to the actual holiday time, such as “last minute” bookings
Financial support	**OECD** (2007)**:** Ski area operators believe that costs should be also shared with accommodation industry and the whole community, fact that can lead to conflicts
Cooperation, mergers, ski conglomerates	Do not present any limits, potential conflicts or constraints in both of the studies of **OECD** (2007) and of **Scott and McBoyle** (2007)
Diversification (winter revenue diversification, all year tourism)	**OECD** (2007)**:** The activities which are not related to snow cannot substitute revenues produced by snow related offers. Negative impacts of climate change also in summer. Conflict with mountain agriculture for land which used to be for agricultural purposes. **Scott and McBoyle** (2007)**:** Substantial investments
Cloud seeding	**Scott and McBoyle** (2007)**:** Substantial investments No convincing scientific evidences that this measure really works
Withdrawal from ski tourism	**OECD** (2007)**:** Winter tourism represents the main source of income and employment for many ski resorts; therefore if the ski tourism is discarded the local economy will definitely suffer.

Table 5 Limits, potential conflicts and constraints of adaptation measures taken by tourism providers in winter destination

Source: Own design based on Scott and McBoyle (2007), OECD (2007) and Pütz et al. (2011)

3.4 Summary of literature review

The previous literature review has successfully addressed and clarified important terms and structures which will be used for the rest of this study. Thanks to the literature review, now the reader has a general understanding of topics such as climate change, impacts of climate change, adaptation measures, drivers and barriers for such measures. The literature has shown that climate change is an extremely popular notion nowadays and that its impacts can be really extreme for some persons and businesses. As tourism is one of the most vulnerable industries to climate change impacts, especially in the winter destinations, the specific impacts have been reviewed and also what behaviors have the tourism business adapted. The literature is focused on the Swiss Alps, as the region studied (SNP region) is part of this mountain chain. From the work of other researchers it resulted that there are several adaptation measures that tourism business can implement, triggered by specific factors but also obstructed by various barriers. Further on, the author of this study will investigate the specific case of SNP region, with the aim of finding which are the impacts of climate change in the area and how are the businesses there reacting.

4 Results and discussion

In this chapter there will be presented the most important findings resulted after analyzing the data collected through interviews. Chapter 4 is organized according to the interview structure, which mainly follows the order of chapters presented in the literature review. In each subchapter, there will be presented the results from interviews and these results will also be discussed, by comparing them with the literature.

4.1 Physical impacts of climate change in the SNP region and peculiarities of this area

In this chapter there are treated the topics of physical impacts of climate change in the SNP region and there are also presented the special characteristics this area has. The author of this study considered that addressing the physical impacts of climate change in the studied area needed to be the first step when conducting the interviews with experts, in order to have an understanding of the reality that happens in the SNP region.

4.1.1 Results from tourism experts

Discussions with tourism experts allowed the author of this master thesis to establish a list with the most important physical impacts that occur in the SNP region. This list will serve as a basis for the following topics that are discussed in the interview.

Almost all the interviewees affirmed that the **amount of snow** currently is and it will also be in the future a physical impact of climate change. Persons who are very familiar with the SNP region, like Hans Lozza (Communications & PR Manager at Swiss National Park), Constanze Conradin (from Biosfera Val Müstair) or Reto Rupf (who has made several studies in the area) agreed on the fact that last years but also in the current season (2015/2016) there was less snow than usual. Also Bruno Abegg, who is well known for his studies in the field of climate change and tourism, stated that the most important physical impact is on the snow cover. Additionally, Hans Lozza explained that along with the fact that snow comes in fewer amounts it also comes in **shorter periods**, so the snow season is diminished. Moreover, Claudio Daguati, which is part of the tourism office Ferienregion Engadin Val Müstair, said that the start of **ski season has started later** with one month in this season (2015/2016). He also added that **the snow level has increased**. Finally, all the experts agreed that the impact of less snow cover will persist also in the future.

Another impact which was often brought into the discussion was the **increasing temperature**. Hans Lozza acknowledges that in the area the average temperature is higher and he also base his statement on a very significant fact, namely that in the month of November 2015, there was established an absolute record, with the highest temperature ever measured in a November. Ms. Lehmann, who has also researched the phenomenon of climate change in tourism, also provides some very pragmatic facts, by saying that the temperatures will increase in the whole canton by 0.9 – 3.4 ° C until the year 2050. Also this impact is named by Reto Rupf, who states that temperature augmentation will affect the region.

A change in the weather pattern is the next impact which concerns the experts interviewed for this study. In this impact is highlighted the fact that weather will not be as regular as it was until now. Therefore one expert says, related to snow amounts that there can be long periods with no snow and suddenly periods with lots of it. Another expert stated that sometimes, the weather can be very dry and warm and suddenly lots of precipitations can occur. One aspect agreed by interviewees is that in the winter there will be more rain and also more extreme events. Persons who are spending most of their time in the studied area, like Hans Lozza and Claudio Daguati mentioned that more rain is a main impact: "*We have more rain." (H. Lozza)* and "*We observed that it rains more than in snows." (C. Daguati).*

Dryness and **water scarcity** are two related impacts that have been presented by the experts. Bruno Abegg names the less water impact three times which can be a proof of its importance. Moreover he is confirmed by Hans Lozza who acknowledges that currently, there is a problem with the water resources in the River In. Regarding the dryness, Bruno Abegg mentions that the year 2015 was very dry and the climate scenarios say that also in the future the dryness will increase. However, with regards to dryness of the area, Reto Rupf is uncertain saying that in the future it can be drier or even more humid.

Other impact named in the discussion with experts is the **danger of rock falls** which are triggered by **the melting of permafrost**. These two impacts have been named by the interviewees who are more familiar with the Easter Side of the SNP, namely the region Val Müstair. Two of the interviewees agreed that the **period of ice coverage on the lakes and ice rink is shorter**. M**elting of the small glaciers** existent in the SNP region is another physical impact named by one interviewee and Reto Rupf mentions that there will be some **changes in the ecosystem** as some species of animals could change their behaviors.

Based on the answers of interviewees Figure 5 has been developed, summarizing the most important physical impacts of climate change in the SNP region. After the discussion with experts, the author classified the impacts according to their importance based on how often the interviewees named them and with what intensity. Therefore, the physical impacts colored with dark background seem to be more important and more relevant for the studied area.

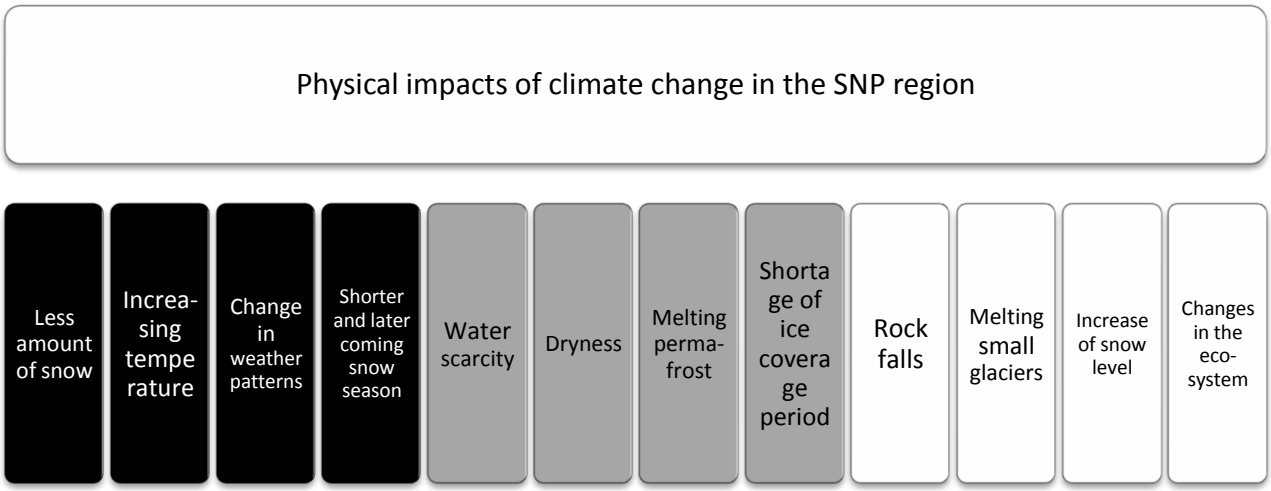

Figure 5 Physical impacts of climate change in the SNP region
Source: Own design based on interviews analysis

When it comes to the peculiarities that the SNP region has, compared with other regions in the Swiss Alps, one aspect has stood out, namely the **dryness** of the area. Hans Lozza stated in several times that the area is characterized by a dry climate due to its localization in the inner Alps. This is characterized by low precipitations, and Mr. Lozza give the example of Zernez, which has a very low average value for an Alpine destination, which is around 700 mm/year. Bruno Abegg and Reto Rupf agree with Mr. Lozza's statement saying that specific to the studied area is the dry climate. Also Ms. Conradin and Mr. Daguati agreed that the local climate is a peculiarity. Mr. Rupf provides some information about the effects of this dryness, with regards to climate change impacts. He mentions that due to the aridity existent in the area, the impacts of climate change will be more intense, and he emphasizes on the impacts on the ecosystem.

Another aspect that could differentiate the SNP region to other regions in Swiss Alps is mentioned by Ms. Therese Lehmann. She names the **high altitudes** that this region has and, according to her statements the whole area is less vulnerable to climate change impacts. Ms. Lehmann calls this as a *competitive advantage* which will help the region in the future, where the climate change impact will be more intense. Moreover, these high altitudes are beneficial for the area also in the summer time, because, according to Ms. Lehmann's affirmation, although the trend of increasing temperatures is visible, the region will still remain during summer a *cool area*.

Therefore, the results regarding the peculiarities of the area can be structured according to the following graph:

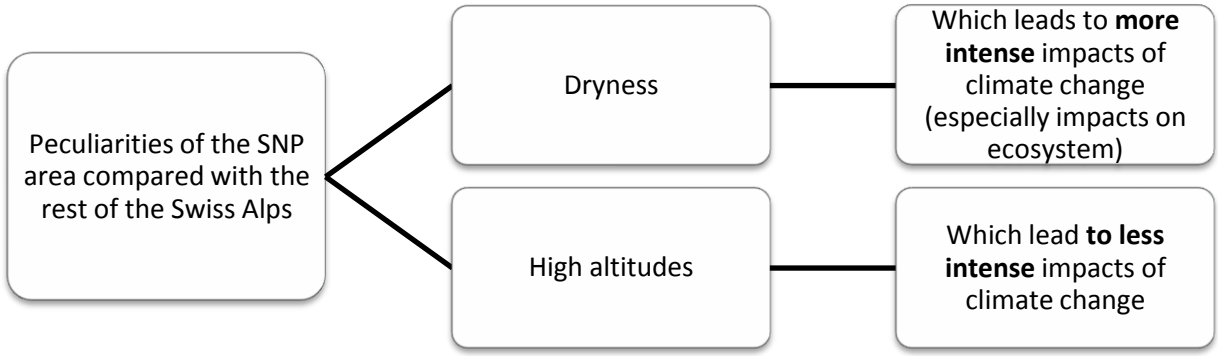

Figure 6 Peculiarities of SNP region and the implications regarding climate change impacts
Source: Own design based on the interviews results

4.1.2 Discussion

One can argue that the results provided in this chapter are very similar with the findings from literature review. Almost all the answers of the experts are also supported by the literature, only with one exception, namely the impact on the ice coverage. Therefore, this code was introduced in the codebook from the interview text.

In rest, all the codes developed in the theory driven codebook have been assigned to statements from the interviews' text. Impacts such as less amounts of snow, increasing temperatures, changes in weather patterns, water scarcity, dryness and reduced snow season are highly confirmed by literature, in the studies treating the climate change impacts on Swiss Alps, like those of Bürki et al. (2003, December); Matasci (2012); Bavay et al. (2013); Pütz et al. (2011); Koenig and Abegg (1997).

What is interesting is that although the impacts of melting permafrost and its association with hazardous events like rock falls and melting glaciers are highly present in the literature, in the case of the SNP region it seems not to be such important impacts. Moreover, this impact, of melting permafrost was only named by the interviewees from the Val Müstair area.

The answer of Reto Rupf, regarding the changes in the ecosystem as some species will modify their behavior is confirmed by Matasci (2012) who classify these aspects as changes in scenic beauty. Moreover, the author says that these changes can have a positive or negative impact. However, as this impact was referred to occur in the future, with a high degree of uncertainty, the interviewee did not mention the way it will influence the region (positive or negative).

The final interesting fact is that the impact mentioned by Claudio Daguati and by Hans Lozza, namely the shorter period of ice coverage, was not found in the impacts provided by the literature review.

As a conclusion to the part treating physical impacts, it can be stated that in general all the interviewees' answers confirmed the effects presented in the literature and moreover, with the exception of impact upon dryness of the region, all the experts provided answers going in the same direction, without existing contradictory answers among interviewees or answers that contradict the literature.

Regarding the topic of SNP region's **peculiarities**, it can be seen that most of the experts agreed on one aspect, namely the distinct climate that this area has. The particularity that has been named, regarding the climate in this area, is given by dryness. The results from the expert interviews are confirmed by literature, which mentions that the valleys situated in the inner Alps, are protected against precipitation coming from directions north or south (MeteoSwiss, 2014). The same source confirms the statement of Hans Lozza, by mentioning that in the Canton of Graubünden, the average amounts of precipitation are between 600 and 700 mm/year, while in the rest of the Alps the average is 2'000 mm/year (ibid). Moreover, Pütz et al (2011) mention that the area of Scuol is very dry, with average amounts of precipitation of around 750 mm/year. This aridity will determine, according to the statement of Reto Rupf more intense impacts of climate change in the future, especially the changes in the ecosystem. This is an interesting finding which could not be found in the literature.

The second peculiarity of this area is given by its high altitudes and due to this aspect the region does not face severe impacts of global warming, and will also not face in the future. This is confirmed by literature where is mentioned that canton of Graubünden, where the SNP region is situated, occupies the second place regarding the mean altitude of ski areas (Koenig & Abegg, 1997) (OECD, 2007). Moreover, the literature acknowledges that Graubünden will be on the winners' side when discussing about vulnerability of ski resorts along Alps; and that this canton will still be snow reliable even with a temperature rise of 2ºC (Koenig & Abegg, 1997) (OECD, 2007). The experts mention that regions' high altitudes will be a competitive advantage which will also help the area during summer time. The reasoning is that although the temperatures will increase, the SNP region will still be a cool area during summer season and it will attract the tourists coming from lower altitude regions. This interesting finding is confirmed by the findings of Serquet and Rebetez (2011) who, in a study

done in the Swiss Alps, discovered that domestic tourists spend more nights in the mountain hotels during summer time, due to hot temperatures.

Peculiarities of SNP region prove to have both positive and negative impacts for the area. On the one hand, the area is characterized by a drier than average climate, which can determine that impacts of climate change to be more intense. On the other hand, the high altitudes of the area represent and advantage and due to this, the climate change impacts can be less intense.

It can be argued that based on the natural characteristics of the area (like climate or altitudes) there is an equilibrium regarding the intensity of climate change impacts and it is difficult to assess what will influence more these impacts in the area: will it be the dryness (with negative impacts) or will it be high altitudes (with its positive aspects)? The author considers that this equilibrium can be disturbed, either in a positive or in a negative manner by the human intervention, and that is why the next topics discussed are strictly referring to what behaviors have people and businesses in the area adapted with regards to climate change.

4.2 Impacts of climate change on tourism businesses and awareness of tourism businesses representatives

In this chapter the impacts which are strictly affecting the tourism businesses are presented, after the discussions with tourism experts and tourism providers. The author considered that it is important to have an understanding of how the physical impacts identified in previous chapter can influence the tourism industry in the area. Moreover, the degree of awareness of tourism providers is assessed.

4.2.1 Results from tourism experts

After the identification of the physical impacts that occur in the SNP region due to climate change, the next question brought into discussion was to what extent the tourism businesses from the area are affected by the physical impacts.

Almost all the interviewees agreed that the impacts named in the previous chapter have an important impact on how the tourism providers operate and they admitted that the **attractiveness in winter season will decrease** in the SNP area. Bruno Abegg firmly declared that everything that is snow related will be affected. Constanze Conradin is also categorical and states that in the future there will be **fewer tourists** coming in the area in winter. Moreover, she emphasized on the importance of snow in the area in the winter season, and declared that when the snow is missing the tourists are not so excited to go in the area. Hans Lozza is confirming the information from Ms. Conradin and states that problems for winter sports are serious without snow. In accordance with the same line of thought Claudio Daguati mentions that there are problems for tourism business because of the bad weather. He mentions that bad quality of weather and therefore **bad condition of the facilities** determines **fewer tourists** to come. The problem of touristic facilities is well illustrated by Mr. Daguati who mentions that one weekend before the interview (30-31 January), so in the middle of winter season, in the area Val Müstair, there was only one slope opened and it was in bad condition. Moreover, he sadly acknowledged that he was the only tourist there. Mr. Rupf confirms that problems for Val Müstair could occur, at least in the

areas with lower altitudes. He added that the ski opportunities in Zuoz (cross country skiing), Scuol, Ftan will not be in the future as vast as they used to be. For example, he mentions that in ski area of Zuoz there can occur serious problems due to the orientation of slopes, which are facing north. He emphasizes that the guests might not enjoy the white stripes of artificial snow surrounded by areas with no snow. The same idea is also presented by Hans Lozza, who is asking himself if the tourists enjoy artificial snow or if they prefer other places where there is natural snow. Constanze Conradin and Claudio Daguati seem to answer the question of Mr. Lozza and specify that most of the tourists choose to go to other places where the slopes are open and in good conditions. Another interesting finding was the statement of Ms. Conradin who said that it can be the case that maybe in the future tourists will adapt to the new conditions and therefore the snow sports will become less popular. This affirmation was also provided by Ms. Lehmann

It can be deduced from the statements of experts that lack of snow has the greatest impact on tourism businesses. This physical impact determines the degree of attractiveness of SNP region to decrease and therefore fewer tourists to come in the area.

Claudio Daguati names another impact of climate change on tourism businesses which is the **reduction of the ski season**. He explains that usually the ski season in Val Müstair starts on the 15th of December, but due to weather conditions which were not appropriate for practicing snow sports, this year the ski season was only opened on the 15th of January. This is an important impact on tourism businesses in the area which lead to the next identified effect, which is given by **economic difficulties** that the tourism industry may face in the area. Reto Rupf acknowledges that the economic difficulties can obstruct the maintenance of areas of Zuoz and Val Müstair. Claudio Daguati, from the area of Val Müstair mentions that many people did not have a place to work for approximate one month, before the late opening of ski season. He mentions that especially for transportation providers and restaurants it was a really difficult time before 15th of January.

As the lack of snow is the most important impact on tourism businesses in the SNP region, there is a clear need for artificial snow. This need leads to another impact named by Hans Lozza, meaning the **increased dependency on water and energy resources**. He mentions that more energy and water are used for the production of snow and that in the moment when the interview occurred (15 December 2015) all facilities in the area for skiing, sledding or cross country skiing were possible with the help of the artificial snow. He brings into discussion the question of sustainability of this measure and mentions that snowmaking can be affected by problems with water and electricity supply.

Other interesting findings were given by the fact that, although the interviewees were asked to name the impacts of climate change on tourism businesses in the SNP region, some of them started to mention other facts that affect this industry in the area. This is important in order to have a broader understanding of the situation in the studied area. Hans Lozza, for example, acknowledges that an explanation for the decreasing number of tourists in area can be, together with climate change, the strong Swiss Franc. He was referring to the Swiss Franc appreciation with 20%, decision of Swiss National Bank made on the 15th of January 2015 (Inman, 2015). Therese Lehmann also mentions that the area is affected due to aspects such as competition coming from other countries such as "*new ski resorts opened in Eastern Europe, in Azerbaijan*" (T. Lehmann). She adds that in an area like the SNP region, which has really high altitudes, the economic factors are those who count more than the

impacts of climate change. Ms. Lehmann also mentions that currently there are too many ski resorts and that the market is saturated. Another aspect that influences the tourism business in the SNP region and is not related to climate change, but it was named, is the distance from the big cities.

As a summary to this part, it can be said that the experts acknowledged the importance of climate change and identified impacts of this phenomenon in the tourism industry in the SNP region. The impacts can be better visualized in Figure 7. As it can be seen in the Figure, the impacts on tourism businesses in the SNP region are connected and derive from one another. Of course, these impacts have as a starting point the physical impacts of climate change, which have been discussed in the previous chapter.

However, some of the experts did not put the delicate situation of tourism in the area only on the shoulders of climate change. Therefore, some other reasons for explaining the current state of tourism in the SNP region have been mentioned.

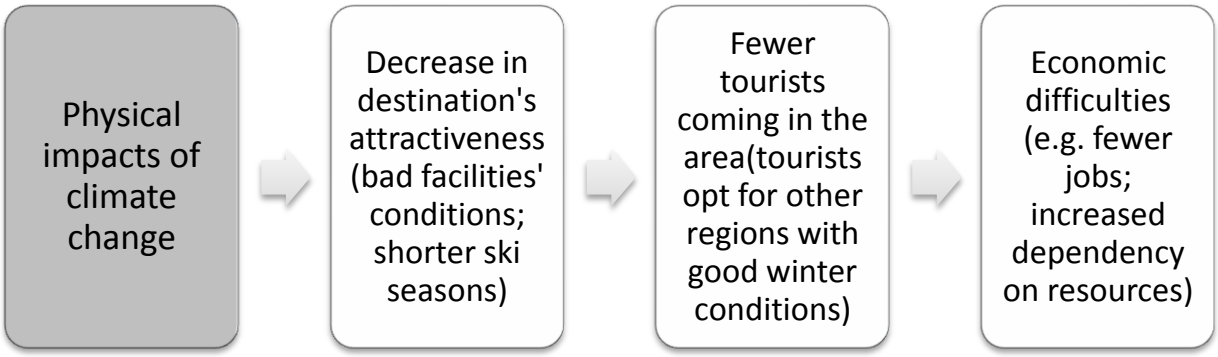

Figure 7 Impacts of climate change on the tourism business in the SNP region from the experts' perspective
Source: Own design based on the interviews results

After the experts have been asked to name the impacts that climate change has on the tourism businesses during winter season, the next question raised was about the degree of awareness of the tourism providers. The reason for asking this question is to discover, from the researchers' perspective to what extent the tourism providers link climate change with some of the problems they face. Of course, representatives of tourism businesses will be asked to state their opinions about how they perceive climate change and how the phenomenon affects their operations. Further on there will be presented the findings that resulted after the interviews with experts.

When the question about if the tourism providers are aware of climate change has been asked, all of the interviewees agreed that the tourism businesses are, in smaller or in larger proportions. For example, Mr. Bruno Abegg mentions that "*most of them"* are aware, while Hans Lozza says that "*many of them" are* and Mr. Rupf states that "*some of them" are aware.* Constanze Conradin is more specific and mentions that *"the big tourism providers are aware".* Ms. Lehmann answers very general saying that "*yes, of course they are aware".* Some of the experts motivate their answer and the reasons why they consider that tourism providers are aware are diverse. For example, Bruno Abegg says that one reason why they are aware of the phenomenon is the high media coverage and another one is their

experience with climate change impacts. Claudio Daguati states that the investments made by tourism businesses to adapt to climate change are a proof of their awareness. According to the statements of experts, the tourism providers that are aware can be divided in two classes: those who take action and those who, although are aware, do not act in this direction. The first class is identified by Reto Rupf and Claudio Daguati who mentions that tourism businesses are informed about climate change impacts and are searching for actions, and also that their investments represent the proof of their awareness. In the same line of thoughts with the second group is the category mentioned by Hans Lozza, naming those providers who think that these impacts of climate change are only some evanescent impacts and everything will be again as it was in the past. Therefore, it can be concluded that although all the interviewees agreed that some tourism providers are aware of climate change, when it comes to the modalities the businesses became informed and their further options for action or not the opinions are diverse. Figure 8 summarizes the results of the question how aware are tourism providers according to the experts.

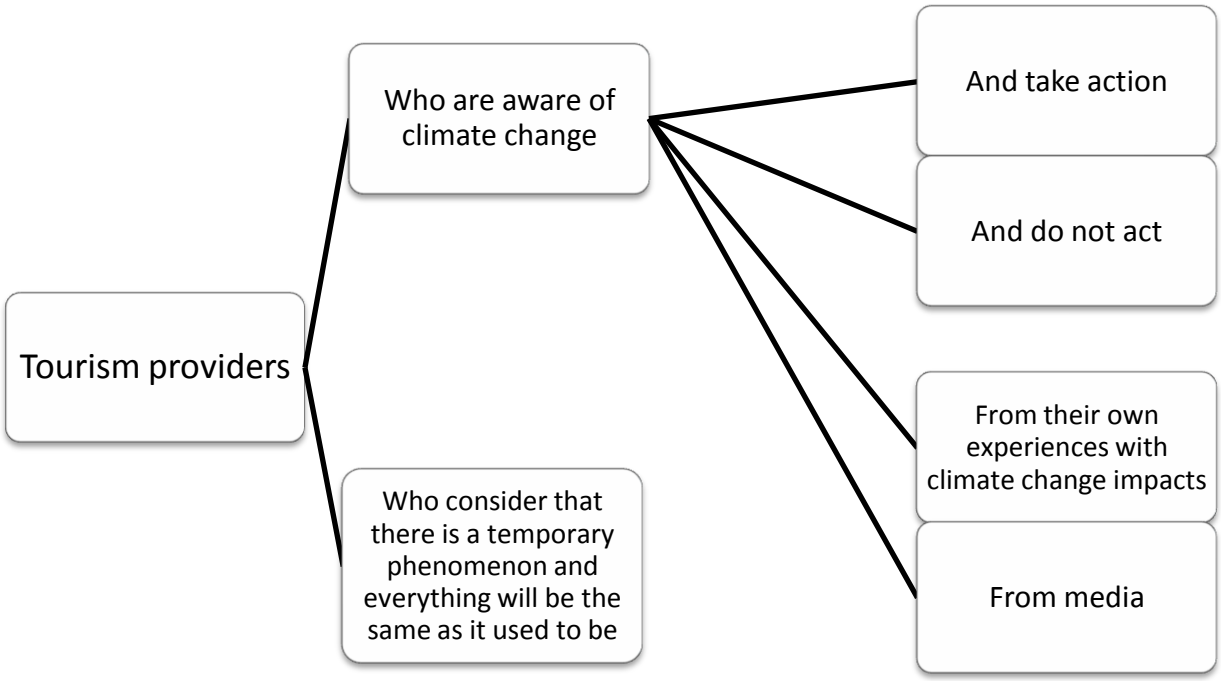

Figure 8 Awareness of tourism providers with regards to climate change in the SNP region
Source: Own design based on the interviews results

4.2.2 Results from tourism businesses representatives

The discussions with tourism providers from the SNP region were really interesting and revealed that currently there is no consensus about impacts of climate change on their businesses. The answers for the question "*Do you think your business is affected by climate change, and if yes please explain how?"* were very diverse and covered multiple points of view. Therefore, the author tried to group the answers in order to establish a classification.

The first category of answers is given by the tourism providers who acknowledged that **climate change affects their businesses**. In this category, **two subgroups** were identified, namely those who are **negatively affected** and those who consider that climate change **positively influences** their operations.

Most of the answers can be assigned in the first subgroup. Representatives of a ski lift company, hotels, ski instructor and ski schools admit that climate change has a negative impact on their operations. Most of them name the problem with having fewer tourists as being the most important. A representative of Bergbahnen Zuoz (the ski lift company in Zuoz) admits that *"there are fewer tourists coming when there is less snow"* and also that tourists prefer to go in other places, where the snow is.

Adrian Lehman, managing director from Hotel Altana, Scuol admits that this year they have fewer guests but he cannot say that climate change is the only factor responsible for this. He added that he identified a change in tourists' behavior, which is for sure related to the change in weather conditions: "*strictly referring to the weather,* ***people book shorter holidays****".* Another hotel representative from Scuol admits that in the first 3 weeks of 2016 his hotel faced a considerable drop in the number of tourists. A ski instructor from Scuol mentions that the business is affected by climate change, mainly in early winter when snow cover is no longer a certain aspect. Another ski school representative from Zuoz admits that the school is affected by climate change in terms that tourists are not attracted to come and take classes when on the slopes "*everything is green and only one white stripe*". Moreover, the same ski school representative added that people do not even feel safe when the situation on slope is like the one named before. She mentioned that in December tourists remarked that they can get serious injuries in the case they will fall off the slopes. However, the persons from the ski school from Zuoz admitted there are also some other aspects that influence the business, apart from climate change. A representative of the ski school Snow Sport Scuol firmly says that their operations are negatively affected by climate change. The main effect is that they faced **losses** for the month of December, and also that they cannot afford to have the same number of instructors as in the past. Therefore, their **business becomes smaller**.

Another named impact is that climate change **increases costs** of tourism businesses. Here is given the example of Tourism office Ferienregion Engadin Val Müstair which organized the World Cup for cross country skiing in the season 2014/2015. Claudio Daguati states that due to lack of natural snow, they needed to produce lots of artificial snow for the event. He mentions that the costs only for producing snow were extremely high, up to 15-20% of the total event budget.

As a separate category can be distinguished the tourism providers who, although they saw the physical impacts of climate change and they even faced some negative impacts on their businesses are not certain yet if the bad weather conditions are explained by climate change. For example, two hotel representatives affirm that: "*I do not know whether it is climate change. We have had just 2 winters with very late snowfalls*" and respectively "*you cannot properly say if the [...] last 2 years with low snow or no snow incoming is due to climate change*". However, the second one admits that, although he considers that it is difficult to prove that climate change occurs, he is "*convinced there is a climate change*". Nevertheless, both hotel representatives provide examples of how their businesses are affected by bad weather conditions.

Only one interviewee can be placed in the group of tourism providers who consider that **climate change has positive impacts** on their operation. The interviewee is Kurt Baumgartner, a person very involved in the touristic phenomenon, being owner of several important hotels in Scuol such as Belvedere hotel 4*or Guardaval hotel 4*. When asked

about climate change, he provided the answer that his opinion is that climate change positively impacts his businesses. Mr. Baumgartner also provides some reasons for this statement, which emphasize on the high altitude this area has, which can be a competitive advantage. He admits that in comparison with other resorts situated at lower altitudes, he cannot feel any negative impact at the moment.

The second category is composed of the tourism providers who consider that their operations are currently **not affected by climate change**. For example, a hotel representative from Scuol mentions that the hotel operations are not influenced at the moment because of climate. He admits that some differences can be felt, but he mentions that at his hotel there is not a problem with less tourists coming due to warmer temperatures in the winter. The same person mentions that the winters started to come later, but the tourists understand the situation and know that there is not the hotel's fault. Moreover, he explains that Scuol is a destination where tourists have many options for spending their time (such as hiking or spa) and they do not come in the area only for skiing. However, the same interviewee mentions that although for the hotel he cannot feel any impact of climate change in the number of incoming tourists**, the restaurant was not as busy as in the past**.

As in the case of the answers from the first group (climate change experts) the tourism providers have also mentioned that their businesses are also affected by other factors, not only climate change. The representatives of Hotel Altana from Scuol, Hotel Astras from Scuol and of a ski school from Zuoz named that the exchange rate Euro – Swiss Franc really impacts their businesses.

As for every results identified until now there is provided a figure for a facile visualization. Therefore Figure 9 summarizes the findings resulted from the discussion with tourism providers, when these have been asked about how climate change influences their operations. The author considered this to be very useful, especially in a case with very diverse opinions as the situation of this question.

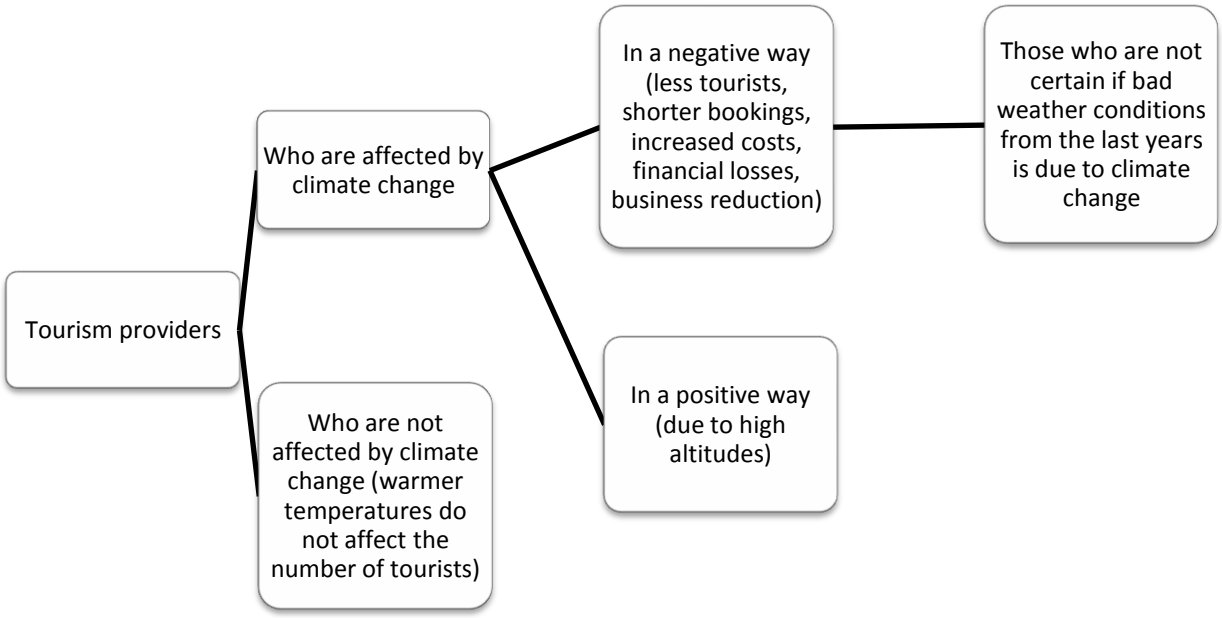

Figure 9 Impacts of climate change on the tourism businesses in the SNP region from the tourism providers' perspective
Source: Own design based on the interviews results

The next aspect which the author considered worth to find was which of the physical impacts of climate change have the greatest influence on the tourism businesses in the SNP area. After discussing this aspect with experts who are not involved in tourism businesses, finding right from those directly affected which are the greatest impacts was the next step. The answers were not so diverse, like in the case of the question regarding impacts of climate change on the tourism businesses. Most on the interviewees agreed that **lack of snow** is the main issue that can affect the welfare of their operations. Hotels and ski schools representatives mention that lower amounts of snow have the greatest impacts on their businesses.

It is emphasized the dependence of ski schools on snow cover and also the fact that for this type of businesses, there is nothing that can be done in the absence of the white layer. A representative of a ski school from Zuoz states: "*the fact that it is less snow has the greatest impact on our ski school*" while a person from Snow Sport Scuol mentions that "*as a ski school, if we have no snow we cannot do anything*". Another ski instructor from Scuol acknowledges that "*lack of sufficient amounts of snow*" have the biggest impacts on his activity.

Hotel representative reveal the importance of tourists coming for practicing winter sports and therefore name the lack of snow as the biggest impact. A person from Hotel Filli in Scuol names that "*lack of snow determines skiers to not come in the area"* while Adrian Lehmann from Hotel Altana acknowledges that if there is no snow, those responsible for ski area will face difficult times to prepare the slopes.

The **later start of winter season** is the next impact named as being important for tourism businesses. The interviewee from Hotel Astras acknowledges that the winter starts too late and is confirmed by the statement of a ski instructor from Scuol who says that the winter in the SNP area is continuously shortening and that in late autumn and early winter time there is no more guarantee of snow cover.

The next physical impact of climate change which has an important influence on tourism businesses in the area is, according to Bergbahnen Zuoz representative the **increased temperature.** She mentions that when the temperature is too high they face serious problems while making artificial snow. She added that, at least from the perspective of the company she works for, "*it is all about temperature*". Mr. Lehmann from Hotel Altana supports this statement and admits that higher temperatures make very difficult the process of snow making. An interesting answer was received from a ski school representative in Zuoz who said that as long as there is enough snow, there is not a problem when there are higher temperatures, because skiers enjoy warm weather and that "*they can ski in T-shirts*". She also added that, in general, tourists do not enjoy if it snows while they ski. Therefore due to the fact that they cannot see well and they do not feel safe, skiers do not come on the slopes when it snows. It can be seen that, although the whole destination can be seen as a whole, one physical impact on climate change that seriously affect one business is not necessarily harmful for other businesses.

Figure 10 summarizes the findings of this part, by stating all the physical impacts that have been name as having a serious impact for tourism businesses.

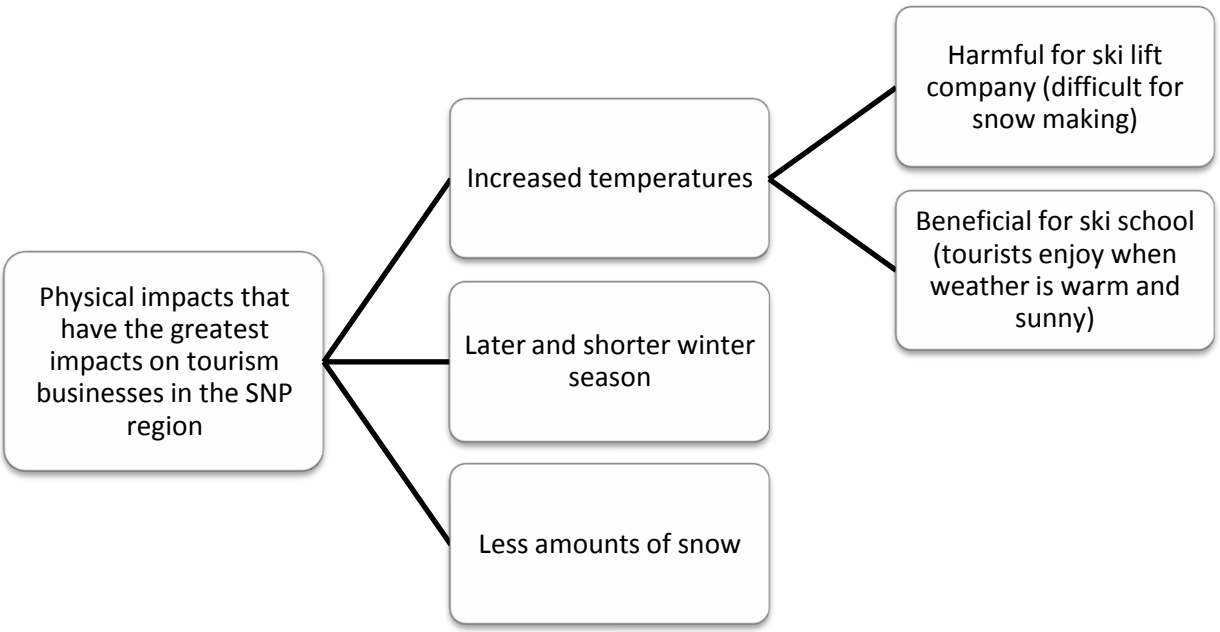

Figure 10 Most important physical impacts of climate change from the tourism providers' perspective
Source: Own design based on the interviews results

4.2.3 Discussion

Because all the results from this chapter, be it from the researchers' or from the tourism providers' perspective, are interrelated, there will be discussed together, comparing the findings coming from the literature with those from interviews, but also trying to identify similarities and differences between researchers' answers and those of tourism businesses. Three main issues are to be discussed in this part, namely: impacts of climate change on tourism business in the SNP area (from the researchers' and providers' perspectives), degree of awareness of tourism providers and most important physical impact affecting the businesses.

Regarding the impacts of climate change on tourism business in the SNP region identified by the researchers it can be mentioned that in most of the cases answers are complementary and all the arguments go in the same direction. The results show that the experts identified three main types of impacts that tourism industry currently face and will also challenge it in the future. These impacts are: a decrease in destination's attractiveness (due to bad conditions of facilities and also to a shorter and later ski season), fewer tourists coming in the area (tourists choose to go to other places with good facilities) and finally economic difficulties (such as fewer jobs or increasing dependency on certain resources).

These results can be placed in a sequential order, starting from the decrease of attractiveness which determines fewer tourists in the area and finally leading to economic difficulties for providers. The main cause of these impacts is represented by the physical effects that climate change brings in the area.

Going back to the literature, and having into consideration that very often tourists experience the entire portfolio of services and goods existent within a destination **as a whole offer**

(Bieger, 2008 as cited in Wyss et al, 2014), one can argue that if a small part of the offer suffers, then the whole experience of tourists will be affected. This goes in the same line of thoughts with the statement of Mr. Daguati who acknowledged that due to one aspect in bad condition (the ski facilities) there were no tourists in the middle of winter season in the area. Some of the experts said that tourists might be reluctant to artificial snow on the slopes and will search and opt for other destinations with good facilities. This is confirmed by literature where is stated that skiers are very flexible and can easily change the time and/or the destination for their holiday (Scott & McBoyle, 2007). Of course, this involves that other destinations will gain from this climate variability while others will suffer. Elsasser and Bürki (2002) acknowledge that climate change will cause a new model of privileged and disadvantaged ski tourism regions. Matasci (2012) mentions this aspect of positive or negative changes of climate variability for tourism activities and it confirms the statements of C. Conradin and C. Daguati who acknowledge that people prefer to go to other places with better facilities than to stay in the region when there is no snow and conditions are bad. This aspect is also revealed in a study of Scott et al. (2012) when after asking the tourists how they would react if "the next five winters would have very little natural snow", 49% of them would ski at more snow reliable destinations.

The increasing temperatures and therefore lack of snow determined the Val Müstair ski area to open ski season one month later than usual. According to C. Daguati**, the transportation providers** and the **restaurants** faced serious problems in this time due to lack clients and of activity. This is confirmed by Koenig and Abegg (1997), who have analyzed the impacts of three consecutive snow-deficient winters at the end of the 1980s on the winter tourism in Switzerland and the accommodation providers were less affected by low demand, than the category of transportation providers.

The shortened ski season due to lack of snow is definitely a serious problem for the tourism providers in the SNP area. The literature confirms how important is the snow reliability for a winter destination, being in top requirements of tourists coming in Switzerland (Elsasser & Bürki, 2002). Moreover, skiing is an essential factor for tourists when choosing Scuol, located in the SNP region, with high requirements for skiing infrastructure (Pütz et al, 2011). The finding according to which the attractiveness of the SNP region decreases due to lack of snow is confirmed by Bürki et al. (2003, December) who admit that snow is a pillar for resorts' attractiveness.

The experts identified that the area faces and will also be challenged by some economic difficulties. Decreased attractiveness through shorter ski season, lack of snow, bad conditions for facilities will eventually lead to economic problems such as those named by C. Daguati who mentions that for approximately one month people could not work because of the late ski season opening, or those mentioned by H. Lozza who acknowledge that already the tourism businesses started to use more and more water and energy resources, and that the operators' dependency on these resources has increased. The bad economical results have been stated also in literature, where Elsasser and Bürki (2002) mention that climate change would involve financial costs of approximate CHF 2.3 to 3.2 billion per year by 2050.

What was interesting in the answers of experts is that some of them argued that tourism businesses in SNP region are more affected by other aspects than by climate change. Among these are factors are: the strong Swiss Franc, the competition from new opened resorts in areas such as Eastern Europe or Azerbaijan, the distance from big cities or the

decrease in the popularity of snow sports. For example, Therese Lehmann mentions that in such a high altitude area as SNP region, currently there is not a big problem with climate change, but with the other aspects.

As a conclusion to the results from the researchers and experts regarding the climate change impacts on tourism businesses in the SNP region, it can be said that all the findings have been found and confirmed by literature, and no contradiction among interviewees or between their answers and literature could be identified.

When discussing about the degree of awareness of tourism businesses from the SNP region regarding the climate change, all of the experts agreed that the tourism providers are informed about this phenomenon. However, the experts' answers present some small differences regarding the extent to which the tourism actors are informed. While one interviewee mentions that the majority of them are aware, another says that only the big tourism providers are. Moreover, the modalities the tourism businesses have familiarized with climate change are diverse and the experts named that one way is due to media coverage and a second option is the providers' own experiences with climate change impacts such as problems with amounts of snow. Furthermore, from the experts' answers a classification of tourism providers who are aware of climate change has been established. There are two categories, first one is composed from those who are informed about climate change and are taking action, by searching for alternatives or making investments. The second category is represented by tourism providers who are aware of climate change but do not act in this direction. The first category is confirmed by literature in a study 14 years ago, where is mentioned that the tourism stakeholders are not impassible to climate change impacts, but they are changing their behaviors (Elsasser & Bürki, 2002).

Finally a special category was identified by Hans Lozza who names those providers who still believe that is something temporary and soon the situation will return to normal. Also this aspect is covered by literature, where it is stipulated that some persons are still negating climate change, despite the intense media coverage and all the evidences from the nature (Häkkinen & Akrami, 2014).

As a conclusion it can be said that tourism providers in the SNP region are divided in those who are aware of climate change and those who consider that it is only a temporary phenomenon. Moreover those who are aware are also divided in the category of actors who act in this direction and in the category of those who do not take action. Further on, the results coming from the discussions with tourism provider from SNP region will be interpreted.

As it can be seen in chapter 4.2.2 the findings resulted from the discussions with tourism providers regarding the impacts of climate change are very diverse and several points of view have been raised.

Most of the tourism providers agreed that **their businesses are affected in a negative way** by climate change. They named impacts such as fewer tourists coming in the area, shorter bookings, increased costs, financial losses or business reduction.

The fact that there are **fewer tourists** coming in the area was named by all types of actors involved in tourism industry in the area: ski lift company, hotels, hotel's restaurant and ski school. The representative of a ski school from Zuoz mentions that for tourists it is not so

attractive to go in the area and take ski classes when on the slope is only one white stripe and in rest everything is not covered by snow. She added that tourists confessed that they do not feel safe in the eventuality they will fall off the slope. This aspect is also one commented by the experts Hans Lozza and Reto Rupf who were asking rhetorically if the tourists enjoy these white stripes of artificial snow or they go to other resorts. Moreover, literature confirms that some tourists are reluctant to artificial snow in a study done by Pütz et al. (2011) 51% of the interviewed skiers supported the option of artificial snow.

One representative from Bergbahnen Zuoz confirms another fact discussed with the group of researchers, namely that tourists prefer to go where good conditions and facilities are; aspect confirmed by the study of Matasci (2012) who name this as negative (and in the same time positive for the resorts who receive the tourists) changes in climate variability for touristic activities. The problem with less tourists coming is also named by accommodation facilities, such as one hotel representative who admits that in first 3 weeks of 2016 there was a serious drop in the number of tourists, and also by food providers, such as one hotel representative discussing about hotel's restaurant who acknowledged that they had less to work. Related to this change in tourists behaviors, meaning that they prefer to go to other places, the managing director of Hotel Altana from Scuol, Mr. Adrian Lehmann identified another aspect is tourists decisions, namely their choice for **booking shorter holidays**. The interviewee says that while the fact that fewer tourists are coming can be explained also by other factors apart from climate change, the trend of booking shorter holidays is strictly related to weather conditions. This aspect was, however, not found in literature or in the discussion with the first group of experts.

The next impact named by those who are in the best position to discuss about them is represented by the **economic difficulties**. These have also been mentioned by experts from the first group, such as Reto Rupf or Hans Lozza and are also present in literature, in the study of Elsasser and Bürki (2002). Examples of such difficulties are given by ski school Snow Sport Scuol representative, who acknowledged that they have experienced **financial losses** in December and also that their **business becomes smaller**, since they cannot afford to keep all the instructors. Claudio Daguati also mentioned that in the Val Müstair region, the winter period before 15th of January 2016 was very difficult for transportation providers and restaurants that had nothing to work, since the ski season could not be opened. Rosselló-Nadal (2014) also mentions that financial activity of such mountain destinations depends on supportive snow conditions. Moreover, from the perspective of a tourism provider, Claudio Daguati mentions that the tourism office Ferienregion Engadin Val Müstair had very high costs with snowmaking while preparing for the World Cup event for cross country skiing that was hold in Val Müstair region in the season 2014/2015. He admitted that 15-20% of the whole event budget was used only for artificial snow, which is a very high proportion. The literature also discusses about increased costs for tourism industry due to climate change (Elsasser & Bürki, 2002). To economic difficulties also leads the next impact mentioned by tourism providers, meaning that **the ski season becomes shorter**. One ski school and one hotel representative acknowledged that there is a problem with the snow that comes later and therefore the early winter time is no more snow guaranteed. Also Claudio Daguati has mentioned that due to bad weather conditions, the season start has been delayed with one month this year.

An interesting finding within this part was to discover that, although some tourism providers acknowledged that weather in last winter times was not as beneficial for winter sports as it

used to be (shorter winter season, less snow), **they were not sure whether this can be explained by climate change**. Those who expressed their skepticism about climate change are both representatives of hotels. However, both mentioned that they felt some changes in demand, one identifying that guests book shorter holidays and another confessing that his hotel faced a serious drop in the guests' number. When asking to assess the degree of awareness, one expert from the first group of interviewees acknowledged that there could be some providers who do not accredit climate change for the current bad weather, and they may consider that is a momentary situation with everything coming soon back to normal. Also in literature is named the category of persons who are skeptical about climate change or at least about some aspects about it (Häkkinen & Akrami, 2014). Moreover, it can be the case that tourism businesses representatives from this area consider the presence of climate change topic is too excessive in media, science or politics (as suggested by Elsasser and Bürki, 2002) and they might be tempted to treat the topic with suspicion. Therefore, the discussion with the first group of experts is confirmed by literature but also by the results coming from the tourism providers.

As a summary, those tourism representatives who mentioned that are negatively affected by climate change, specified the following ways their businesses are influenced: presence of fewer tourists (due to shorter season, bad weather condition, bad facilities' conditions), tourists booking shorter holidays, financial losses, inability to maintain the size of the business (in terms of employees) and increased costs.

Maybe the most interesting finding of this part was to hear from an owner of several hotels in Scuol that he considers to be **positively affected by climate change**. He bases his answer on the fact that the areas his hotels operate in, the altitude is relatively high, with the ski area extended up to approximate 2'800m. He says that snow will not be a problem for the area also in the future and that compared to other resorts which are situated at lower altitudes, his hotels are definitely not negative affected. The interviewee's answer it could be deduced that by "positive" impacts and based on the arguments, he meant that tourists who usually go to other resorts from lower altitudes will come in the area where his hotels are located. His statement has a theoretical background, having into consideration that the canton Graubünden, where the SNP area is situated, occupies the second place regarding the mean altitude of ski areas, and it is seen as being placed on the winners' side regarding the vulnerability related to climate change, among other ski resorts in the Alps (Koenig & Abegg, 1997) (OECD, 2007). Elsasser and Bürki (2002) also mention that in the future winter sport tourism will intensify in the areas with high altitudes which will still be snow reliable, and they give the example of canton Graubünden. Going back to the discussion with first group of experts, Ms. Lehmann also names the high altitudes of this region as being a peculiarity that will strengthen the area with a competitive advantage. In addition, a study of Serquet and Rebetez (2011) shows that in the summer time, the number of nights spent by domestic tourists travelling to high altitude areas of Switzerland due to hot temperatures that occur in lower regions is higher.

Until now there has been discussed the **category of tourism providers who acknowledged that climate change has an impact** on their operations, be it negative or positive. What is interesting is that both types of impacts are supported by literature and also by the discussion with first group of experts. However, as it was already mentioned, the answers of tourism providers are diverse and in some cases they were contradictory. Figure 11 tries to underline this contradiction between the statements of tourism providers.

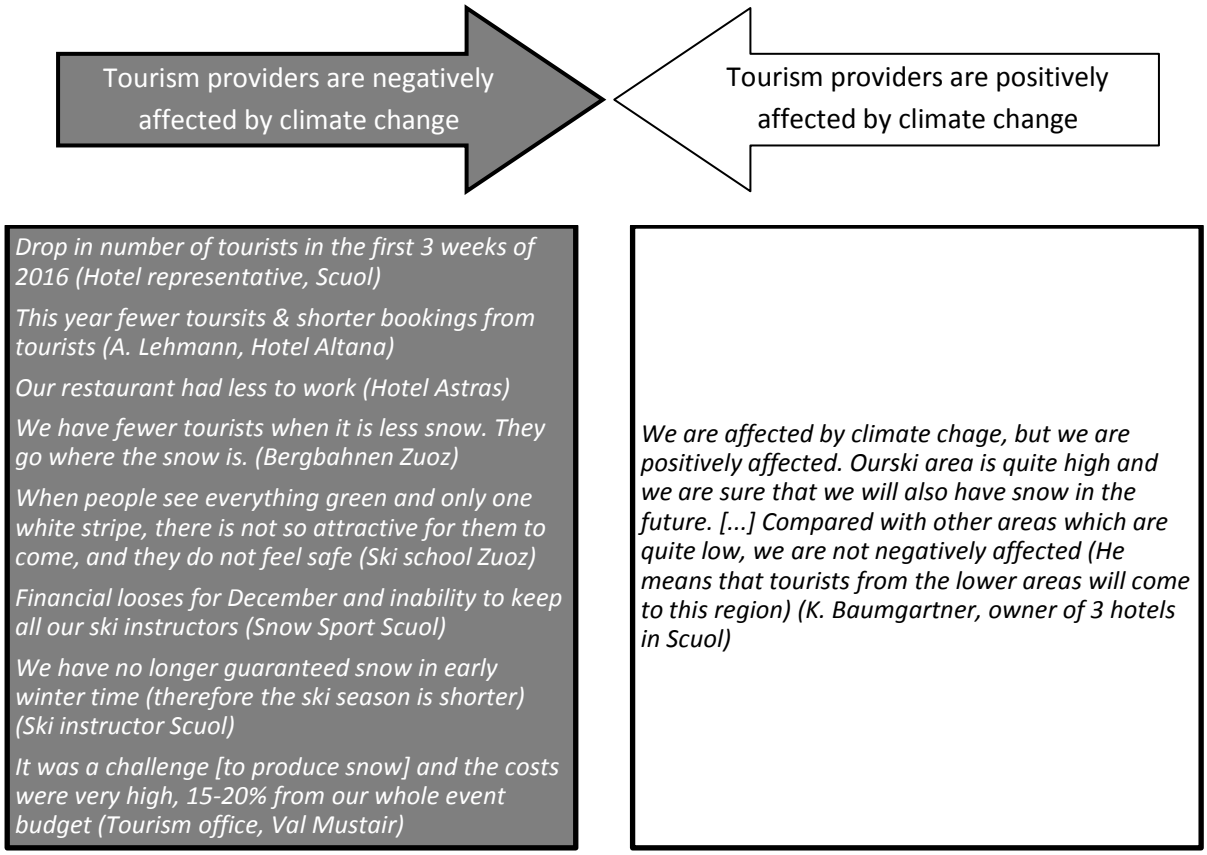

Figure 11 Positive vs. negative impacts of climate change on the tourism business in the SNP region
Source: Source: Own design based on the tourism providers' interviews results

The second big category of tourism providers is represented by **those who mentioned that climate change does not affect their operations either positive or negative**. It is true that this mention has been made only by one tourism representative talking about the hotel he works for. He clearly specifies that although he can feel some differences in climate conditions, the hotel does not face a problem with smaller number of tourists coming due to warmer weather. In the discussion with first group of experts, researcher Therese Lehmann acknowledged that currently the tourism business in the area is not really affected by climate change, due to high altitudes this area has. Moreover, Elsasser and Bürki (2002) specify that although climate change could produce some problems to lower altitudes ski resorts, the areas situated at medium and high altitudes will "*scarcely be affected"* (Elsasser & Bürki, 2002, p. 3). However, the hotel representative does not mention that the operations would be positively affected either as specified by Mr. Baumgartner or as implicitly suggested by Elssaser and Bürki (2002), Koenig and Abegg (1997) or OECD (2007) when saying that ski resorts from Graubünden will be on the winners' side.

After understanding how the tourism businesses are affected by climate change in the winter season, finding which physical impact of the phenomenon has the greatest impact of the tourism actors was the next step. There have been mentioned three physical impacts which are interrelated. The impacts named by tourism businesses were: increased temperatures, less amounts of snow and shorter winter season. However, these impacts are interconnected, the warmer temperatures determining less amounts of snowfall and also a shorter snow season.

The **less amounts of snow** proved to be the most feared physical impact for most of the interviewees. Ski schools representatives acknowledged that this has the greatest impact on their business and without snow there is nothing they can do. Also hotels representative mentioned that lack of snow in the region determines tourists to avoid the area. The importance of snow is highly acknowledged in literature and therefore it is obvious that when this resource is missing, the destination suffers. Bürki et al. (2003, December) stated that the most important relation between climate change and mountain tourism results from the less amounts of snow. Moreover, they mention that it is very rare to make a profit out of ski tourism when the snow is not in good conditions. Also Rossello-Nadal (2014) states that financial activity of mountain destinations is highly dependent on supportive snow conditions. The problem with snow amounts is highly presented in literature, and several predictions have been made with regards to level of snow reliability (see studies of Abegg et al. (n.d.), Elsasser and Bürki (2002), Bavay et al. (2013 or Wyss et al. (2014)). Moreover, from the discussion with the first group of experts it resulted that lack of snow is one of the most important impacts for the region.

A **later and shorter the snow season** was another physical impact named as relevant by the tourism providers. One hotel representative and one ski instructor acknowledged that winter and snow come later. This can be related to the statements of Hans Lozza who mentions that snow comes in fewer amounts and also in shorter periods. Furthermore, the ski season in Val Müstair region started one month later than usual in the season 2015/2016, according to what Claudio Daguati mentioned during interview.

Finally, it was very interesting to discover that an impact which is very harmful to one tourism providers can be beneficial to other. This resulted from the discussion with one representative of Bergbahnen Zuoz, who acknowledged that **increasing temperatures are the toughest enemy of their businesses**. She explained that they can produce snow only if the temperatures are lower than -4 degrees Celsius. On the other hand, one representative from a ski school from Zuoz stated that **high temperatures are not a problem** as long as there is snow on the slopes, because the tourists enjoy the warm weather and that they can ski in T-shirts.

All three physical impacts that have been named by tourism providers as being the most relevant for their businesses are supported by literature and have also been found in the discussions with the researchers. Moreover, the classification made in Figure 5 based on the answers of researchers is confirmed and the impacts less amounts of snow, increasing temperatures and **later and shorter snow season** deserve their places on a dark background. However, other important physical impacts named by first group of experts (such as change of weather patterns, dryness and water scarcity, melting permafrost, rock falls etc) have not been mentioned by tourism providers in the SNP region.

This part has presented and interpreted the results of three main topics which are interrelated and therefore this is why the author considered appropriate to treat them together. The tree main topics that have been discussed are the impacts of climate change on tourism businesses in the SNP area, the awareness of tourism providers and the physical impacts considered the most relevant for the area.

4.3 Vulnerability of diverse tourism sub-sectors in the SNP region

In this chapter there will be presented the results and the interpretation of findings which emerged from the discussions with the group of researchers and with the group of tourism providers from the SNP region. As in the case of topics revealed until now, the issue of sectors' vulnerability will be treated first from the perspective of climate change researchers and experts and then from the point of view of tourism providers from the SNP area. After presenting the results from the interviews, in the discussion part the answers will be compared, commented and related to the literature. Further on, there are presented the results from the discussion with first group of experts.

4.3.1 Results from tourism experts

The discussion with experts helped the author of this master thesis to make a ranking of the most vulnerable touristic sector.

Almost all the interviewees (apart from Ms. Lehmann) named the **activities providers** (such as ski schools) as being the most vulnerable part of the touristic supply side. The reasons named are strictly related to their dependence on snow cover. Bruno Abegg acknowledges that ski instructors are "*directly dependent on snow*" while Reto Rupf and Claudio Daguati firmly state that when there is no snow, the ski schools and ski instructors "*are closed"* (R. Rupf) and respectively *"sit and wait; they are not paid"* (C. Daguati). Constanze Conradin has also the same opinion, that winter activities providers are the most vulnerable and the most affected.

Transportation providers are firmly named by Ms. Lehmann as being the most vulnerable part of the supply side. She explains her decision through the high investments the cable car companies make, and she adds that all the other parts (activity providers, restaurants, accommodation) are dependent on these transportation providers. Therefore, if these are affected, the whole supply is in trouble. Transportation providers are also named by Bruno Abegg who says that this type is also very dependent on snow amounts, such as the activities providers.

Accommodation sector is named as being a vulnerable sector by Constanze Conradin and by Ms. Lehmann. However, Bruno Abegg mentions that accommodation providers are less vulnerable than those businesses directly dependent on snow amounts, such as activities or transportation providers. He added that although this season the lack of snow was a problem for Alps, the statistics show that many tourists have been present in accommodation facilities.

Hans Lozza acknowledges that one can say that the **whole tourism sector** is vulnerable, but he considers accommodation, winter sport providers, and also restaurants as being the most affected.

The certain conclusion that can be drawn is that, according to experts' answers, the winter activities providers are most vulnerable part of the supply side in the SNP region. However, naming which sector can be place on the second position, third, and so on, is difficult since, the experts' answers are diverse. Further on, the results from the interviews with tourism providers will be presented.

4.3.2 Results from tourism businesses representatives

The findings emerged from the answers of tourism providers are slightly easier to present in comparison with those from the first group, since almost all the interviewees named the same thing. It was interesting to hear from representatives of hotels, ski schools and ski lift company having a systemic thinking and stating that "*all the sectors", "the whole valley", "the whole region"* are/is equally affected. The managing director of Hotel Altana mentions that, in the SNP region, most of the people are connected in smaller or larger proportions with tourism and live from this industry. He mentions that if the tourists do not come in the region, all the tourism actors are negatively affected. Also the representative of the ski lift company Bergbahnen Zuoz acknowledges that everything is "*like a circle*" and that for the whole valley climate change represents a big problem. She added that if the snow does not come, tourists are not in hotels, therefore are not coming to the slopes and so on. Another hotel representative acknowledges that all the parts of supply side are equally vulnerable to climate change impacts. One ski school representative from Zuoz also agrees that all the actors are vulnerable to the same extent. She urges for collaboration among them, saying that they have to work together because they are in the same situation.

Mr. Adrian Lehmann from Hotel Altana added to the idea that the whole tourism industry is affected, that, due to fewer tourists coming in region, and therefore less income for the area, it will be difficult to maintain the area and the environment. Thus, according to Mr. Lehman, the **nature** could suffer due to lack of financial resources needed for its preservation.

One ski instructor from Scuol names that **activities providers** followed by the **accommodation providers** are the most vulnerable tourism actors in the SNP region.

Finally, Mr. Baumgartner is supporting his point of view earlier named, that climate change is not negatively affected the area. Therefore he says once again that the area is currently immune to negative climate impacts due to its high altitudes. He added that the area will still be safe for the next 30-50 years.

4.3.3 Discussion

As it can be seen in the above section with results, the question "Which part of the tourism supply side is the most vulnerable to climate change impacts?" separated the interviewees into two groups.

For the first group, the interviewees agreed that winter **activities providers** are the most vulnerable actor regarding the climate change impacts. The researchers intensely named these actors due to the high snow dependency the activities providers present. From the side of tourism providers, the answer was almost universally that **all the tourism sub-sectors** are equally vulnerable. The tourism businesses representatives supported their answers by saying that all the tourism supply actors are interrelated and very dependent on the tourists' comings. Therefore, if the area faces a drop in tourists' number, the whole region suffers. Although different, both points of view are supported by literature, in the study of Scott and Jones (2006) as cited in MoE (2011), who place the hotel and resorts, attraction operators and the entire communities as having a very low adaptive capacity to climate change impacts, and therefore a high vulnerability.

Moreover, as suggested by Koenig and Abegg (1997) who say that, for some Swiss alpine area, winter tourism is the most important source of income, one interviewee acknowledged that in the SNP region there are only few people who are not involved directly or indirectly in the tourism industry.

A debated aspect among the first group of interviewees is given by the **vulnerability of accommodation providers.** They have been named as being on the second position according to their vulnerability by Constanze Conradin, Therese Lehmann and also by Hans Lozza, who put them in top weak providers, along with winter sports one and with restaurants. Moreover, one interviewee from the second group, a ski instructor named the accommodation sector as being most vulnerable, after the activities providers. On the other side is situated the statement of Bruno Abegg, who firmly says that accommodation sector is less vulnerable than activities and transportation providers due to the fact that they are not directly on amounts of snow. He supports his statement by saying that statistics show that although the winter condition are bad in the Alps, tourists still are present in accommodation facilities. The information from Mr. Abegg is confirmed by a statement of Claudio Daguati, who as an answer to an earlier question, mentions that transportation providers and restaurants have been really affected due to a late ski season start. He does not mention the accommodation and therefore, he confirms the statement of Mr. Abegg and also of Mr. Lozza, who is the only one who names **restaurants** as being a vulnerable tourism sub-sector. The two experts are confirmed by literature, in a study of Koenig and Abegg (1997), who have analyzed the impacts of three consecutive snow-deficient winters at the end of the 1980s on the winter tourism in Switzerland and the accommodation providers were less affected by low demand, than the category of transportation providers.

Along with the providers who offer opportunities for winter activities, such as ski schools, Bruno Abegg named the **transportation providers** as being the most vulnerable. He mentions that the two sub-sectors (activity and transportation providers) are directly dependent on snow cover. Moreover, he added that when tourists do not repeatedly use the cable cars (like while doing winter sports, such as skiing or snowboarding), and they use them only once (for example in case of hiking) then, even if the tourists are present in the area, their behavior is not profitable for transportation companies. Also Therese Lehmann names this category and places the cable car company on the first position. Her argument is that cable car companies make high investments and therefore their operations and profitability can be seriously affected due to climate change. Moreover she emphasizes on the importance of cable car companies for ski resorts, saying that all other sub-sectors (accommodation, activities and so on) depend on the welfare of them. The answers of the two climate change researchers is totally confirmed by the study of Hoffmann et al. (2009) who name three important characteristics of ski lift operators and reasons why the authors have chosen them for that specific study: (1) these companies are directly dependent on the availability of natural snow; (2) in comparison with other actors, such as ski schools, the ski lift operators make larger investments and (3) these companies are considered the “nucleus” of ski resorts and the authors mention that other stakeholders depend on their prosperous operations. Therefore, the arguments of researchers Bruno Abegg and Therese Lehmann are highly confirmed by the findings of literature.

On the side on tourism providers, most of them firmly agreed that all the tourism sub-sectors are equally vulnerable. It was interesting to see that, although they were representing their hotels, cable car companies or their ski schools, the interviewees did not tend to victimize

themselves and to name the category they belong to. Most of them said that their businesses are interconnected, and the fewer tourists come in the area, the more affected will be the whole tourism industry. Their statements are confirmed by Hans Lozza who also acknowledged that the whole tourism sector is vulnerable. Moreover, one representative of a ski school from Zuoz, not only agrees that all actors are equally vulnerable, but she urges for cooperation among them. She mentions that, although the tourism actors might not realize, they are all in the same situation and they need to work together. Cooperation among tourism stakeholders in order to overcome negative impacts of climate change is a highly intense concept used in literature. For example, Wyss et al. (2014) name that cooperation among the actors along the tourism supply chain is a key element driving most of the actions against climate change impacts to success in an alpine tourism context. Also Pütz et al. (2011) call for immediate collaboration among tourism stakeholders for handling the planning process regarding snowmaking. Finally, Matasci et al. (2014) discovered that cooperation is a key option for overcoming obstacles which can occur while handling climate change issue. This option was named exactly by the tourism stakeholders, in the above mentioned study of Matasci et al. (2014).

An interesting finding is the answer of Mr. Lehmann from Hotel Altana who mentioned in the first place that the whole tourism business in the area is vulnerable, but he also identified a special stakeholder, which, in his opinion is also very vulnerable. He mentioned the **nature** as being also vulnerable and explained that, due to the fact that a large proportion of people living in the area are working in tourism, when the incomes are lower, then there are no funds remaining for maintaining the environment. This interesting statement was, however not found in literature.

In conclusion it can be argued that, although within the two interviewed groups the answers were in the same line of thoughts, there is a certain difference between persons who are not directly involved in tourism and those who are actually working in this industry, while assessing the vulnerability of the sector to climate change impacts. While those who are looking at the tourism industry from outside have tried to identify a certain ring of the chain as being the most vulnerable (concluding that activities providers are that ring) the persons who earn their living by working in tourism acknowledged that it cannot be only one part of the system affected without affecting the whole arrangement (and therefore, their conclusion was that the whole tourism industry in the SNP area is equally vulnerable).

4.4 Adaptation measures taken by tourism providers in the SNP region

At this moment there have been presented and discussed the results regarding what physical impacts has climate change in the SNP region, peculiarities of the area, effects of those impacts on tourism businesses and vulnerability of the diverse tourism sub-sectors in the area. As one of the objectives of this master thesis was to deliver information about tourism businesses' behaviors regarding climate change, identifying what adaptation measures they have implemented is the first step. Therefore, in this chapter, the results and the interpretations of findings that have emerged from the discussions with the first and the second group of interviewees will be presented.

4.4.1 Results from tourism experts

The answers of tourism experts to the question of what types of measures have been adopted by tourism providers in the SNP region are very complex and diverse.

Snow making is, according to Bruno Abegg the most popular adaptation measure and it has, of course, been implemented in the area. Moreover, he added that for the ski area of Scuol, the operators have improved and enlarged the snow making capacities. Snow making is a measure also named by Constanze Conradin, who says that this is a method which started to be used 10 years ago. He added that the snow making facilities have been improved and the operators have connected some pipelines to the water supply. Moreover, she mentions that in order to be sure that the resorts will have snow many operators (such as Minschuns, the ski area of Val Müstair) have somehow changed their behaviors and started to make snow earlier, around the month of October. They produce the snow and store it until the season start when they start to use it. Hans Lozza also acknowledges that ski area operators in the region Val Müstair make investments and produce more artificial snow.

Development of the ski area is another measure named by the interviewees. Bruno Abegg provides the example of Scuol ski area where, according to the researcher, they intend to move their operations at higher altitude and on **north facing slopes**. He added that the operators in Scuol are willing to renounce to the lower parts of the ski area. Hans Lozza and Reto Rupf also mention that in the Val Müstair area the building of a new cable car line is projected, which will link the municipality of Tschierv to the existing facilities.

Other adaptation measures identified by the first group of interviewees can be all placed under the umbrella of **diversification**. Claudio Daguati acknowledges that in the area it can be observed a trend towards diversifying the offer. He names in the first place the activities that are not necessarily related to snow, such as **ice skating**, **painting** or even **llama trekking**. Moreover, he affirms that these activities were received with high enchantment by tourists. Furthermore, he provides examples of activities that are snow dependent but without focusing only on skiing. He acknowledged that when the for example only one slope is open it can be not appealing for tourists to ski every day on the same slope. Therefore, from his job function as marketing assistant at Tourism office Val Müstair, he worked together with ski operator representative and with a ski school owner on a program which included different activities on the slope, such as **sledding**, **cross country skiing**, **snow shoes walking** and, of course, alpine skiing. Reto Rupf also mentions that diversification is a current trend in the SNP area. He states that this winter there were some occasions when, in the same cable car there were altogether skiers, snowboarders, mountain bikers and hikers. He says that one measure for diversification was taken by SNP who opened the **hiking trails** also during this winter time (although usually SNP trails are not open during winter time) because there was no snow. He also added that sometimes, the providers are constrained to adapt and he gives the example when in the area there was no snow in the ski areas, but the lakes were frozen. Therefore "*the operators "forced" their guests to go for **ice skating***" (Reto Rupf). He added that *"that was wonderful"* because the tourists were open to try the skating but he acknowledges that it would not have been so successful if the guests would really have wanted to go skiing. Another interesting diversification modality provided by Reto Rupf is the **alternative of arts**. He gives the example of Hotel Castell in Zuoz by saying that "*it is strong related to arts and they have guests who love arts very much".* Finally, Reto Rupf states that some providers try to focus more on summer season or to look for alternatives such as

wellness. Hans Lozza also admits that in Scuol the health tourism is more intense promoted, and he mentions that this can be a good alternative for people who are not ski passionate to come in the area. He added that in the area there are more **winter walking** possibilities because of the presence of more elderly persons. Diversification towards wellness is Scuol is also named by Ms. Lehmann and she also added the option of **biking** in the area of Val Müstair. The same researcher calls these measures as being "low regret options" which means that the actions are not done only because of climate change, but they have also the role to develop the region. Finally, related to the same topic of diversification discusses Ms. Conradin who says that the accommodation providers try to offer diversity to their clients.

Hans Lozza also names some **mitigation** activities that are done in the area, such as the initiative of Scuol Tourism Office of trying to convince more tourists to come by public transportation using attractive ticket rates and the program Zernez Energia 2020 through which there is intended the reduction of fossil fuels' consumption. Also Ms. Lehmann added examples of mitigation activities, such as Energy Plus hotel in Muottas Muragl (in Samedan, close to Sankt Moritz), photovoltaic systems or the luggage transfer program implemented in Scuol (meaning that while travelling among different destinations in the area, the tourists' luggage is picked up from the hotel and delivered to the next accommodation, so the tourists do not have to take care of their luggage).

Hans Lozza stated an interesting fact, namely that at the moment, he does not see a different type of tourism. He says that tourism industry in **the SNP area is still based on winter sports,** due to the high profitability of this kind of tourism. He acknowledges that for Scuol, for instance, skiing is very important and without ski the industry *"would collapse".* He expressed his concern about sustainability of the classic types of measures (such as snowmaking or expanding the ski area of Val Müstair) and mentioned that in a small area such as Val Müstair, sustainable measures could be implemented.

The experts also expressed their opinions about the time when the tourism providers started to implement adaptation measures. Hans Lozza says, regarding to winter walking, that this activity started to become more attractive approximately 10-15 years ago. Reto Rupf considers that tourism providers started to consider these types of measure about 5 years ago. Finally, Claudio Daguati considers that due to a serious lack of snow, this year represents the starting point for adaptation measures, because last years the region had always good snow.

For a more facile visualization, figure 12 has been created, and it comprises all the answers of the first group of interviewees.

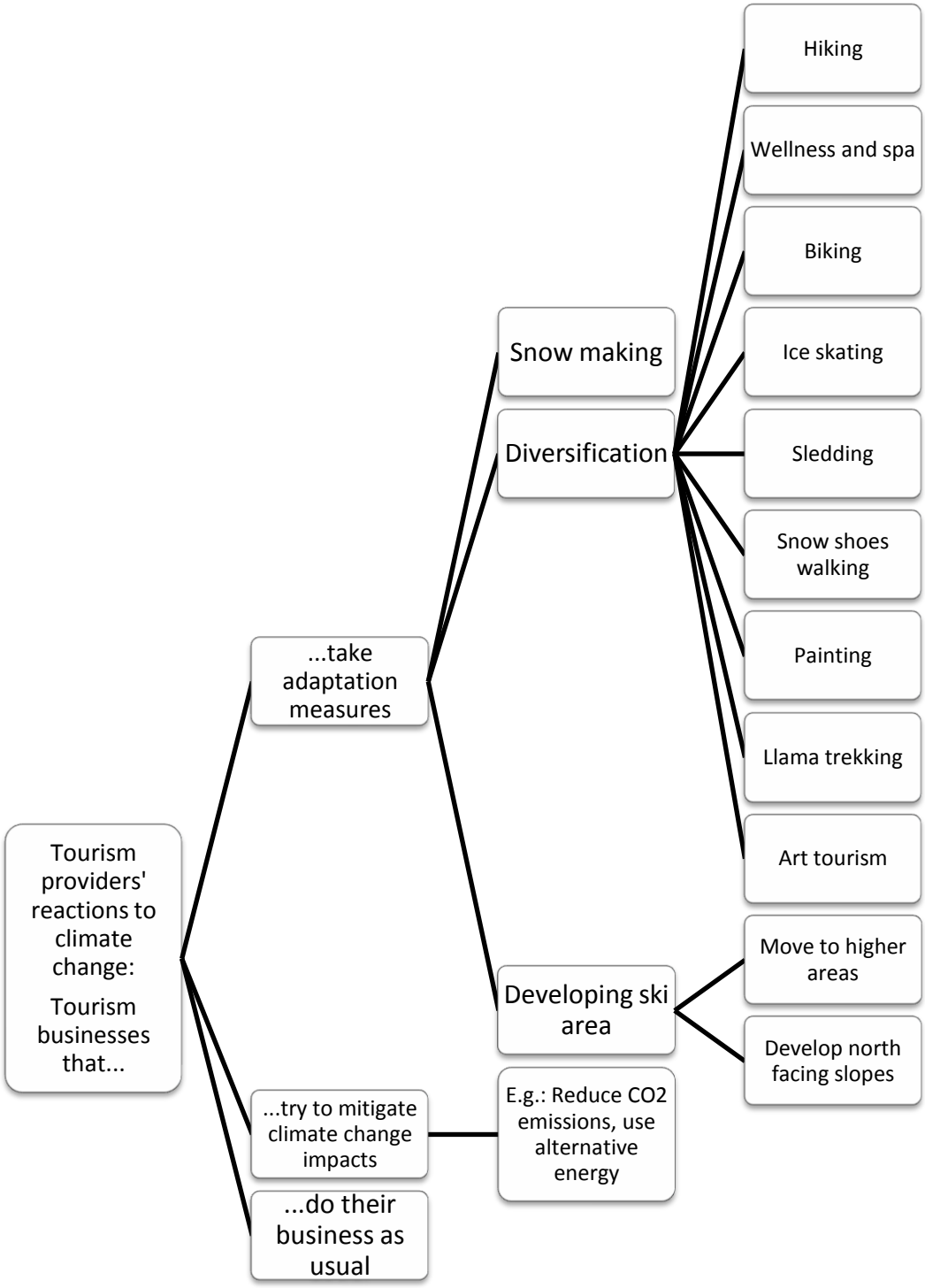

Figure 12 Behaviors of tourism providers with regards to climate change impacts, form the experts perspective

Source: Own design based on the interviews results

4.4.2 Results from tourism businesses representatives

The interviews with tourism providers revealed that they can be classified in three main categories, namely those who have implemented adaptation measures, those who have implemented mitigation measures and those who have not implemented any types of measures.

The adaptation measures implemented by tourism providers in the SNP area depend, of course, of the sub-sector they operate in, but are also diverse within the same sub-sector. For example, one representative of Bergbahnen Zuoz named that the company's only adaptation measure is to produce **artificial snow**. She added that there is nothing else that the company can do.

The second sub-sector whose representatives acknowledged that their companies implemented adaptation measures is represented by the hotels. The managing director of Hotel Altana from Scuol, Adrian Lehmann, mentions that they "*definitely recommend the guests alternatives towards what they can do with the current* (meaning low level) *snow situation*". He added that instead of trying to include the ski pass in the rooms' tariffs, he informs the guests that when they cannot ski because of bad conditions, they can opt for **cross country skiing**, **winter walking** or **ice climbing**. One representative of hotel Astras in Scuol, mentions that they organized a program for tourists, which includes activities such as "**eisstocksport**" which is a game similar with curling. Another hotel representative states that they offer a "*variety of events*" for their guests for the days when skiing is not possible.

Events are offered as alternatives to skiing also by a ski school from Zuoz. The representative mentioned that they organized a competition which consisted of going up on mountain by bike (because there was no natural snow) and coming down by skiing on the slope covered with artificial snow. She added that the approximate 50 competitors were very excited and they have enjoyed the event.

The interviews showed that the Tourism Office Val Müstair is also engaged and tries to help the businesses from the area. Claudio Daguati mentions that the **cooperation** between the tourism office and tourism businesses consists of holding briefings and discussions, about what alternative providers can offer to the guests. He says that the tourism office advices the providers about alternatives that are not dependent on snow amounts, such as **walking paths** or **visits to museums**.

The second category is represented by Kurt Baumgartner, who acknowledged that his hotels adapted some **mitigation** measures. They are involved in a program through which they reduce the consumption of fossil fuels. His hotels use instead alternative energy, such as solar power and they also isolate better the buildings.

Final category consists of those tourism businesses who **do not take any type of action**, be it for mitigate climate change effects or for adapting to its impacts. In this category can be place one ski school from Scuol whose representative mentions that they cannot do anything, and that there is the ski lift company's task to produce snow. Another ski instructor acknowledged that his ski school does not do implement any measure. The reason named by him is that this ski school is only a secondary occupation in winter for its workers. Also, one hotel representative mentions that his establishment did not implement yet any mitigations actions, such as reducing energy consumption, due to lack of financial resources.

All the categories that have resulted from the discussions with tourism providers operating in the SNP region can be better visualized in Figure X.

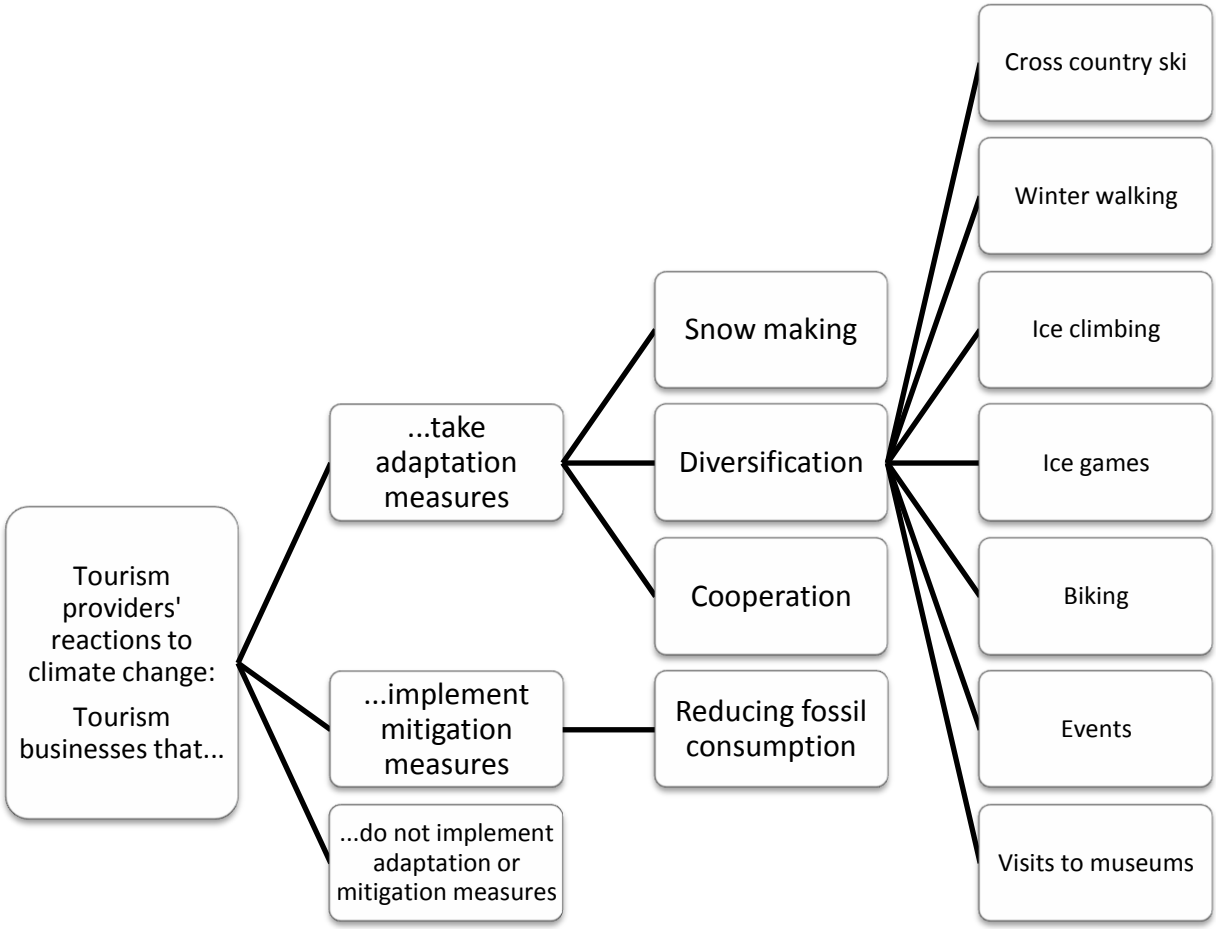

Figure 13 Behaviors of tourism providers with regards to climate change impacts based on the discussions with tourism providers
Source: Own design based on the interviews results

4.4.3 Discussion

The last two figures present the summary of the answers received from the first group of interviewees and also from the tourism providers. It can easily be observed that the figures are very similar, and that in a large proportion the answers from tourism experts match those from tourism businesses representatives. Three categories could be established from the discussions with both of the interviewees' groups.

First division is represented by those **providers who have implemented adaptation measures**, and this is the main finding of this chapter.

The answers provided are very similar, and start with the measure of **producing artificial snow**. Bruno Abegg acknowledges that this is the most popular adaptation measure that can be implemented. Constanze Conradin and Hans Lozza also confirm that in the area snow making is a very used technique. Literature confirms this aspect, and Tranos and Davoudi (2014) name snowmaking as being the most preferred measure. Also the representative of Bergbahnen Zuoz admits that the only measure they can implement is the one of making artificial snow. However, Hans Lozza is questioning the production of artificial snow, and he argues that this traditional technique is not very sustainable.

The next adaptation measure named was the **development of the ski areas**. This action was mentioned only by the first group, but there is a good point that they have discussed actions of those providers that could not be directly interviewed. Regarding the ski area of Scuol, Bruno Abegg names that they indent to move their operations to a high altitude valley, with the slopes facing north. He added that Bergbahnen Scuol have been determined do to many actions (also to improve their snow making capacities) due to the dry area and due to the fact that their slopes are exposed to the South. This measure of moving to higher altitudes and to develop north facing slopes is highly present in the literature. Almost 20 years ago, Koenig and Abegg (1997) mention the *development of higher skiing areas* as being one response strategies for climate change impacts. Later on, Elsasser and Bürki (2002), Scott and McBoyle (2007), Hoffmann et al. (2009) or Abegg et al. (n.d.) name the activities of developing higher ski areas and north facing slopes as being important adaptation measures. Somehow similar is the mention of Hans Lozza and of Reto Rupf, who mentioned the plan of Val Müstair ski area of opening a new cable car which will better link Tschierv to the ski domain. This measure can also be assigned as an action for developing the ski area although it is not necessarily the same as the plans of Bergbahnen Scuol. However, both Hans Lozza and Reto Rupf are skeptical about this investment, considering that these traditional measures should be rather substituted with more sustainable actions.

The most discussed adaptation measure, named by most of the researchers and most of the tourism providers is the broad term of offer **diversification.** This is a main adaptation strategy followed by tourism businesses in the SNP area while treating the issue of climate change. The first group named several diversification options which have been confirmed and complemented by the providers' answers. Therefore, most popular diversification strategies implemented by the tourism businesses in the SNP area are: providing hiking opportunities, biking, events, wellness or ice related activities (such as ice skating, ice games, ice climbing). Other options are painting, llama trekking, art tourism, and visits to museum or sledding. In literature are presented several options that can be used for diversification by diverse researchers. Overall, the activities used by tourism businesses from the SNP region can be found as examples in diverse studies. Koenig and Abegg (1997) name diversification as being one option for resorts which are or is expected to be affected by climate change. They name under the umbrella of diversification cultural activities, or entertainment and sports events. Actions named by Reto Rupf (arts tourism), Claudio Daguati (visits to museums) and by the representative of ski school Zuoz (duathlon event) can be placed in the categories of Koenig and Abegg (1997). Scott and McBoyle (2007) name under the header called *revenue diversification* activities such as skating, indoor pools, health and wellness spas, snowmobiling and fitness centers or games rooms. Although not all, some of them are also present in the SNP region, namely ice skating and wellness tourism. Related to ice, there are several activities practiced in the SNP region as alternatives for skiing, such as ice skating, ice climbing or games on ice (similar with curling). Regarding wellness tourism, named by Reto Rupf and Hans Lozza, Scuol is well known for its facilities for this kind of tourism (Pütz et al, 2011).

Introducing alternative slope activities is a measure named in literature by Hoffmann et al. (2009) and goes in the same line of thoughts with the statement of Claduio Daguati who acknowledged that, when having only one open slope, one cannot expect that tourists will practice alpine skiing the whole holiday on the same slope. Therefore, alternatives to alpine skiing must be introduced, such as sledding, cross country skiing or snow shoes walking.

Biking is another option named by both groups of interviewees which is supported by literature. Therese Lehmann mentioned it as an option used in Val Müstair area while a representative of a ski school in Zuoz presented a case when they organized a contest where the competitors needed to use bikes to go up on the mountain and skis to come down. This measure is also named by Hoffmann et al. (2009).

Llama trekking was another activity used as diversification in the area of Val Müstair, as it is confessed by Claudio Daguati. Scott and McBoyle (2007) recommend horseback riding as an activity meant to diversify the providers' offers and what those from Val Müstair did is very similar with the recommendation from the literature.

Cooperation among tourism stakeholders is the last type of adaptation measures existent in the SNP region. This resulted from the statement of Tourism Office Val Müstair representative, Claudio Daguati, who mentioned that the organization he works for holds briefings and discussions with the providers and informs them about what measures can be taken to make climate change impacts less harmful. Cooperation, in diverse forms, is highly presented in literature as being an essential measure that can be taken. Koenig and Abegg (1997) name cooperation as having beneficial effects with regards to financial situation and investment strategies. Also Wyss et al. (2014) emphasize that cooperation among tourism actors is a key element which drive most of the adaptation measures to success. Moreover, Matasci et al. (2014) identified that lack of quality information about climate change and climate change effects is an important impediment for tourism stakeholders who try to adapt. Therefore this is why the action of Tourism Office Val Müstair who informs tourism providers and cooperates with them is very important and beneficial for the area. Other types of cooperation such as fusion of companies (Koenig and Abegg, 1997) or ski conglomerates (Scott & McBoyle, 2007) have however not been identified among the answers of the interviewees. Cooperation also stays at the base of some mitigation actions taken by tourism actors with regards to climate change impacts. One example is luggage transfer program named by Therese Lehmann, present in the Engadine Valley, which is an obvious example of cooperation among public transportation sector and tourism industry. This type of measure is supported by literature, where Hoffmann et al. (2009) name it as cooperation with local sectors.

The second division is represented by those **providers who have implemented mitigation measures**. The examples provided by first group of interviewees are very similar with those of the tourism providers. Most actions focus on reducing the CO2 emissions (by trying to persuade tourists to come by public transportation) and substituting the fossil fuels with alternative energy such as solar power. Nevertheless, there is one hotel representative who added that his establishment does not take any mitigation measures. It is very interesting that while asking about adaptation measures, some mitigation measures emerged, and even in the study of Elsasser and Bürki (2002) they stated that tourism industry needs to focus more on mitigation strategies, especially with actions regarding the traffic generated by this industry. Thus, the importance of mitigation measures, such as those that try to reduce the number of tourists who use their personal cars, is confirmed by literature.

The third division is composed of those who **do not implement any adaptation measures**. These providers prefer to do their "businesses as usual" as Elsasser and Bürki (2002, p. 256) name the action when the providers (and also the demand side) do not change their behaviors. Hans Lozza is one expert who acknowledges that, in his opinion, providers in the

SNP region do not really make notable changes in their operations and they still prefer traditional measures (such as snowmaking) and still depend on winter tourism. From the discussions with tourism businesses representatives, it resulted that some of them, do not implement any adaptation measures due to diverse reasons (which will be discussed in Chapter 4.6 - Barriers). It can be observed that few providers mentioned that they do not adapt their businesses, and that they are part of the sub-sector of activities providers. However, Elsasser and Bürki (2002) warn that this measure (business as usual) should not be considered as a true strategies when treating climate change.

In conclusion to this chapter one can say that reactions of tourism providers in the SNP region regarding the climate change impacts are very similar with the findings from the discussion with tourism experts and also with the aspects presented in literature review. It was interesting to discover that in the area there are more adaptation measures implemented than actions intended to mitigate the climate change impacts. Regarding the adaptation measures, the classic techniques of snow making is still popular and intensely used in the SNP region. However, regarding this measure some persons might raise the issue of its sustainability.

It resulted that the renowned measure of developing ski areas is also used in the SNP region but, as in the case of snowmaking, investing huge amounts of money in new ski facilities brings into discussion the question of sustainability.

Regarding the diversification strategy, many of the options offered by literature are used in the SNP region as well. However, there are some activities named in the literature (such as (gastronomy tourism, install blankets for snow conservation, concerts or toboggan-run), which although might be also appropriate for the SNP region, they were not named by the interviewees. Although this does not necessarily mean that the measures are not implemented by other actors in the area (which have not been interviewed) this aspect of what other diversification activities are appropriate for the area can be studied in the future. Cooperation is seen as a very positive aspect in literature and its existence was also found in the SNP region. It is present among tourism stakeholders but also between tourism and other local industry (such as public transportation).

Finally, one can argue that several adaptation measures are being implemented in the SNP area by providers who operate in almost every sub-sectors of tourism.

4.5 Drivers for implementing adaptation measures

After identifying the most popular adaptation measures implemented by tourism providers in the SNP region, the next aspect this thesis will present is which are the triggering factors that determined the businesses to take action. Therefore, this chapter presents the results and the interpretation of results emerged from the discussion with tourism providers who have been asked which are the drivers that made them to react to climate change.

4.5.1 Results from tourism businesses representatives

The representatives of tourism businesses in the SNP region who have implemented adaptation measures agreed that **one major driver to take action is the less amounts of snow**. They acknowledged that this physical impact is interrelated **with the number of**

tourists coming in the region and therefore, these are the main reasons for adapting to climate change.

For example, one representative from Bergbahnen Zuoz that "*if there is no snow, tourists do not come*" and this is why they decided to start making snow, and especially in the last years to do this process more intense. One hotel representative, who mentioned that they adapted to climate change by offering alternatives to alpine skiing, also acknowledged that less snow means fewer tourists and this is why they decided to take action. Another hotel representative from Scuol named the less amounts of snow as being the triggering factor that determined them to diversify and to offer various events for days when skiing is not possible. The answer of a ski school representative from Zuoz goes in the same line of thoughts and the person stated that they organized an event for bikers and skiers because *"we had to diversify somehow the offer, to provide an alternative due to the lack of snow"*. She added that tourists' behaviors were also a determinant factor, because *"tourists may be afraid to go on the slopes with little artificial snow."*

The **second driver** that led to actions of tourism providers to treat climate change issue is given by **economic reasons**. It is true that this answer was given by a provider when discussing about the mitigation measures his business implemented. Mr. Baumgartner names the financial resources as being the driver that determined his hotels to enter the program through which they have to reduce the fossil fuels consumption and to be more efficient when using the energy (with actions mentioned in previous chapter, such as building isolation). He stated that the hotels receive money from the government and that can also make serious economies due to the fact that they acquire less oil.

An interesting answer was provided by one instructor of a ski school from Scuol. He mentioned that they do not take adaptation measures because the ski school is only a secondary occupation in winter for its workers.

It can be summarized that the relation between the lack of snow and the decrease in the tourists' number is the most relevant driver. This association was the only triggering factor which was named by tourism providers who did implement adaptation measures. Economic reasons have been named as drivers to implement mitigation measures.

4.5.2 Discussion

It was interesting to observe that the businesses that implemented adaptation measures named as main reason for them **the lack of snow** which eventually leads to a **decrease in tourists' number**. Businesses from diverse tourism sub-sectors in the SNP region (such as cable car company, hotels, ski school) named that their adaptation measures are mainly driven by the above name relation between the lack of snow and number of tourists. This is confirmed by the study of Matasci (2012) who discovered that less amounts of snow and changes occurred in the demand side (in this case the decrease of demand) are important triggering factors for tourism stakeholders to adapt to climate change. The study of Hoffmann et al. (2009) discovered that the more dependent a company is on the affected business the more will be willing to adapt the respective company will be. As their study was based on ski lift companies, one can argue that also the results from Bergbahnen Zuoz confirm the study mentioned above. It is clear that in a region where winter tourism and especially ski tourism have a great importance (it can be seen from the number of touristic facilities in the area –

Chapter 3.2), a cable car company is heavily dependent on its winter time operations. This is also confirmed by Seilbahnen Schweiz (2006) where is acknowledged that more than 80% of the ski lift operators' revenues in 2005 originated from the winter season. This theory, that the more dependent a company is to the affected business the more it will adapt can be also confirmed from the answer of a ski school representative who acknowledged that his business does not implement any measures because it represents only a second occupation for its workers. Therefore, the fact that their living does not depend only on this business is the reason that determined the ski school to not take any measures.

Another trigger factor identified by the study of Hoffmann et al. (2009) was the awareness of the providers with regards to climate change effects. It has to be mentioned that during the interviews the participants definitely showed that are informed about the phenomenon of climate change, through their answers and attitudes. Therefore, even if they did not clearly specify their awareness as a driver, the author of this thesis concluded that this can be added on the triggering factors.

The same study of Hoffmann et al. (2009) could not confirm the hypothesis according to which the more vulnerable a company is to climate change impacts the more it will adapt. This is also the situation in this study, where (as concluded in Chapter 4.3 – Vulnerability) companies belonging to the most vulnerable sub-sector (the activities providers) acknowledged that did not implement any measures. However, while representative of two ski schools said that their companies did not adapt to climate change, one person from another ski school stated that they did. Therefore, one can say that vulnerability was not found as a driver to implement adaptation measures.

When discussing about drivers for implementing **mitigation** measures, economic reasons are named as being important. The owner of 3 hotels in Scuol acknowledged that financial reasons are the first motivation to start mitigation actions. This is confirmed by the study of Matasci (2012), who discovered that providers can implement actions with regards to climate change also due to reasons which are not related to the amounts of snow. The work mentioned above names economic situation and conditions in neighboring regions as other factors apart from the lack of snow.

In conclusion it can be said that, when strictly referring to adaptation measures, the most important driver that determined tourism providers in the SNP area to adapt to climate change is given by the relation between lack of snow and number of tourists. Moreover, the dependency on the affected business (like in the opposite cases of Bergbahnen Zuoz and of the ski school from Scuol) and the awareness of providers also play important roles for determining implementation of adaptation measures. It can also be concluded that vulnerability of businesses is not a triggering factor for adapting.

4.6 Barriers for implementing adaptation measures

Until now, this master thesis revealed, among other aspects, what adaptation measures have been implemented in the SNP region by the tourism providers and what are the triggering factors that determined the actors to react to climate change. However, in the literature one can remark the existence of several barriers that can obstruct in different ways the measures

to be implemented. In this chapter, the barriers that have been found as hindering the adaptation actions of tourism providers in the SNP region will be presented and interpreted.

4.6.1 Results from tourism experts

The first group of interviewees named multiple barriers faced by tourism providers when implementing measures which aim to adapt the businesses to the phenomenon of climate change. There have been mentioned aspects viewed from different points of view and also barriers which are tangible but also which are immaterial.

Lack of financial resources is the barrier that most experts agreed on. Bruno Abegg and Constanze Conradin firmly mention that money is a serious problem. Also Hans Lozza and Reto Rupf acknowledge that currently for tourism businesses is difficult to keep their incomes and *"if you don't earn money with conventional tourism, you cannot invest in other types of tourism*" (H. Lozza). Also Claudio Daguati states that *"cost is a big barrier".* He was more specific and added that while larger resorts such as Scuol have better possibilities for investments, smaller resorts, such as Val Müstair really face a challenge to invest.

Due to the barrier named above, another obstacle occurs, according to the experts' opinions. Therefore, the next barrier identified is the **lack of long term perspective**. Bruno Abegg states that: "*Another barrier can be short time frame thinking*" and he explained that several companies are facing tough times to keep their daily business. Therefore, as long as for these actors it is difficult to run their current businesses, planning long term strategies might be not a priority. The same thoughts are also shared by Therese Lehmann, who considers that tourism providers have as current priorities to persuade tourists to come in the destinations. Therefore, the tourism operators might be very busy with this aspect and they "*might not have time to think for the long term problems*" (T. Lehmann). She also added that one current problem is represented by the **strong Swiss Franc**.

The next barrier identified by tourism experts is the opposition that providers face while implementing adaptation measures, such as snow making. Constanze Conradin named that **environmental organizations**, such as Pro Natura represent a barrier for slopes operators to produce snow. According to Ms. Conradin, these organizations are against producing snow due to the fact that substances present in the artificial snow might have negative impacts on the environment. Hans Lozza also stated that some might blame the actions of environmental organizations because "*they try to avoid more technical installations*". Also Claudio Daguati brings this aspect into discussion and says that for the area of Val Müstair, which has the status of a biosphere, environmental organizations and some regulations can restrict the actions that can be done.

The majority of interviewees also agreed on the aspect that **diminished water resources** are a serious barrier for snow making, which is a very used adaptation measure in the area. Claudio Daguati mentions that the area Val Müstair had problems with water supply and due to these obstacles the slope operators could not produce snow and could not open the season. Also Reto Rupf acknowledges that in the current season (2015/2016) in the area there are problems with the water availability due to summer and autumn which were very dry. Hans Lozza also states that dryness can lead to problems with having not enough water, while Bruno Abegg mentions that in the ski area of Scuol, the operators are already "*struggling to have enough water to make snow*". Also Ms. Lehmann states that in Scuol, one

third of the available water is used for making snow and she mentioned that with the measure of artificial snow questions regarding its **sustainability** can arise. Another barrier has been mentioned for the measure of snow making, namely the **uncertainty that tourists are willing to come in the area and ski on artificial snow**, or they will go to other resorts, question raised by Hans Lozza.

Another barrier is, according to Hans Lozza the fact that there still are **some providers who consider that climate change does not exist**, and that it has been invented by environmental organizations. He considers that this is the main barrier.

Therese Lehmann names two other barriers, which are (1) **the lack of innovation capabilities** for developing new products and for shifting to summer tourism and (2) the fact that people in the Alps have a conservator behavior and are **not willing to change too much** the state of affairs.

The **dependency on the winter tourism** is the next barrier named by Bruno Abegg. He acknowledges that some providers *"are on a track and it is not possible for them to leave it"* and explains that there are tourism actors, such as cable car companies, which need to keep their core business, naming to transport people, and it can be difficult for them to try to offer alternatives. He also added that the cable car companies are more profitable when they sell tickets (or passes) to skiers, who use the cable car several times a day comparing with selling only one way ticket for hikers.

Figure 14 summarizes the findings that emerged after the discussions with tourism experts.

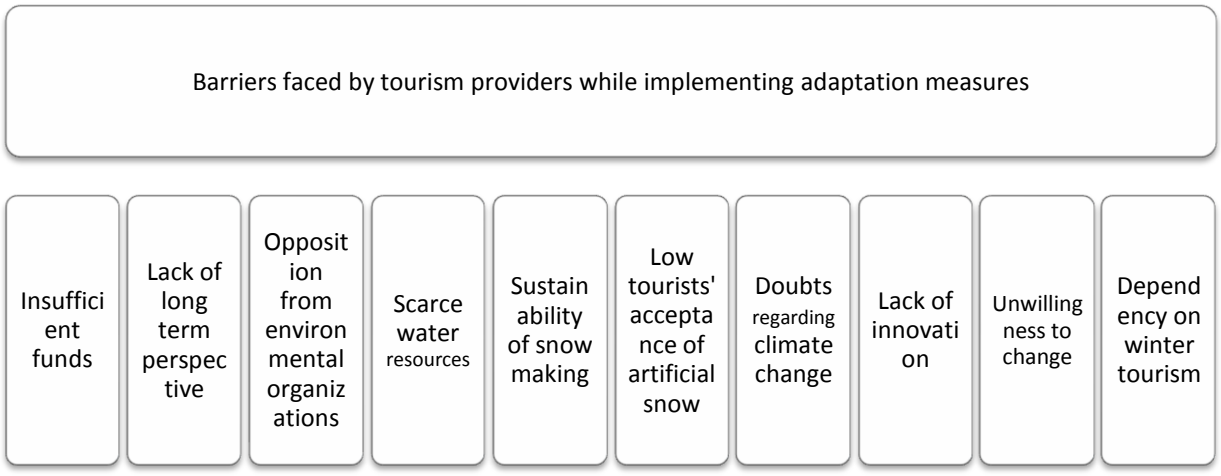

Figure 14 Barriers faced by tourism providers in the SNP region while implementing adaptation measures, based on the discussion with tourism experts
Source: Own design based on the interviews results

4.6.2 Results from tourism businesses representatives

When discussing about the barriers that can obstruct their adaptation measures, tourism businesses representatives provided interesting and various answers which will be further on presented. It is important to mention that some interviewees also named barriers that hinder them to implement mitigation measures.

One representative from Bergbahnen Zuoz acknowledged that there is a **big cost** for the company to produce artificial snow. She mentioned that, although this is an important barrier

for them, they have to produce artificial snow; otherwise, the company's income will dramatically suffer. Also Kurt Baumgartner mentioned that the cost for implementing a certain mitigation measure can represent an obstacle. He was referring to the program for reducing fossil fuels consumption that his hotels are part of, and he added that the costs for implementing this program can be a barrier for other hotels which do not have a prosper financial situation at the moment.

Also related to financial resources is the answer of one hotel representative from Scuol, who acknowledged that his hotel does not afford to implement any mitigation measures, due to **insufficient funds**.

Lack of long term perspective and the fact that the **measures might not be profitable** are two other interrelated barrier named by Kurt Baumgartner. He explained, strictly related to the mitigation actions his hotels do, that with the current low oil price, other hotels might not feel the need to reduce oil consumption. This is, according to Mr. Baumgartner, a short term vision which can hinder the actions of other providers. Secondly, he added that the costs for implementing the program he is in are high and also related with the low cost of oil, the measure might not be profitable in the short term. However, he considers that it is important to have a long term perspective and that is why he tries to reduce his hotels' dependency on oil.

Managing director of Hotel Altana from Scuol states that some **institutional barriers** might hinder the implementation of adaptation measures, such as diversification. He gives an example that there are some regulations which prohibit the access to certain areas due to environment protection. He added that this kind of regulations "*might represent an obstacle for alternative offers*".

High temperatures represent another barrier for Bergbahnen Zuoz and for their snow making activity. The representative added that this is a serious barrier that can obstruct them to do the only adaptation measure that is in their power, namely snow making. She specified that at the moment Bergbahnen Zuoz does not face big problems with the water supply.

The amount of work for implementing adaptation measures was another barrier named by one representative of a ski school from Zuoz. She was strictly referring to the event (competition for bikers and skiers) that her company organized.

A low cooperation among the tourism stakeholders is, according to Adrian Lehmann from Hotel Altana, another obstacle that is hindering the adaptation process. He mentions that people do not work together as well as they are able to.

Finally, an interesting answer was provided by another hotel representative, who stated that **there are no barriers** for them to diversify their offer and to offer various events for the tourists.

As a summary to the barriers identified by the tourism businesses representative, Figure 15 is provided:

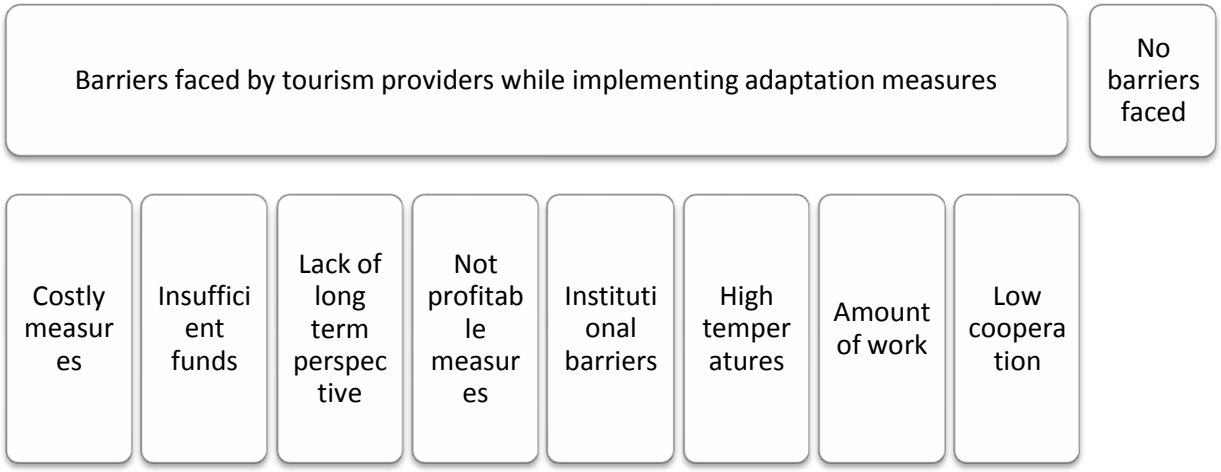

Figure 15 Barriers faced by tourism providers in the SNP region while implementing adaptation measures, based on the discussion with tourism providers
Source: Own design based on the interviews results

4.6.3 Discussion

The results presented above show that barriers play an important role when discussing about adaptation measures and several such obstacles may occur. Both groups of interviewees named diverse barriers, sometimes sharing the same opinions and in other cases complementing each other.

The barrier of **insufficient funds** is named by the both groups of interviewees and therefore represents a serious obstacle for the area. Both the experts and the providers acknowledged that having the money needed for adaptation measures investments is currently a problem. The literature confirms that financial resources might hinder the implementation of adaptation measures, and, for example, in the study of Matasci et al. (2014) *economic barriers* are recognized as being particularly important. In the same category identified by Matasci et al. (2014) are also placed the barriers according to which a measure is too costly or it does not provide a good balance between its costs and its benefits. Too expensive measures have been named by tourism providers when referring to the option of snow making and to the implementation of mitigation programs. Another representative of a ski school confessed, when strictly referring to the event organized by her company with the purpose of offering variety to clients, that there was a difficult task to coordinate that event. The balance between costs and benefits is also a barrier named by tourism providers in the SNP area, and is the case mentioned by K. Baumgartner, who states that currently the oil price is low and the investment for reducing oil consumption is too high. Therefore the respective mitigation measure is perceived by some actors as being not profitable.

The lack of long term perspective is another barrier which is very relevant for the SNP region. Representatives of both groups have named it but it is related with the previous barrier. The findings showed that due to difficult current financial results, the providers are too occupied to be concerned about the daily operations and how to attract tourists in the short term. Therefore they might not have the time, or the financial resources to consider long term strategies. This barrier is also present in the study of Matasci et al. (2014) where the Swiss tourism stakeholders have been asked about obstacles. The strong Swiss franc was also considered a barrier in that study and it is also named by Therese Lehmann.

Opposition from environmental groups was a barrier named by tourism experts who are located in the area (by Constanze Conradin from Biosfera Val Müstair and by Claudio Daguati from Tourism office Bal Müstair). They explained that such environmental organizations might be a barrier for tourism providers to implement measures like snow making. The literature confirms that is some cases, implementing adaptation actions can be obstructed by opposition from such environmental groups (OECD, 2007). Also related to the artificial snow the interviewees named as barriers **high temperatures** (which do not allow slope operators to produce the snow), **decreased water resources**, **sustainability** of the measure and also a **low acceptance** of skiers for artificial snow. All these aspects are highly supported by literature. The facts that (1) this measure is ineffective at temperatures higher than -2 ºC, (2) that it needs lots of water amounts, (3) that it is not very sustainable (because it has negative environmental impacts of alpine vegetation and on water reserves) and (4) that it does not present a high acceptance from tourists are confirmed in studies such as those of Scott and McBoyle (2007), OECD (2007) and Pütz et al. (2011).

The obstacle named by one hotel representative who stated that some regulations might hinder some adaptation measures (such as hiking in protected areas) was assigned to the category of **institutional barriers.** This barrier is also present in literature, in the study of Matasci et al. (2014) who discovered that this type of obstacles have a particular importance among tourism stakeholders of Switzerland.

Another barrier is given by some providers' **skepticism with regards to climate change**, as one interviewee acknowledges. He added that some people do not want to accept that there is climate change. This aspect is very sensitive and it can be seen also in this master thesis, in the previous chapter that some providers were not sure whether climate change is the real cause of the last couple of years with less snow. However, counting the number of providers who were uncertain about climate change, one can observe that they are fewer than those who recognized climate change as a real problem. Similar with the previous barrier is the obstacle identified by Ms. Lehmann, namely that some **providers are not willing to change**, and a cause which explains this is the conservative mentality that people living in the Alps have and also that there is **a lack of innovation** for creating new products and alternatives to winter tourism. However, in a study of Matasci et al. (2014) they have discovered that Swiss people are in general aware of climate change and agree that some adaptation measures are necessary. This is why, in the same study, it has been mentioned that barriers related to social acceptability do not represent a threat for the adaptation process. Bruno Abegg brought into discussion another delicate aspect, namely that **some providers are very dependent on their winter operations**, thus they cannot change their core business. This aspect is confirmed by literature, where is acknowledged the importance of winter tourism for some destination, and therefore is explained their dependence. Bürki et al. (2003, December) and also Koenig and Abegg (1997) state that winter sports are the main source of income for Swiss alpine areas. Also in a report of OECD (2007) it is acknowledged that the local economy of many winter destinations will seriously suffer if the ski tourism would be discarded, due to its important role as income and jobs generator. Moreover, in the same report is suggested that activities not related to winter tourism cannot substitute the revenues produced by snow related offers. The dependency of some operators on the winter season tourism is illustrated by the fact that in 2005, more than 80% of the ski lift operators' revenues came in the winter season (Seilbahnen Schweiz, 2006).

Low cooperation among tourism stakeholder was named exactly by a tourism business representative as being another barrier. Importance of cooperation is highly acknowledged by literature. Matasci et al. (2014) named lack of cooperation as being a barrier for adaptation measures, while Wyss et al. (2014) consider that cooperation among the tourism actors is a key element driving most of the adaptations measures to success in an alpine tourism context. However, one can argue that a certain amount of cooperation exists also in the SNP region and the collaboration between Tourism Office Val Müstair and the rest of tourism providers but also the collaboration between tourism and public transportation (for the luggage transfer) confirm this.

This chapter showed that barriers can be diverse and can emerge from different reasons and stakeholders. **Financial reasons**, however seem to be the most relevant obstacle for providers to implement measures related to climate change. Moreover, these financial reasons can determine a **lack of long term perspective** which is also seen as a barrier for implementing changes. Added to these measures which are strictly related to the providers, other barriers which are less controllable by tourism business are important, such as **institutional barriers** or **oppositions from environmental groups.**

4.7 Consequences of adaptation measures implemented

After understanding the physical impacts and the peculiarities of SNP area with regards to climate change, finding what adaptation measures implement the tourism providers and also discovering the barriers they face, investigating the consequences of the measures was the next step of this master thesis. Therefore, this chapter presents what are the effects of actions taken by tourism providers in the SNP region. Both groups of interviewees have been asked, in order to have a more complex visualization of the situation.

4.7.1 Results from tourism experts

The tourism experts have provided diverse answers and they discussed the consequences from both perspectives, of the tourists' and the providers'.

A popular answer among the experts was that a main consequence of implementing adaptation measures is that the **costs increase** for providers and therefore the prices that are paid by tourists. Bruno Abegg affirmed that skiing is already a relatively expensive activity, and it can become even more expensive due to "*additional transportation facilities and snow making machines*" that are needed to maintain appropriate conditions. Claudio Daguati has also acknowledged that the prices of tickets might increase due to higher costs that will occur with the process of snow making. The same thoughts shares Constanze Conradin as well, who says that making snow will increase the costs of operators. Therese Lehmann added that "*investments for adaptation measures will be enormous to maintain the snow guarantee*" and that by year 2030 the share of investments for climate change during winter should be at around 10-20%, according to the experts interviews she conducted for her doctorate thesis.

Hans Lozza stated that the activities of Tourism Office Scuol of trying to persuade tourists to do other activities **will reduce the providers' dependency on snow amounts**. Related to this answer is the consequence provided by Reto Rupf, Bruno Abegg and Constanze Conrading, who acknowledged that **popularity of winter sports will decrease** in the future.

Another consequence of adaptation measures which has been identified by experts in a **change in the degree of tourists' satisfaction**. According to Mr. Daguati, having some alternatives to ski tourism determines tourists to be less dissatisfied and to complain less. On the other side is the opinion of Mr. Lozza who mentions that if a region changes its strategy becoming more sustainable and stop the production of snow, it may lose guests who want to ski. Ms. Conradin also points out the aspect of tourists' satisfaction and she mentions that there are guests who do not care about artificial snow and guests who do not enjoy only a white stripe and everything around not covered with snow.

A last consequence is named by Mr. Daguati who states that the adaptation measures produce an **impact upon the landscape**. He gives the example of an area close to the studied region where there have been pipelines installed for water needed for snow making. He explains that the ground is affected and the grass does not grow anymore due to those pipelines.

The complex answers provided by tourism experts are summarized by Figure 16:

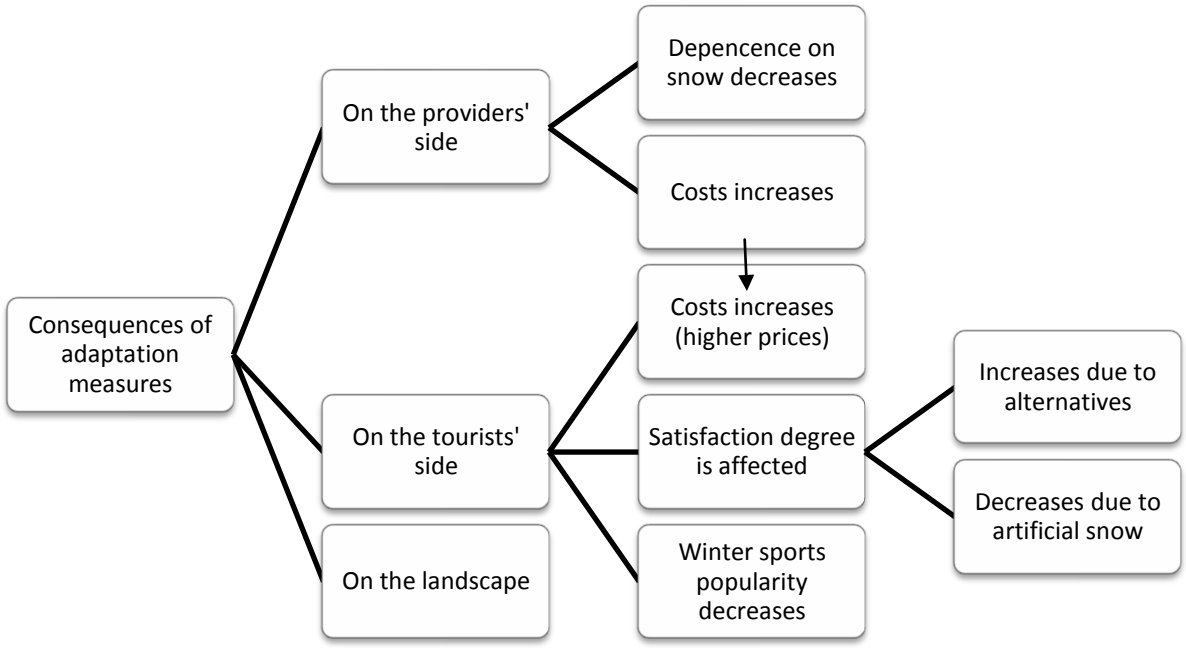

Figure 16 Consequences of adaptation measures, based on the discussion with tourism experts
Source: Own design based on the interviews results

4.7.2 Results from tourism businesses representatives

Discussions with provider showed that they are very concerned what consequences their measures have on the tourists' side.

Adrian Lehmann from Hotel Altana (who stated as measures that the hotel tries to provide alternative to skiing for its guests) mentioned that the **increase in tourists' satisfaction** is an important consequence of the measures they implemented. He added that guests are happy because they "*discover the Lower Engadine in a different way, [...] from a different point of view, apart from the ski area*". Another hotel representative stated that due to diverse events they organize when skiing is not possible the guests were "*occupied and less frustrated that they could not ski*". The increase in tourists' satisfaction was also the

consequence mentioned by one representative of a ski school from Zuoz who organized a competition for where the participants needed to go up on the mountain by bike and down by skis. She mentioned that the tourists were really enthusiastic on the thought that they can bike during winter. One representative of Bergbahnen Zuoz, who previously mentioned that the only measure they do is to make snow, stated that tourists are pleased when there is a good snow cover for ski and that for the skiers "*there is no difference whether there is artificial or natural snow*". She added that there is very important to have good snow on slopes, no matter if it is natural or not.

Related to the increase of tourists' satisfaction is the next consequence stated by providers for their adaptation measures, namely the **number of tourists' bookings.** Adrian Lehmann from Hotel Altana considers that his hotel will probably have further bookings from the same guests. He mentions that this is expected to be a future consequence, because currently his hotel **does not experience any direct benefit**, apart from the increase in the guests' satisfaction. Kurt Baumgartner added that the actions his hotels are involved in (measures for mitigating the impacts of climate change) will have a **good image** in tourists' perception and the reputation will increase. He was not sure if there are some effects on tourists' bookings because of the mitigation actions his hotels do, but he explained that a certain consequence is represented by a cost reduction. He explained that due to the program for mitigation actions (such as using alternative energy) that his hotels are involved, they pay less for oil.

As the providers also delivered diverse answers, Figure 17 has been established, with the purpose of summarizing the results coming from tourism businesses representatives.

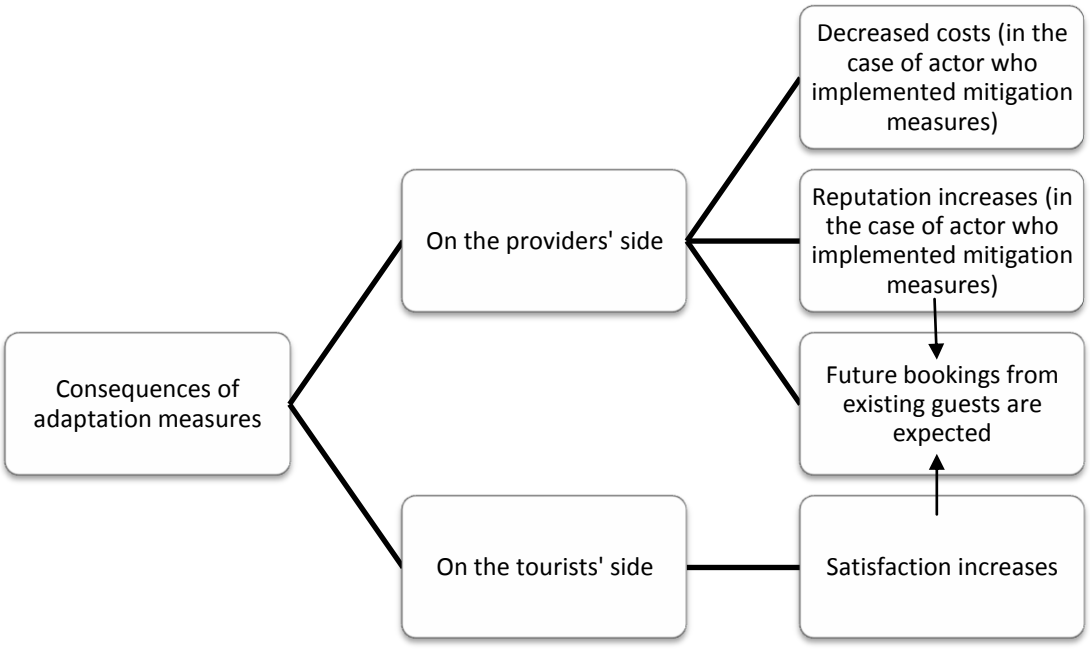

Figure 17 Consequences of adaptation measures, based on the discussion with tourism providers
Source: Own design based on the interviews results

4.7.3 Discussion

As it can be seen in the last two figures the consequences named by tourism experts are confirmed to a certain extent by what the providers have named. However, the providers also complemented the first group of interviewees and also delivered additional answers.

One consequence named by both groups is the **change in guests' satisfaction**. It was interesting to see that tourism providers give a higher importance to this consequence as it was named by the most of them. While the tourism experts provided different answers about tourists' satisfaction degree (saying that it increase due to alternatives to winter sports and due to existence of artificial snow, or it can even decrease due to the artificial snow) all the providers mentioned that they can observe that **tourists' satisfaction increase** due to measures they take. This is also the reason why **more bookings are expected** from guests who have already experienced the alternatives. Providers acknowledge that tourists are happier because they can better discover the area, because they receive alternatives to winter sports or because they can take part to various events and competitions. Even when the artificial snow is brought into discussion, one representative of Bergbahnen Zuoz said that tourists are pleased when they have good snow, no matter if it is natural or not. The importance of snow for a resort' attractiveness is also underlined in literature. Bürki et al. (2003, December) consider that snow is a pillar for determining a winter destination's attractiveness. Also Pütz et al. (2011) found out that skiing is an essential motivational factor for tourists choosing Scuol. In the same study named above is presented the fact that tourists might not totally accept the artificial snow, and the authors discovered that 51% of the interviewed skiers supported the option of artificial snow.

The **changes in costs situation** have been also identified as being important consequences of measures taken by tourism businesses. The tourism experts agreed that the **costs will increase**, for providers such as slopes operators which need to produce snow, or to change aspects of their infrastructure. The report of OECD (2007) names this consequence of increasing costs for those who produce snow. There is specified that more water and energy is needed for the process of snow making, and this is why this action becomes more expensive. Of course that the increasing costs for operators will affect the ticket prices and therefore the tourists' costs will also increase. However, **one tourism provider identified a decrease in his costs**, due to the mitigation measures he implemented. Because the hotels he own are involved in a program through which he needs to reduce fossil fuels consumption and to use alternative energy, the interviewee stated that he observed a decreased cost with oil acquisition. Also the interviewee added that his hotels' **reputation increases** due to the program they are involved in and that **there are expected more bookings**, although he could not confirm that this is the current situation. Information about this consequence have not been found during establishing the literature review for this master thesis.

The experts stated that due to adaptation measures such as diversification of the offer, their **dependence on snow decreases**. The experts went further with the explanations and mentioned that **ski tourism might becomes less popular** due to the fact that tourists' behaviors will change and they will prefer more the alternatives offered by providers, such as hiking.

One interesting answer provided by a tourism expert was that one consequence of adaptation measures is that **landscape can be affected**. He named that the new installations (such as pipelines used for connecting snow making machines to the water)

negatively affect the ground and the vegetation. This aspect is also confirmed by the report of OECD (2007) where is acknowledged that the measures for developing ski areas might disturb the mountain environments, while the artificial snow might negatively impact the alpine vegetation.

As a conclusion to this chapter, it can be stated that consequences of adaptation (and mitigation) measures taken by tourism providers in the SNP are diverse and have effects on three main stakeholder categories. First is the tourism providers themselves, which face consequences such as changes in costs situation (increased but also decreased costs), increased reputation and decreased dependence on snow cover. The second category is represented by tourists, who also face consequences of adaptation measures implemented by providers. Consequences for tourists are increased prices (due to increasing costs of providers) and changes in their satisfaction (increased but also reduced satisfaction). Finally, the third stakeholder is represented by environment which may also face consequences, such as landscape degradation, due to adaptation measures of tourism businesses to climate change.

5 Final conclusion

As it can be seen in the introduction chapter, this thesis intended to accomplish 5 main objectives: (1) to have a common understanding of terms and concepts related to the topic of this study; (2) to provide information about how climate change physically affects the SNP region and what peculiarities does the area present; (3) to identify how are the tourism businesses in the SNP region affected by physical impacts of climate change; (4) to discover which types of actors operating in the tourism sector in the SNP area are the most vulnerable and (5) to provide information about tourism businesses' behaviors with regards to climate change, meaning to offer details about their adaptation measures, their drivers for implementing such measures, barriers and consequences of these measures.

In relation with the first objective, it can be stated that climate change is a current issue of nowadays' societies and this phenomenon "succeeded" to be massively present in research papers and in media. Climate change was defined as being any long term change in the Earth's overall climate, change that can refer to a modification of, for example, the average temperature or of the amount of precipitation. However, it the nowadays context through the expression *climate change* it is referred the strict phenomenon of *global warming*. It was also revealed that many stakeholders from diverse industries give so much importance to this phenomenon because it really threatens our planet and also because it was discovered that human activities accelerate its effects, and therefore it is in humans' power to reduce our harmful activities. Many industries have been identified as being extremely vulnerable to climate change but, the industry of tourism is in the top sectors which are affected (Williams, 2014). Going more into details, it was revealed that among other types of tourism, winter tourism is particularly vulnerable as mountain areas are very sensitive to climate variability (Scott et al. 2012). Moreover, it can be concluded that tourism providers in Switzerland are in general aware of climate change and try to adapt their behaviors. However, there are several drivers that can obstruct these measures for being implemented.

Also related to the first objective, it was successfully pointed out the importance of tourism industry for Switzerland, and it was concluded that this sector is a giant job creator and revenue generator for the country. Moreover, the importance of tourism in the SNP area was revealed mainly through the presence of several touristic establishments (such as hotels and holiday apartments) and facilities (such as km of slopes).

In relation with the second objective, namely to provide information about physical impacts of climate change in the SNP region and about area's peculiarities, it appeared that less amounts of snow, increasing temperatures, changes in weather patterns (not as regular anymore) and shorter and later snow seasons are the impacts the most notable for the area. It was also found that the area has two main peculiarities, its dryness and its high altitudes and due to these aspects, the impacts of climate change can be more intense (because of the area's dryness) or they can be less intense (due to high altitudes of the area).

The third objective was to identify how are the tourism businesses in the SNP region affected by physical impacts of climate change. First of all, regarding the degree of awareness it can be concluded that the majority of the tourism providers are aware of the impacts of climate change. Their businesses are mainly negatively affected in terms of fewer tourists coming, shorter bookings of these, increased costs and business reduction.

Objective number four was to discover which types of actors operating in the tourism sector in the SNP area are the most vulnerable. Here it was interesting to observe that while the interviewees who are not directly involved in tourism industry identified, almost unanimously that activity providers are the most vulnerable sub-sector due to their dependence of snow cover. However, the representatives of tourism businesses stated (also almost unanimously) that the whole sector is equally vulnerable. It was therefore, revealed the interdependency among tourism sub-sectors.

Objective number five involved to find out aspects regarding the tourism providers' behaviors with regards to climate change, and to discover what kind of adaptation measures they implemented, their drivers for implementing such measures, barriers and consequences of these measures.

Regarding adaptation measures, it appeared that four main types of actions have been taken in the area. First of all is the traditional measure of producing artificial snow. It is used in all ski areas from the studied region. Secondly, the adaptation measure of developing the ski area is used. Ski operators try to move their operations to higher altitudes and to develop north facing slopes. The third action involves that tourism providers diversify their offer. Several activities have been included in order to offer the guests an alternative to ski. Among these alternatives, there can be mentioned the next activities are intense promoted in the SNP region: hiking, biking, ice skating, various events, health tourism and cultural tourism. The last type of actions taken by tourism stakeholders in the SNP region is to increase the cooperation. They cooperate within the tourism industry but also with other sectors. Good examples are (1) the case of DMO Val Müstair which informs providers about what alternatives can be offered to tourists and even helps them to establish activities programs; and (2) the cooperation between tourism industry and public transportation for the luggage transfer program.

The factors that determined the providers to adapt to climate change appeared to be, first of all, the lack of snow which determines fewer tourists to come in the area but also the dependency on the affected business.

With regards to barriers which obstruct adaptation measures to be implemented, the most relevant for the SNP region are: lack of financial funds; lack of long term perspective (providers currently face difficult times and are concentrated on how to attract tourists in the short term); opposition from environmental organizations, water resources and high temperatures for snow making; and some institutional barriers (such as rules which can hinder providers to offer some alternatives – for example prohibition to enter in certain areas).

Regarding the consequences of adaptation measures implemented in the SNP area it appeared that three main categories can be defined. First, there are the consequences faced by tourism providers such as increasing costs, increasing reputation and decreasing dependence on snow cover. Secondly, there are the consequences that are faced by tourists, such as increasing prices and changes in their satisfaction level (which can be positive or negative). Lastly, the third category is represented by consequences on the landscape, such as negative impacts on ground and vegetation due to adaptation measures, such as pipelines connecting ski areas to water resources.

As a final conclusion it can be stated that all the objectives have been successfully accomplished and all the research question and sub-questions have been answered. The author considers that this master thesis represents a small but important drop of water in an ocean abounding of research papers treating the aspect of climate change in tourism. Moreover, the author believes that this master thesis can be helpful both for academicians (who might need a starting point for their research) and for practitioners (who might seek for examples of adaptation measures or barriers that need to be taken into consideration).

6 Limitations and delimitations

As **limitations** can be named the followings:

- Language, as the author's level of German (the language spoken in the studied area) is low, the literature review and the oral interviews have be conducted in English. This was indeed a limitation because, while trying to contact tourism providers for interviews, some of them did not feel confident enough with their English level and did not accept to answer the questions. However, this aspect has been overcome with the help of e-mail interviews. The author was helped by German native speakers to translate the interview questions and also the answers received. Moreover, the implications of this action (of conducting interviews by e-mail) have been considered and mentioned in Chapter 2.3.
- Location, as the author is not located in the studied area. However, this barrier has been overcome with the help of Skype or of the telephone.
- Number of interviewees, especially from the tourism providers group. The author managed to conduct 9 interviews with tourism providers in the area. Although solid conclusions could be drawn, the author considers that it would have been better to have a larger sample. In many aspects saturation has been reached, but there are situations where more interviews would have been appropriate.

Therefore, as the limitations named above might have a serious impact on the quality of thesis, the author recommends for future studies done in this direction, to be done by German speaker researchers who eventually will include more persons in their sample.

Delimitations:

- The study focused on studying the climate change impacts on tourism businesses and the latter's reactions in the **Swiss National Park region** (see geographical delimitation in Chapter 3.2) during **winter season**, for the reasons named in Chapter 1.2

7 Resources and ethical issues

The main resources needed for establishing the current master thesis are:

- Time. For this master thesis the author has worked during the period October 2015 – March 2016. The timetable which was followed can be seen in Appendix 35.
- Financial resources. This kind of resources was needed for transportation to diverse locations for meeting with advisors and interviewees; it was also necessary for conducting phone interviews.
- Equipment. All available technical equipments have been used for facilitating the establishment of this master thesis and for improving its quality, such as: laptop for research and writing, Microsoft Word for analyzing the interviews, recorder for registering the interviews, telephone for conducting the interviews.

Because during the process of writing this thesis several interactions with diverse persons happened, **ethical issues** needed to be considered. The author considers that all the precautions have been taken in order to prevent any kind of ethical issue to occur. All persons involved in this research have been treated with maximum amounts of professionalism and of respect. Interviewees have been asked for their permissions before the interviews have been recorded and their preferences have been catered.

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Appendices

Appendix 1: Interview guideline for tourism experts

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?
2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?
3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?
4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?
5. Are the tourism providers of the SNP region **aware** of climate change?
6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?
7. What are the **consequences** of these actions for the tourism businesses?
8. What are the **barriers** that can obstruct these measures to be implemented?

Appendix 2: Interview guideline for tourism providers

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?
2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?
3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?
4. What are the **drivers** that determined your business to implement these measures?
5. **Since when** did you start doing these actions?
6. What are the **consequences** of your actions for your business?
7. What are the **barriers** that can obstruct these measures to be implemented?
8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

Appendix 3: Codebook

Level			Name	Clarifications (if necessary)	Presence in literature
1			**Physical impacts of climate change in the SNP region**		
	1.1		Less amounts of snow		Bürki et al. (2003, December) Matasci (2012)
	1.2		Glaciers melting		Bürki et al. (2003, December) Matasci (2012)
	1.3		Permafrost melting		Bürki et al. (2003, December) Matasci (2012)
	1.4		Changing weather conditions		Bürki et al. (2003, December) Matasci (2012)
		1.4.1	More precipitations		
		1.4.2	Higher fog level		
	1.5		Increase in frequency of hazardous events (floods, landslides, falling rocks)		Matasci (2012)
	1.6		Water scarcity		Matasci (2012)
	1.7		Changes in scenic beauty		Matasci (2012)
		1.7.1	*Positive*		Matasci (2012)
		1.7.2	*Negative*		Matasci (2012)
	1.8		Increased temperatures		(Abegg, Bürki, & Elsasser, n.d.) (Wyss, Abegg, & Luthe, 2014)
	1.9		Reduced snow season		Bavay et al. (2013)
	1.10		Increase of snow level		Bavay et al. (2013) (Elsasser & Bürki, 2002).
	1.11		Dryness		Matasci (2012) Pütz et al. (2011)
2			**Impacts on tourism business**		
	2.1		Decreased attractiveness in winter		(Wyss, Abegg, & Luthe, 2014) (MoE, 2011), Koenig and Abegg (1997)
	2.2		More tourists in summer		Serquet & Rebetez (2011)
	2.3		Financial costs		(Elsasser & Bürki, 2002).
	2.4		Changes of climate variability for tourism activities		Matasci (2012)

		2.4.1	*Positive*		
		2.4.2	*Negative*		
3			**Adaptation measures**		
	3.1		Development of higher skiing areas		Koenig and Abegg (1997)
	3.2		Snow making		Koenig and Abegg (1997), (Tranos & Davoudi, 2014) Abegg et al. (n.d.) Scott and McBoyle (2007)
	3.3		Diversification		Koenig and Abegg (1997) Scott and McBoyle (2007) Hoffmann et al. (2009)
		3.3.1	Sport events		Hoffmann et al. (2009)
		3.3.2	Snowmobiling		Scott and McBoyle (2007)
		3.3.3	Skating		
		3.3.4	Indoor pools		
		3.3.5	Health and wellness spas		
		3.3.6	Fitness centers		
		3.3.7	Games rooms		
		3.3.8	Golf		
		3.3.9	Rafting		
		3.3.10	Mountain biking		
		3.3.11	Horseback riding		
		3.3.12	Alternative slope activities		Hoffmann et al. (2009)
		3.3.13	Develop winter/summer hiking trails		
		3.3.14	Offer theme hiking		
		3.3.15	Concerts		
		3.3.16	Adventure and fun sports		
		3.3.17	Develop gastronomy		
		3.3.18	Build toboggan-run for winter/summer		
		3.3.19	Develop snowshoeing trails		
	3.4		Cooperation		Koenig and Abegg (1997), Pütz et al. (2011), Matasci et al. (2014), Wyss et al. (2014)
		3.4.1	Cooperate with local industry		Hoffmann et al. (2009)

		3.4.2	Cooperate with other ski lift operators		Hoffmann et al. (2009)
	3.5		Development of north facing slopes		Abegg et al. (n.d.) Scott and McBoyle (2007) OECD (2007)
	3.6		Glacier skiing		Abegg et al. (n.d.)
	3.7		Landscaping and slope development		Abegg et al. (n.d.) Scott and McBoyle (2007)
	3.8		Reduce ski season		Abegg et al. (n.d.)
	3.9		Financial tools		
	3.10		Could seeding	Cloud seeding is a weather modification technology that has been used to produce additional precipitation (Scott & McBoyle, 2007)	(Scott & McBoyle, 2007)
	3.11		Ski conglomerates		
	3.12		Marketing incentives		
	3.13		Indoor ski areas		
	3.14		Install blankets for snow conservation		Hoffmann et al. (2009)
	3.15		Open slopes with less snow than usual		
	3.16		Split costs with local industry		
	3.17		Split costs with local authority		
	3.18		Merge with other ski lift operators		
	3.19		Effect snow insurance		OECD (2007) Hoffmann et al. (2009) Scott and McBoyle (2007)
	3.20		Business as usual	Both supply and demand sides keep their actual behaviors without changing it.	Elsasser and Burki (2002)
	3.21		Cancel ski tourism		Elsasser and Burki (2002)
4			**Tourism stakeholders are aware of climate change**		

	4.1		Yes		Elsasser and Bürki (2002)
	4.2		No		
5			**Drivers**		
	5.1		High degree of awareness about climate change impacts		Hoffmann et al. (2009)
	5.2		Dependence on the business		
	5.3		High ability to adapt		
	5.4		Less amounts of snow		Matasci (2012)
	5.5		Ecnomic situation		
	5.6		Situation in neighboring regions		
	5.7		Changes that occure in the demand side		
6			**Barriers**		
	6.1		Insufficient funds		Matasci et al. (2014)
	6.2		Not profitable measures		
	6.3		Institutional barriers		
	6.4		Lack of long term perspective		
	6.5		Strock Swiss Franc		
	6.6		Lack of action at international level		
	6.7		Concern that jobs and the incomes in that region would be affected		
	6.8		Opposition from public and/or environmental groups		Scott and McBoyle (2007), OECD (2007)
	6.9		Negative impacts on Alpine vegetation		OECD (2007)
	6.10		Noise pollution		
	6.11		Unsustainable strategy for the long term		
	6.12		Limited or no options for expansions for some ski areas		

	6.13		Substantial investments, Costly measures		Scott and McBoyle (2007), OECD (2007)
	6.14		Water resources		
	6.15		High temperatures	Applicable for snow making	OECD (2007), Scott and McBoyle (2007) Pütz et al. (2011)
	6.16		Low acceptance of tourists for artificial snow		Pütz et al. (2011)
	6.17		Negative impacts on economy, losses		OECD (2007)
	6.18		Conflicts for sharing costs		
	6.19		Conflicts with other industries for land	For example conflicts with agriculture sector	
	6.20		Not evidences that cloud seeding works	Applicable for cloud seeding	Scott and McBoyle (2007)
	6.21		Winter tourism is the main source of income and employment and cannot be discarded		OECD (2007)
	6.22		Difficulty to identify the changes that already happen or to identify the impacts of these changes (Barriers obstructing social feasibility)		Matasci et al. (2014)
	6.23		Population is not willing to accept certain adaptation measures (Barriers obstructing social acceptability)		Matasci et al. (2014)

Appendix 4: Interview with Mr. Bruno Abegg

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?

The most important impact is impact on snow cover. The area is relatively high so one could say that this area is a little bit less vulnerable than other areas, but there are still some impacts. It is a rather dry area which is already a problem with regards to snow; the drier it is the less snow. Because of this dryness they have less snow and less water.

Another impact could be on water availability.

Year 2015 was very dry. In the ski area of Scuol they are struggling to have enough water to make snow. Climate scenarios say that it will become drier in summer, maybe a little bit wetter in winter. That would be another potential impact.

2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?

What is special about this area is that it is dry.

3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?

Winter season usually means snow based tourism, so everything that is snow based will be affected.

4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

The most vulnerable are the sectors and enterprises that are directly dependent on snow, meaning the transportation companies, ski instructors. Less vulnerable are the accommodation providers. Looking at this Christmas holiday, where there was no snow in the whole Alps, when you look at the figures, the people were there. In terms of numbers it was ok for accommodation. Also for the cable car companies, people were there, but they spent less money – they went up the mountain, buying only a ticket, not a pass. Although skiing and snowboarding are still very important, there is an increasing number of people willing to do different things while being in the mountain. Some years ago skiing was much more important and now people doing winter holiday don't go skiing that often. Maybe skiing isn't that important anymore. This can be the reason why the accommodation sector is less vulnerable.

5. Are the tourism providers of the SNP region **aware** of climate change?

Most of them are. One reason is because this subject is in the media all the time. Another thing is their experience → retreating glaciers, there are problems with snow and also with making snow.

6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?

Speaking about winter tourism the most popular adaptation measure is making snow and of course they implemented snow making.

The ski area of Scuol did a lot because there is a very dry area, very sunny, exposed to the South. They improved and enlarged the snow making capacities and looking at the plans they have – they want to extend the ski area to another small valley which is now untouched. The valley is high, about 2'200m and it is North exposed. So they try to move the operations higher on the mountain and to include north facing slopes. As compensation, they are willing to give up some of the low line parts of the ski area. That is special. This is a proof that they are really thinking at climate change. They are trying to diversify.

7. What are the **consequences** of these actions for the tourism businesses?

Climate change is not the only factor affecting the tourism in Switzerland. Other thing is the Swiss Franc → less people from abroad come in Switzerland, more people from Switzerland go abroad. Future demand for skiing can be another factor. On a global scale ski demand is stagnating. Skiing is relatively expensive and can become more expensive due to additional transportation facilities and snow making machines that they potentially need in the future. For the same money tourists can go to other places, like Canary Islands. Skiing is not so important in the Swiss culture as in the past → providers are already struggling for customers.

8. What are the **barriers** that can obstruct these measures to be implemented?

Transportation companies can only make money if they transport masses of people going up and down, not only the hiker who buys only one ticket. Therefore they need to keep their core business – that of transporting people. This can be a challenge for them to come up with new offers that bring money. When you look at the cable car companies, of course they try to enlarge the summer business but it does not work only with hikers. An interesting segment is the mountain bikers because they also go up and down many times. One barrier is money, it is very simply.

Another barrier can a short time frame thinking. Climate change is already happening but it will continue. Many companies are struggling to keep up the daily business. They do not have the capacities to do some long term thinking. So the barrier in a few companies is the short term thinking

Another barrier is that many of them are so much depending on winter tourism that they cannot even think of something else. And they invest money to keep this winter business running. They are on a track and it is not possible for them to leave it.
I would not say there is a lack of knowledge. There is a lot of information online, they can observe the market.
It is not easy to replace the ski tourism.

Appendix 5: Interview with Mr. Reto Rupf

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?

It is all about the climate models. Actually I don't know whether it will a little bit drier or not. That is one of the main questions. Another thing, that will affect the region around is the temperature augmentation. But there is a big discussion, this winter time was not snow and even now it is just a little bit of snow. I think in Zuoz they have now artificial snow, they could provide some slopes. Very important is that people like to experience the winter feeling. So the physical impacts, we have the temperatures that will go up, and therefore also species of animals, wildlife could change their behavior. Maybe more humid, more dried, I don't know exactly. An expert in snails made a book about snails behavior in Val Mustair, and he already observed that the snails are going up. The ecosystem as a whole will change.

2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?

I think it is similar, but it also something special in terms that the region is in the inner Alps, and there they don't have that much precipitation. Maybe if there would be a change then the effect will be bigger than in other region. Then also the ecosystem change would be bigger. There would enter some new species. An example is in the Upper Engadine, the ducks were common until 1950. But now they are back there.

3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?

Maybe in Val Mustair there are some difficulties, at least in the low parts, maybe in the area of Tschierv not that much, and the ski area is quite high. Now they have a project to build a cable car from Tschierv to the ski area. I think that there would be a good advice not to concentrate so much on winter tourism, but on the other hand the winter tourists spend more money than summer guests. They have to try to keep their winter business but they have to build not only on skiing so they have to diversify their offers.

In Zernez they have some cross country skiing which could be affected, so in Zernez there won't be so much possibilities for winter sport than it is nowadays. They have also an ice field with artificial ice, so they can maintain it as well.

And the others, like Scuol, F-tan, with the ski businesses will be affected. They have some parts in the higher areas which are quite safe for the next 20-50 years or so. They will be affected but they have the wellness, spa tourism.

In Zuoz there can be some problems because their ski slopes are south oriented. The question is whether the guests will enjoy the white stripes of slopes or not. And maybe there are some economic difficulties to hold this area. Also in the Val Mustair maybe is the same.

4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

I think the activity providers are the most vulnerable. The structure of the destination is different in Switzerland compared with destinations from North America or Northern Europe. There they have companies which provide accommodation, activities, transportation, all in one company. But in Switzerland the hotel is alone; ski school is by itself, private tiny companies. Then there are fewer chances. If your business is affected, then you have to leave. I consider that activities providers are the most vulnerable and affected. If there is no snow, the ski school is closed. Maybe they can change their activities, but with other people. One person who is ski instructor cannot change to be something else.

5. Are the tourism providers of the SNP region **aware** of climate change?

Some of them are aware and are looking for alternatives, like arts or wellness. Hotel Castle in Zuoz is strong related to arts and they have guests who love arts very much. So another sort of winter feeling, not just skiing. In Zernez they are related to the Swiss National Park. This winter, because it was no snow the SNP opened their trails, but I don't know how many people visited it. It is a big question for Val Mustair, whether they should invest in this cable car or no.

6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?

I already told you about diversification. Some change the season, focus more on summer. There were some occasions this year, in a cable care there were mountain bikers, skiers, hikers and snowboarders all together. Maybe that is an option too. It might be a problem if guests will book a winter holiday and there is no snow. You have to change your plans and your mind. You have to provide what you offered to your guests. This winter they had some success. There were no snow in the skiing areas in the Alps, or just artificial snow but they had the frozen lakes. And they forced their

guests to go for ice skating. That was wonderful, but if the guests wanted to go skiing, then it would not be so interesting.
I think about 5 years they started to think about climate change actions.

7. What are the **consequences** of these actions for the tourism businesses?

Maybe they have to implement new structure, or to think about new alternatives and to reposition themselves. I think with this diversification there will be a decline, and also tourists will not feel so comfortable. At least the next 10 years the winter feeling will be in tourists and they will still want to have winter time, winter vacation. I think that in the future the interest of tourists for ski and winter sports will be smaller. Some will go to higher altitudes but the amount of skiers will be smaller. There will be new chances in the summer tourism.

8. What are the **barriers** that can obstruct these measures to be implemented?

The lack of money to make investments. It is difficult to gain money to make investments. The main investment is free of charge and it is the investment of changing mentalities.
This year it was also a problem with water supply, because the summer was very dry and the autumn also quite dry.

Appendix 6: Interview with Mr. Hans Lozza

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?

There are the same like in other regions. We have less snow and for shorter periods, we have higher average temperatures, more rain and more extreme events, it can be for a long time very dry and warm and sudden very heavy precipitation. In the last 3 years we had no snow around Christmas, this is really extraordinary. The ice coverage on the lakes starts later and stops earlier than years before. This is registered. The period of ice is much shorter than it was years ago. There are no glaciers here in the region, so it is difficult to say if there is a change there but we are depending on the glaciers that are higher up, because we get the water from there. At the moment we have very low water in the River In which comes down from the Upper Engadin. So this is something that will be a problem in the next hundred years, because we are highly dependent on that water. This is what I see and which is also measurable.

In the last November we had the highest temperature ever measured in November, so this was an absolutely record.

In this region there are only small glaciers, but if you look on the map, 50 years ago there were many more small glaciers that have disappeared.

2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?

The only thing that I can say, this is a very dry region because it is in the inner Alps, protected around and around by the mountains and because of that we have low precipitation, that means for Zernez for instance is just around 700 mm/year, which is very low, therefore we are very depending on the water from the glaciers. For the rest it is the same thing like in other places in the Alps. Peculiarity is really the dry situation.

3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?

If you don't have snow it is very difficult to do snow sports, you need lots of technical snow, at the moment for instance (15 December 2015) everything for skiing is technical snow, also for ski country, for sledding. So all these winter sports could not happen without technical snow. This shows how highly dependent we are on the technical snow whose production process is not sustainable at all. On the one hand side we should try to avoid such energy intensive activities, on the other hand we are talking about sustainable tourism and these don't go very well together. Tourists want to ski and the providers want to offer them the possibility and the consequences are that we use much more energy, and that we are highly dependent on water and electricity. This will cause problems with water and electricity supply. For example at the end of this winter, if it will continue to be so dry we will have a problem with not enough water and not enough electricity.

At the moment the question is if the tourists come to do winter sports on technical snow, or do they go to other places. So, without snow there is a problem for winter sports. It is however difficult to explain the drop in the tourists number in the last years, is it due to the lack of snow or due to the strong Swiss Franc.

4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

Vulnerable is the whole tourism sector, because if the tourists don't come, they don't consume, don't sleep, don't eat.

I would say that accommodation and winter sport providers are the most vulnerable but also the restaurants.

5. Are the tourism providers of the SNP region **aware** of climate change?

Many of them are, but maybe they still believe that the situation will go like it was before. They continue to invest in the winter sport activities which are very costly and energy intensive. Many people discuss about sustainability but in the end they go on like they did before. There has not been a change in what is offered to the guests, a really fundamental change has not happened. In certain areas, they try to put more people on public transportation. So small steps are made, but in general there is the same tourism as it was 50 years ago. Maybe they are aware, but they don't do a lot.

6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?

There are much more winter walking possibilities because there are more elderly people who want to walk also in winter. I don't see a different tourism. It is still based on winter sports, because winter sports are economically profitable, but also very cost intensive. In region Tschierv – Val Mustair they do a lot of investments, they want to make a new track to go up, and more technical snow, so although there is a small area where sustainability could be implemented, they prefer to invest in traditional measures.

Winter walking started 10-15 years ago to be more attractive, due to more elderly people and less snow in the winter. Scuol Tourismus tries to convince more people to come by public transportation through attractive ticket rates, sustainability is only possible if the guests also try to change something. Sustainability cannot happen overnight, it should be step by step from both sides (supply and demand). For Scuol skiing is very important, without ski, it would collapse. The alternatives are not there at the moment.
In Scuol, they try to promote health tourism; this can be an alternative for people who don't want to ski to come here. They made good steps in this direction last years.
In Zernez, through the program Zernez Energia 2020 they try to reduce the consumption of fossil fuels and to use alternative energy.
In Zuoz is quite similar to Scuol, they have a small skiing area, they focus more on families with children, ski schools.

7. What are the **consequences** of these actions for the tourism businesses?

Scuol Tourismus wants to have a more sustainable tourism and try to persuade guests to do other activities, therefore with the time they would be less snow dependent, but they need to develop alternatives – winter walking is one, maybe there are different ones.
Regarding tourists, the question is if they accept the new offers from the providers, or just move and go skiing in some other resorts.
For example, if you are a sustainable region and do not produce technical snow, you can lose guests who want to ski.
It is easier for tourism providers to produce snow, electricity and water for trying to maintain at least a part of what they had before.

8. What are the **barriers** that can obstruct these measures to be implemented?

Some people (tourism providers) do not really accept the pressure of climate change. Others can say that the environmental organization is responsible for the ecological problems of the region because they try to avoid more technical installation. There are also some people who say that climate change does not exist, and it has been invented by some environmental organization. Although quantitative measures show that there is a change, some people do not want to see it → this is the main barrier. And they don't believe that there are some alternatives, saying that sustainable tourism is nothing at all.
Money can be another aspect: if you don't earn money with conventional tourism, you cannot invest in other forms. At the moment nobody is willing to invest. This is a very dangerous situation at the moment.

Appendix 7: Interview with Ms. Constanze Conradin

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?

In the future there will be less snow. Not that regular as it was in the last years. A long time no snow and when it comes, it is a lot of snow, or a little, but not regular. Also permafrost will melt. Correlated with the melt of the permafrost, there can be some rock falls.

2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?

In general it would be similar with the rest of Alps. The Unterengadin (from Zernez to Scuol) and from Scuol to Innsbruck is a Central Alpine area with a continental climate already, but maybe in the future it will be more extreme also there.

3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?

There will be fewer tourists. Nowadays there is the possibility to book a hotel one day before and if you know that there is no snow, then you don't go. When there is no snow here, people are not coming and go to other places. It could be that the behavior of tourists will change (there would be tourist willing to do hiking and which are happy that there is no snow). This takes time, and maybe in 50-100 years ski and snowboarding will not be that popular anymore. In the next years it would be a big problem for tourism providers.

4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

Most affected are the winter activities providers. Then there are the hotels.

5. Are the tourism providers of the SNP region **aware** of climate change?

The big tourism providers are aware.

6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?

They use snow making machines since 10 years ago. Recently, they have connected pipelines to the water supply.

Many providers such as Minschun (ski area) began to make snow earlier, around October, by using the water from the small lakes to be sure that they will have snow. They create a big mountain of snow and when the ski season starts they take the snow and put it on the slopes. However, they can only make snow if the temperatures are low enough. This was a very big problem also last year here in Val Mustair when the temperatures until December were not low enough to make snow.

Also the accommodations maybe try to provide some alternatives, to diversify their offers.

7. What are the **consequences** of these actions for the tourism businesses?

For the tourism providers there is more cost, for making the snow.

For the tourists, there are some who don't like the artificial snow and that everything is brown and only one slope white, and others who don't care if it is artificial snow.

8. What are the **barriers** that can obstruct these measures to be implemented?

One of barrier is the cost.

Another is the nature based NGOs, like Pro Natura. They do not agree to make artificial snow, because in this snow there is a kind of chemical for the snow to last longer. These NGOs don't want that artificial snow is produced. The need is so high for the artificial snow, but they try to do something.

In general I think climate change will be a problem for this region.

Appendix 8: Interview with Ms. Therese Lehmann

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?

There will be increasing temperatures in all seasons for the Canton and in winter until 2050 between 0.9 to 3.4 degrees Celsius, and in winter there will be more precipitations, that could be a plus of 26% which means that at higher altitudes it will be in form of snow and at about 1000m will be more in rain and in summer is a tendency of decrease of precipitation, it could be between -6 to -36%. This scenario comes from the assumption that the emissions will be constant, which is not really realistic; we think that the emissions will increase.

2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?

It is in a way similar with the rest of Swiss Alps, but higher located ski resorts like in Graubünden have a real competitive advantage compared with the Bernese Oberland or with Austria. So Graubünden and Valais will be the winners of Europe. There is also an advantage in summer because of the higher temperatures, so we have this National Park region where in summer is a cool area. But I think there are no more special issues there.

3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?

The area is a little bit independently affected by climate change, is the fact that ski sports is a shrinking market, mainly in Switzerland. People have a lot of other options, like spending their holidays in warmer areas, in Caribbean during winter, mainly for the same price, and also people don't want to ski every year in the same region so they try different regions. Regular customers become rare. Skiing becomes less and less popular. There are also some new ski resorts opened in Eastern Europe, in Azerbaijan, where you thought that will never be ski tourism. There is an oversupply, too much ski resorts. It this region, which is really high 2-3'000m currently there is not really climate change, it is more the economic factors. It is also the distance from big cities; people have to drive too much.

4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

First of all there are the cable cars in winter; they need high investments (intr-un studio se vorbeste despre asta, la adaptation measures pt ski lifts, si compara cu ski school ☺) to have the newest technical standards to be competitive with other regions. They need to have snow and this season was extremely hot, they have no other possibilities. If the business of transportation providers is not doing well, the next affected is the accommodation sector, and all other actors, the whole supply. But the cable cars are really the most important actor and the others are dependent of the cable cars. (BARRIER) Moreover with this artificial snow, there is the question of how sustainable this strategy is; (RECOMMENDATION OF MEASURE) maybe it would be better that the region would promote more nature, silent, wellness tourism. There is really a challenge, because to obtain the similar added value like the ski sports, there are rare alternatives. With winter sports you can sell clothes, tickets... It is really a big economic machine. It would be a chance for this region to make the summer season longer. It can be a problem that some hotels close in September but maybe some tourists want to go there.

5. Are the tourism providers of the SNP region **aware** of climate change?

Yes, of course. They know a lot about climate change. However, knowing and acting is not the same. They know but they do not really act like they should. But there are some good examples of mitigations, like the Energy Plus hotel in Muottas Muragl (in Samedan), there are several photovoltaic systems. Scuol for example has this luggage transport – you can give your baggage to the train and go to the destination without baggage. To be proactive it needs time, and good planning, and innovative heads and money and all these are rare in tourism. You have other problems, like the strong Swiss franc, and you think in the short run that the tourists have to come at your place, and you might not have time to think for the long term problems, like climate change. 10 years before.

6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?

The most adaptation measures are in the field of diversification of supply, like wellness in Scuol, biking in the valley of Mustair. Then the snow guarantee in winter is the main adaptation measure. All these measures are so called "low regret options", meaning that if climate change does not occur as predicted, the measures are still helpful for the development of the region. So these measures are not really only because of climate change. Climate change plays a role, but it is more to develop the whole touristic destination. Real adaptation measures because of climate change are more in the field of natural hazards. So you have to have buildings, and to reduce the risk of natural hazards. But in tourism, the adaptation measures are the "low regret options". A third of the water used in Scuol is for making artificial snow.

7. What are the **consequences** of these actions for the tourism businesses?

Investments for adaptation measures will be enormous to maintain the snow guarantee, and the question is who pays: is it the public sector or it should be the hotels because they profit also from the artificial snow. This will be a huge discussion. And with increasing natural hazards other investments for reducing risk will also be expected. For my PhD I asked some experts and they said that in winter the investments for climate change should be at around 10-20% and in summer between 5-10%. This was the question for the year 2030.

In the end, with these huge investments it really is the question why you don't choose extreme strategies in this region, you can probably get off the tourism and get in probably wild nature zone or something like this. What is the sense when you have only costs?! This National Park region could really be a wild nature zone and you could do some exciting expeditions. Or you also look to work with other sectors, with the energy sector, but it is quite difficult.

8. What are the **barriers** that can obstruct these measures to be implemented?

I think in Swiss tourism, there is really a lack of innovation capability to develop new products or to shift from the winter season to the summer season. It requires new business models, cooperation with other sectors, lateral cooperation, and also horizontal cooperation over other destination, over canton. The structure of the destination is often historical; people won't change anything in the structure. It is a little bit characteristic to the Swiss people in the Alps to be conservator, they don't like to change too much, there is a resistance to change.

Appendix 9: Interview with Mr. Claudio Daguati

1. What are the **physical impacts** of climate change in the SNP region, in the winter season?

We can observe that the temperature is rising, permafrost is melting in the summer time, the snow level is higher, and our ice rink in Tschierv is more closed than open. And it rains more than it snows.

2. Does this area have some **peculiarities** in terms of the physical impacts, or it is similar to what happens in the rest of the Swiss Alps?

I think it is similar. Maybe we have to think that we are on the South Alps and there could be some differences, but I could not tell you the specific differences. But we are more influenced by the south, also for the snow, precipitations and if you take Scuol the valley is East-West oriented and they are more influenced by the north.

3. How is the **tourism business** in this area (which includes municipalities such as Zuoz, Zernez, Scuol, Val Mustair) affected by the above named impacts, in the winter season?

For us, in Val Mustair this year the ski resort opened only on 15th of January, so during Christmas time, when the high season is, the ski resort was closed and especially for transport facilities, restaurants, that was not running, so that was a big impact for us. In our valley we don't have a lot of snow making machines, there is not enough water. There is a problem with the water supply. The temperature was not too high for snow making, but there was not enough water in Val Mustair. In Scuol and Zuoz they produced snow and they could open the ski resort. For us, the people who work in the resort had nothing to work. And I think now, especially in January people look where the slopes are open and good, and I think that less people came because of bad conditions and not proper facilities. Last weekend in the ski resort I was the only tourist; it was only one slope opened, and that was not in a good form.

Usually we open the ski season on the 15th of December, but this was the first year we opened on the 15th of January. Last two years, since I am here, it always snowed in December, just 2 or 3 days before Christmas. Last minute snow came.

Another thing that we feel, we had the world cup event, the cross country ski event in Val Mustair last year, and we had no snow and we had to produce all the snow for the event. It was a challenge because the temperatures were too high and the cost for snow making is high. 15-20% of our budget of approximately 1 million CHF for the event was used for snow making.

And the hotels, they do alternative offers for the guests; you could see people with their mountain bikes during Christmas time.

4. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

I would say the ski schools, ski instructors. If there is now snow, they sit and wait, they are not paid. Even if the ski resort is open, but the conditions are bad, there are also less people coming.

For our valley could be also a challenge that we are very close to big ski resorts, such as Livigno, Scuol-Samnaun, Sudtyrol, which are not more than 1 hour far away.

What we observe this year is not only for alpine ski but also for cross country skiing, we didn't really have slopes until the 16th of January. We had only one of 700m.

5. Are the tourism providers of the SNP region **aware** of climate change?

Well you can see the investments that are made now, for example in Sankt Moritz they built a big artificial lake for snow making, in Scuol they are planning to do some pipelines to take water from the mountain. I would say that the ski resort does more than the hotels.

6. **Have** the businesses from the SNP region already **implemented adaptation measures** with regards to climate change impacts? If yes, what **types of measures** and **since when**?

The ski resorts make the things I said earlier, and then there is the diversification of offers. A good example was this winter in Sankt Moritz on the frozen lakes. They brought down some bars next to the lake and there were hundred people ice skating. Also in the upper part of the Engadine they made like an ice ring you could skate down. You can see that they try to create more alternatives.

I would say that these actions started this winter, because last years the snow came. Sometimes the snow came later like in December or January but this year it didn't come at all.

We (Tourismus Engadin Val Mustair) are prepared to these situations, because we had this in the last years, it is not the first time. We send to hotels some briefings, what they can offer, alternative programs, that are not dependent on snow, like museums, walking paths. Last week I had a meeting with ski resort and with a ski school owner and we made a program for this week; in the morning was skiing and in the afternoon one day was sledging, one day cross country ski, the other day was snow shoes walking. We consider that if it is only one ski slope we cannot pretend that tourists ski seven days always on the same slope. We developed an alternative program. They did also for the ski school during Christmas, so one day they did llama trekking, one day they did painting so for kids was very good.

7. What are the **consequences** of these actions for the tourism businesses?

If you have these alternatives, there were not a lot of complaints from tourists. We had a lot of complaints when the ski resort closed on Sunday although they said that they will close on Monday. We (Tourismus Engadin Val Mustair) were not informed and tourists were also not so well informed. So if there is a negative atmosphere and you do something like this, the reactions are very tough.

Another consequence is given by the rising costs, of course, for the whole snow making, water, energy, and then the tickets become more expensive. If we don't make snow then people go to other resorts. At the moment the tourists that come to our region, they want to ski.

Impact to the landscape it is also a consequence. For example I was last summer in Samnaun and there you can see that the winter sports are there: a lot of ski lifts, and the ground were they made the pipelines is affected, the grass is not growing. In Val Mustair not, because at the moment the ski resort does not invest in facilities there are still like 30 years ago. But the resorts like Samnaun, Scuol, St. Moritz, if you go there in the summer, you see the impact. For example the lake in St. Moritz has now the size of 5 or 6 football fields.

8. What are the **barriers** that can obstruct these measures to be implemented?

Cost is a big barrier. Resorts such as Scuol, Samnaun have other possibilities to invest compared with the Val Mustair. The smaller resorts will face a challenge to invest in facilities.

Other barrier can be the nature protection. In Val Mustair we are in a biosphere, and here we have to work with these nature protection organizations, like Pro Natura. In a biosphere we are more restricted that in other regions.

At the moment, water supply is also a barrier too. I know that in Val Mustair they plan to build pipelines to the ski area. We don't have many slopes, and if we had enough water we could open all of them, but this winter they could open nothing with artificial snow or they couldn't cover the whole slope with artificial snow.

I think that the artificial snow is better that natural snow. The quality is better, it is more compact. The people who want ski on slope they accept it. Indeed, if you want to ski off-slope, then you need natural snow. The problem is when there is only a white stripe on the slope, and the rest is green, then the people are not happy. And also maybe when they see the snow machines working when it snows, the people might be not so happy too.

Appendix 10: Interview with Mr. Adrian Lehmann, Hotel Altana

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?

I think yes, the business is affected by climate. If you ask about the climate change, as you do, it is hard to answer because you cannot properly say if the current, and I am speaking about the last 2 years with low snow or no snow incoming is due to climate change. Definitely, the snow condition, which is coming late, is affecting the season. If it has a direct connection with climate change, that has first to be proven. It is hard to prove that there is a climate change although I am convinced there is a climate change.How is it affected: not necessarily less guests, although this year yes, but also in connection with economic factors, such as exchange rate Euro – Swiss Franc. Otherwise, strictly referring to the weather, the people book shorter holidays.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?

Higher temperatures are of course related to the amount of snow. If snow does not come, definitely there is an impact. No snow means that they have hard times to prepare the ski slopes – less ski slopes means less guests.

Higher temperatures mean also a direct impact on us, the hoteliers and indirectly, with higher temperatures the cable cars and those who take care of the ski slopes have a hard time to make artificial snow. If you don't have a low temperature it is hard to produce artificial snow.

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?

We definitely recommend the guests alternatives towards what they can do with the current snow situation. So, instead of selling the guests ski pass included, we say to the guest that if they cannot go skiing, we have the option of cross country ski, winter walking, hiking, ice climbing, so different options which are not direct related with having enough snow.

4. What are the **drivers** that determined your business to implement these measures?

Less snow, less guests means to acquire guests from other places, or for other purposes. If the guests want to do winter holiday, we need to offer them an alternative. So we have to get guests which are not necessarily skiers, but they do also alternative sports.

5. **Since when** did you start doing these actions?

We as a hotel started to really push these alternatives starting with this year. The options were there before, but as it was not much need for them we did not push them or promote them to the guests as we do this year. I would say that we started this year.

6. What are the **consequences** of your actions for your business?

The guests discover the Lower Engadine in a different way. As we have several returning guests, coming since many years for skiing, they go and take the other options we propose to them, and when they come back to the hotel they tell us that it was beautiful, amazing, we learnt something new. Tourists start to know the valley from a different point of view, apart from the ski area.

Currently there are no direct benefits for your business, but the measures increase the guests' satisfaction. We will probably have further bookings from the same guests.

7. What are the **barriers** that can obstruct these measures to be implemented?

There might be different points like political issues, laws which prohibit certain things, like you might not be allowed to make a walk through this or that area due to wild protected areas. That might be obstacles for alternative offers.

Other things are local political things, like people are not working as well together as they could, low cooperation.

Most obstacles are rules, regulations, laws which are in the way to come up with something.

It also can be the fear of some companies for example to be sued. An example can be when somebody has an accident on a ski slope by not making ski things and the cable cars company allows it but did not offer protection, so at the end insurance might say that they don't pay.

8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

I think the whole region is vulnerable. I say that if the guest is not with us in the hotels, apartments, holiday houses, then the guest is nowhere. If the guest doesn't come in the valley, everybody loses. I as an hotelier will lose the overnight stays so if the guest is not here, he cannot spend money on the ski slopes, or for launch, or for buying new clothes in town. It will economically affect the whole businesses. In our region there are only very, very few people which are somehow not connected to tourism. We all together live from tourism.

If we have fewer guests, we have fewer funds to keep and maintain the area, so nature itself will suffer.

Appendix 11: Interview with one representative from Bergbahnen Zuoz

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?

Of course we are affected. If we don't have snow we cannot go ahead. We need the tourists; we do not have anything else. There are less tourists coming when it is less snow. In the winter time, the tourists want to ski and need the snow, and they are going where the snow is.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?

We can only make snow if the temperature is lower than minus 4 degrees. If it is not that cold, we cannot even make snow. It is all about the temperature.

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?

We can just make snow, we cannot do anything else. We wait until the temperature is low enough.

4. What are the **drivers** that determined your business to implement these measures?

If there is no snow, tourists don't come.

5. **Since when** did you start doing these actions?

It is about 30 years ago, but in the last years the process is more intensive due to warmer winter periods.

6. What are the **consequences** of your actions for your business?

For the tourists I think there is no difference whether there is artificial or natural snow. It is very important to have snow. I don't think people ask there if the snow is artificial or not.

7. What are the **barriers** that can obstruct these measures to be implemented?

The temperature is a big barrier. Then there is the cost, but if we don't make snow, then we don't have any income. At the moment we don't have big problems with the water supply.

8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

I think it is like a circle: if the snow does not come, the tourists don't come so the hotels won't stay well and so on. We don't know how to stop it. For the whole valley Engadine climate change is a big problem.

Appendix 12: Interview with one representative from one hotel from Scuol

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?

Our hotel personally, is not too much affected. Of course we feel some differences, but we are not really affected. It is true that in our restaurant we had less to work, but not in the hotel. We don't feel that there are less guests coming because there is warm. We are more affected by the strong Swiss Franc. Here is Scuol, the people come the whole year because we have the spa, and people can walk. It is too early for this time changing. 60-70 years ago it was also the weather like this, so... We will see what the nature has to offer.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?

The lack of snow has the biggest impact. The winter starts too late, but people know that it is not the hotel's fault. At the moment we have nice weather, good snow. For the winter there is not a problem, there was only for December. The winter lasts 4 months, not just 2 weeks. Winter we always have.

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?

We have program of activities for our guests we play eisstock, some kind of curling, but special actions for the nature we don't do anything.

We don't do anything to reduce energy consumption, because we don't have the money for it. If there is something that does not involve costs we do it, like sorting the rubbish.

4. What are the **drivers** that determined your business to implement these measures?

-

5. **Since when** did you start doing these actions?

-

6. What are the **consequences** of your actions for your business?

-

7. What are the **barriers** that can obstruct these measures to be implemented?

-

8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

-

Appendix 13: Interview with one representative from one hotel from Scuol

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?
I do not know whether it is climate change. We have had just 2 winters with very late snowfalls. This does of course depend on the workload. We have had a big slump this year in the first 3 weeks.
2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?
No snow = no skiers.
3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?
We have offered a wide variety of events for our guests for the days without ski.
4. What are the **drivers** that determined your business to implement these measures?
The lack of snow.
5. **Since when** did you start doing these actions?
Starting with the 24th of December 2015.
6. What are the **consequences** of your actions for your business?
Guests were occupied and consequently less frustrated that they could not ski.
7. What are the **barriers** that can obstruct these measures to be implemented?
There is no barrier for us to do these events.
8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?
All the sectors are equally vulnerable.

Original answer in German:

1. Glauben Sie, dass sich der Klimawandel in der Wintersaison auf Ihr Unternehmen ausgewirkt hat? Wenn ja, wie?
Ich weiss nicht ob es Klimawandel ist. Wir haben einfach 2 Winter mit sehr späten Schneefällen gehabt. Das wirkt sich natürlich auf die Auslastung ab. Wir haben dieses Jahr in den ersten 3 Wochen einen grossen Einbruch gehabt.
2. Welche physischen Auswirkungen der Klimawandels haben den grössten Einfluss auf Ihr Unternehmen in der Wintersaison?
Kein Schnee = keine Skifahrer
3. Hat Ihr Unternehmen Anpassungsmassnahmen im Bezug auf die Auswirkungen des Klimawandels getroffen? Wenn ja, können Sie Beispiele für solche Anpassungsmassnahmen nennen?
Wir haben ein grosse Auswahl an Veranstaltungen für die Skifreien Tage für unsere Gäste angeboten.
4. Was waren die Auslöser, die Ihr Unternehmen dazu bewegt hat, diese Massnahmen einzuführen?
Kein Schnee
5. Wann haben Sie begonnen diese Massnahmeneinzuführen?
Ab dem 24.12.
6. Was sind die Auswirkungen dieser Massnahmen auf ihr Unternehmen?
Die Gäste waren beschäftigt und demzufolge auch weniger frustriert, dass sie nicht Skifahren konnten.
7. Welche Faktoren können diese Massnahmen vor der Realisierung hindern?
Keine
8. Welcher Sektor in der Region des SNP (Unterkunft, Transport, Aktivitäten, Anbieter, etc.) ist durch die Auswirkungen des Klimawandels im Winter besonders gefährdet?
Alle gleichermassen

Appendix 14: Interview with Mr. Baumgartner, hotels owner from Scuol

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?

Yes, I think we are affected but I think we are positive affected. Our ski area is high, starts at around 2'000m and we are sure we have snow in the future even if the climate change occurs. I think we are not negatively affected by climate change. Maybe not positive but really not negative. Compared with other areas which are quite down, we are not negative affected.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?

We have a program through which we should reduce the fossil energy consumption. We are using alternative energy, solar power, isolate more the houses, and so try to consume less oil. Even with the CO2 reduction we get the money back if we reduce it. It is a program which a lot of hotels do in Canton Graubunden. We earn a lot of money if we do something regarding the climate change, if we reduce the CO2 emissions. We have on our agenda some steps to reduce the oil consumption.

4. What are the **drivers** that determined your business to implement these measures?

The money. We get the money back from the Government if we do some things about CO2 reductions so we can get in return money of less oil we use; we have to spend less money on oil.

5. **Since when** did you start doing these actions?

2 years ago.

6. What are the **consequences** of your actions for your business?

I hope the reputation of our hotels goes up. I am not sure if the customers looking at this issue are booking or not, but it is a good image of our hotels in front of the customers. I am not sure if the clients book or not because of this reason.

Another consequence is that we pay less money so we have less costs, I have to use less oil.

7. What are the **barriers** that can obstruct these measures to be implemented?

The oil price is so much down right now; nobody is interested to reduce the oil consumption. But this is a short view. Now the oil is really cheap.

Costs for being part of this program can be another obstacle. Some hotels which don't have money at the moment cannot invest in this program. I my business model, I have a long term vision, I invested the money, it costs me but I hope in the future it reduces my costs. Many hotels have problems with cash flows, now.

8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

For our region I am not that worried, at least for the next 30-50 years. As I told you our ski areas are quite high in altitude. I think Scuol is not affected by climate change right now.

Appendix 16: Interview with one ski instructor from Scuol

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?
Yes, this definitely affects, in particular the fact that the region in autumn / early winter is no longer guaranteed snow.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?
The winter in our area is shortened continuously and lacks sufficient amounts of snow. Even in the lowlands is hardly any snow, which reduced the desire to winter sports.

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?
No, because we are only a very small providers and the ski school is only secondary occupation in winter.

4. What are the **drivers** that determined your business to implement these measures?
-
5. **Since when** did you start doing these actions?
-
6. What are the **consequences** of your actions for your business?
-
7. What are the **barriers** that can obstruct these measures to be implemented?
-
8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?
The most vulnerable are the activities providers, then probably the hotels

Original answer in German:

1. Glauben Sie, dass Ihre Skischule wird durch **den Klimawandel** in der Wintersaison ausgewirkt? Wenn ja, **wie** wird sie ausgewirkt?
Ja, dies wirktsichdefinitivaus, insbesonderedadurch, dass die Region imHerbst / Frühwinternichtmehrschneesicherist.
2. Welche**physischeAuswirkungen des Klimawandels**haben den größtenEinfluss auf IhrGeschäft in der Wintersaison?
Der Winter in unseremGebietverkürztsichstetig und esfehlengenügendeSchneemengen. AuchimUnterlandliegtkaumSchnee, was die Lust auf Wintersportverringert.
3. Hat Ihre Skischule diesbezüglichschon **Massnahmen**ergriffen und umgesetzt? Können SiebitteeinigeBeispiele von Anpassungsmaßnahmen?
Nein, da wirnureinganzkleinerAnbietersind und die SkischulelediglichNebenerwerbim Winter ist.
4. Was sind **die Treiber**, die IhrUnternehmenentschlossen, dieseMaßnahmendurchzuführen?
-
5. **Seitwann**wurden die Massnahmenergriffen und umgesetzt?
-
6. Was sind**die Folgen**IhrerAktionenfürIhrUnternehmen?
-
7. Was sind**möglicheBarrieren**, die verhindernkönnten, dasssolcheMassnahmenumgesetzt warden?
-
8. Welcher**Sektor**(Unterkunft, Transport, AktivitätenAnbieterusw.) ist der von den Folgen des Klimawandel in der Wintersaison am anfälligsten in Ihre Region?
Am Meistenwirdes die Aktivitäten der Anbietertreffen, danachwohl die Hotellerie.

Appendix 17: Interview with one representative from a ski school Zuoz

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?

That's hard to say. On the one had the ski school is affected by climate change; on the other hand we are affected by the strong Swiss Franc. Of course, when the people see everything green and only one white stripe, it is not that attractive to come up and to take the lessons. Also people don't feel safe when they only see the white stripe. They told us in December that if they fall out of the slope they can get injuries.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?

I would say that the fact that it is less snow has the greatest impact on our ski school. The tourists like when it is warm, and they can ski in T-shirt, but when we don't have enough snow, they say that it feels like summer. When it snows too much the tourists also don't come because they cannot see well, it is dangerous.

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?

We had an event on the 30th of December, a duathlon, we started a race where the people had to go up by mountain bike, and then to come down by skiing. It was like a joke, because we didn't have snow so we had to look for an alternative, go biking, and go hiking. We had around 50 competitors.

4. What are the **drivers** that determined your business to implement these measures?

We have to diversify somehow the offer, to offer an alternative due to the lack of snow and also because tourists may be afraid to go on the slopes with few artificial snow.

5. **Since when** did you start doing these actions?

It is my first season here and this is the first event that I know.

6. What are the **consequences** of your actions for your business?

Tourists were very excited, some of them were "Wow, we go biking in the winter!". We have to offer them something.

7. What are the **barriers** that can obstruct these measures to be implemented?

It is a lot of work to do these kind of events.

8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

I would say all of them. They have to work together because they are in the same situation. If one doesn't work, the rest won't work as well. They are together in a way they don't see maybe, but in my opinion they are all important.

Appendix 18: Interview with one representative from a ski school Scuol

1. Do you think your **business is affected** by climate change in the winter season? If yes, **how** is it affected?

Yes, at the moment we have losses in December, so we could not have so much teachers (instructors) this time. We are getting smaller and smaller.

If it would be in the area more companies with snow making machines then we'll have not so big problems.

2. **What physical impacts** of the climate change have the greatest impact on your business in the winter season?

As a ski school, if we have no snow we cannot do anything.

3. Has your company implemented **adaptation measures** with regards to climate change impacts? Can you please give some examples of adaptation measures?

We can't make the snow; this is an action of the lift company, not ours. The effect from climate change is that we are getting smaller and smaller.

4. What are the **drivers** that determined your business to implement these measures?

-

5. **Since when** did you start doing these actions?

-

6. What are the **consequences** of your actions for your business?

-

7. What are the **barriers** that can obstruct these measures to be implemented?

-

8. Which sector (accommodation, transportation, activities providers etc) is **the most vulnerable** to the climate change effects in winter, in the SNP region?

-

Appendix 19: Analysis of physical impacts of climate change in the SNP region

Physical impacts of climate change in the SNP region, in the winter season – Interviews with tourism experts

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
B. Abegg: *R1.The most important impact is impact on snow cover.* *R4. They have less snow.* ***C. Conradin:*** *R1.There will be less snow in the future.* ***H.Lozza:*** *R1. We have less snow and for shorter periods.* *R4. In the last 3 years we had no snow around Christmas* ***R.Rupf:*** *R3. This winter time was not snow and even now it is just a little bit of snow*	Less snow	B. Abegg **reduction** of R1 and R4 in the same code for having the same meaning H. Lozza **reduction** of R1 and R in the same code for having the same meaning. **Explanation**: By *impact of snow cover* B. Abegg means that there is less snow		Confirmed by Bürki et al. (2003, December) Matasci (2012
B. Abegg: *R5. They have less water.* *R6.Another impact could be on water availability.* *R7.In the ski area of Scuol they are struggling to have enough water to make snow.* ***H.Lozza:*** *R9. At the moment we have very low water in the River In*	Water scarcity	B. Abegg reduction of R5, R6,R7 in the same code for having the same meaning		Confirmed by Matasci (2012)
B. Abegg: *R7.Year 2015 was very dry.* *R8.Climate scenarios say that it will become drier in summer* ***R.Rupf:*** *R8. Maybe more humid, maybe drier, I don't know exactly.*	Dryness	B. Abegg **reduction** ofR7 and R8 in the same code for having the same meaning. **Scaling** applied on this code: 1st: It will become drier (B. Abegg R8) 2nd: Uncertainty, it can be more humid or drier (R.Rupf R8)		Confirmed by Matasci (2012) Pütz et al. (2011)
C. Conradin: *R4. (Correlated with the melt of the permafrost) there can be some rock falls.*	Increase in frequency of hazardous events (floods, landslides, falling rocks)			Confirmed by Matasci (2012)
C. Conradin: *R3. Also permafrost will melt* ***C. Daguati:*** ***R1:*** *We can observe that*	Permafrost melting			Confirmed by Bürki et al. (2003, December) Matasci (2012)

permafrost is melting in the summer time				
C. Conradin: *R1.Not that regular as it was in the last years – long time no snow, then lots of snow, not regular.* ***H.Lozza:*** *R2. More extreme events.* *R2. More rain.* *R3. It can be very dry and warm for a long time and sudden very heavy precipitation* ***Ms. Lehmann:*** *R2. In winter there will be more precipitations, that could be a plus of 26% which means that at higher altitudes it will be in form of snow and at about 1000m will be more in rain.* ***C.Daguati:*** *R3: it rains more than snows*	Changing weather patterns	H. Lozza **reduction** ofR2 and R3 in the same code for having the same meaning.		Confirmed by Bürki et al. (2003, December) Matasci (2012)
H. Lozza: *R2. We have higher average temperatures.* *R13. In the last November we had the highest temperature ever measured in November, so this was an absolutely record.* ***Ms. Lehmann:*** *R1. There will be increasing temperatures in all seasons for the Canton and in winter until 2050 between 0.9 to 3.4 degrees Celsius.* ***R.Rupf:*** *R2. Another thing, that will affect the region around is the temperature augmentation.* *R6. We have the temperatures that will go up.* ***C. Daguati:*** *R1: We can observe that the temperature is rising*	Increasing temperatures	H. Lozza **reduction** ofR2 and R13 in the same code for having the same meaning. R. Rupf **reduction** ofR2 and R6 in the same code for having the same meaning.		Confirmed by (Abegg, Bürki, & Elsasser, n.d.) (Wyss, Abegg, & Luthe, 2014)
H.L: *R5. The ice coverage on the lakes starts later and stops earlier than years before. The period of ice is much shorter than it was years ago* ***C. Daguati:***	Shortage of ice coverage period			Not existent in the literature review of this master thesis

R2: *ice rink in Tschierv is more closed than open*				
H.L. *R15. In this region there are only small glaciers, but if you look on the map, 50 years ago there were many more small glaciers that have disappeared*	Melting glaciers			Bürki et al. (2003, December) Matasci (2012)
R.Rupf: *R7. Species of animals, wildlife could change their behaviour.* *R10. The ecosystem as a whole will change.*	Changes in scenic beauty	R. Rupf **reduction** of R7 and R10 in the same code for having the same meaning.		Matasci (2012)
C. Daguati: ***R2:*** *the snow level is higher*	Increase of snow level			
H.Lozza: *R1. We have less snow and* ***for shorter periods.***	Reduced snow season			Bavay et al. (2013)

Appendix 20: Analysis of peculiarities of the SNP region

Peculiarities of SNP region regarding climate change impacts - Interviews with tourism experts

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
B. Abegg: ***R1:*** *special about this area is that it is dry* ***H. Lozza:*** ***R1****: this is a very dry region because it is in the inner Alps* ***R3****: low precipitation* ***R4****: for Zernez, for instance is just around 700 mm/year, which is very low* ***R6:*** *Peculiarity is really the dry situation.* ***R. Rupf:*** ***R2****: they (SNP region) don't have that much precipitation*	Dryness	H. Lozza **reduction** of R1, R3, R4 and R6 in the same code for having the same meaning		Pütz et al (2011) (MeteoSwiss, 2014)
R. Rupf ***R3:*** *(they don't have that much precipitation) then the effects will be bigger than in other regions.* ***R4:*** *also the ecosystem change could be bigger.*	Dryness → stronger impacts	R. Rupf **reduction** of R3 and R4 in the same code for having the same meaning		
T. Lehmann: ***R1.*** *higher located ski resorts like in Graubünden have a real competitive advantage* ***R4****: There is also an advantage in summer because of the higher temperatures, so we have this National Park region where in summer is a cool area*	High altitudes – not so strong impacts	T. Lehmann **reduction** of R1 and R4 in the same code for having the same meaning Explanation: Ms. Lehmann says that due to high altitudes the SNP area has, the impacts (such as less snow or increase in temperature) not be as strong as in other resorts with lower altitudes		(Koenig & Abegg, 1997) (OECD, 2007) Serquet and Rebetez (2011)

Appendix 21: Analysis of physical impacts considered most important for tourism providers

What physical impacts of the climate change have the greatest impact on your business in the winter season? - tourism providers

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
Bergbahnen Zuoz: ***R1:*** *We can only make snow if the temperature is lower than minus 4 degrees* ***R2:*** *It is all about the temperature.* ***Adrian Lehman, Hotel Altana:*** ***R1:*** *Higher temperatures are of course related to the amount of snow* ***R7:*** *If you don't have a low temperature it is hard to produce artificial snow.*	Warm temperatures represent a problem.	The main code of *warm temperature* has been scaled in two other sub codes: Warm temperatures represent a problem and, Warm temperatures do not represent a problem. Statements of Bergbahnen Zuoz representative and of Adrian Lehmann have been reduced into the same code for having the same meaning.		(Abegg, Bürki, & Elsasser, n.d.) (Wyss, Abegg, & Luthe, 2014)
Ski school, Zuoz: ***R2:*** *The tourists like when it is warm, and they can ski in T-shirt.* ***R3:*** *When it snows too much the tourists also don't come because they cannot see well, it is dangerous*	Warm temperatures do not represent a problem.			(Abegg, Bürki, & Elsasser, n.d.) (Wyss, Abegg, & Luthe, 2014)
Adrian Lehman, Hotel Altana: ***R1:*** *If snow does not come, definitely there is an impact.* ***R3:*** *No snow means that they have hard times to prepare the ski slopes* ***Hotel Astras:*** ***R1:*** *The lack of snow has the biggest impact.* ***Hotel Filli:*** ***R1:*** *No snow which determines skiers to not come.* ***Ski instructor, Scuol:*** ***R1:*** *The winter in our area lacks sufficient amounts of snow.* ***Ski shool, Zuoz:*** ***R1:*** *the fact that it is less snow has the greatest impact on our ski school* ***Snowsport Scuol:*** ***R1:*** *As a ski school, if we have no snow we cannot do anything.*	Amount of snow			Bürki et al. (2003, December) Matasci (2012)
Hotel Astras: ***R1:*** *The winter starts too late.* ***Ski instructor, Scuol:*** ***R1:*** *The winter in our area is shortened continuously* *R2 (Q1): the region in autumn / early winter is no longer guaranteed snow.*	Later start of winter season			Bavay et al. (2013)

Appendix 22: Analysis of impacts of climate change on tourism business, from the tourism experts perspective

How is the **tourism business** in this area **affected by the** climate change impacts - Interviews with tourism experts

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
B. Abegg: ***R1:*** *Everything that is snow based will be affected**.*** ***C. Conradin:*** ***R1****: There will be fewer tourists* ***R2:*** *When there is no snow here, people are not coming* ***H. Lozza:*** ***R12:*** *the question is if the tourists come to do winter sports on technical snow, or do they go to other places* ***R13:*** *without snow there is a problem for winter sports.* ***Reto Rupf:*** *R1: Maybe in Val Mustair there are some difficulties, at least in the low parts* *R8: In Zernez they have some cross country skiing which could be affected, so in Zernez there won't be so much possibilities for winter sport than it is nowadays* *R11: And the others, like Scuol, F-tan, with the ski businesses will be affected* *R14: In Zuoz there can be some problems because their ski slopes are south oriented.* *R15: The question is whether the guests will enjoy the white stripes of slopes or not.* ***C. Daguati:*** ***R10:*** *I think that less people came because of bad conditions and not proper facilities. Last weekend in the ski resort I was the only tourist; it was only one slope opened, and that was not in a good form.*	Decreased attractiveness in winter	C. Conradin's statements have been reduced into the same code for having the same meaning. H. Lozza's statements have been reduced into the same code for having the same meaning. R. Rupf's statements have been reduced into the same code for having the same meaning.		(Wyss, Abegg, & Luthe, 2014) (MoE, 2011)**,** Koenig and Abegg (1997)
H. Lozza: ***R5:*** *This (the need for technical snow) shows how highly dependent we are on the technical snow whose production process is not sustainable at all* ***R8:*** *we use much more energy, we are highly dependent on water and electricity*	Increased dependency on resources	H. Lozza's statements have been reduced into the same code for having the same meaning.		OECD (2007)
H. Lozza: ***R15:*** *It is however difficult to explain the drop in the tourists' number in the last years, is it due*	Tourism affected also by other aspects	T. Lehmann's statements have been reduced into the same		(Wyss, Abegg, & Luthe, 2014) (MoE, 2011)**,**

to the lack of snow or due to the strong Swiss Franc. ***T. Lehmann:*** ***R1:*** *The area is a little bit independently affected by climate change* ***R6:*** *There are also some new ski resorts opened in Eastern Europe, in Azerbaijan.* ***R7:*** *There is an oversupply, too much ski resorts* ***R8:*** *It this region, which is really high 2-3'000m currently there is not really climate change, it is more the economic factors* ***R10:*** *It is also the distance from big cities;*		code for having the same meaning.		Koenig and Abegg (1997)
R. Rupf: ***R16****: Maybe there are some economic difficulties to hold this area (Zuoz). Also in the Val Mustair maybe is the same.* ***C. Daguati:*** ***R3:*** *the ski resort was closed and especially for transport facilities, restaurants, that was not running, so that was a big impact for us.* ***R7:*** *For us (Val Mustair), the people who work in the resort had nothing to work (until 15th of January).*	Economic difficulties	C. Daguati's statements have been reduced into the same code for having the same meaning.		(Elsasser & Bürki, 2002)
H. Lozza: ***R12:*** *the question is if the tourists come to do winter sports on technical snow, or do they go to other places* ***C.Conradin:*** ***R3.*** *When there is no snow here, people [...] go to other places.* ***C. Daguati:*** ***R8****: And I think now, especially in January people look where the slopes are open and good*	Tourists go in other resorts → Negative Changes of climate variability for tourism activities			Matasci (2012)
C. Daguati ***R12:*** *Usually we open the ski season on the 15th of December, but this was the first year we opened on the 15th of January*	Later ski season			
T. Lehmann: ***R5:*** *Skiing becomes less and less popular.* ***C. Conradin:*** ***R5.*** *Maybe in 50-100 years ski and snowboarding will not be that popular anymore*	Snow sports become less popular	T. Lehmann's statements have been reduced into the same code for having the same meaning.		

Appendix 23: Analysis of impacts of climate change on tourism business, from the tourism experts perspective

How is the **tourism business** in this area **affected by the** climate change impacts - Interviews with tourism providers

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
Bergbahnen Zuoz: ***R1:*** *Of course we are affected* ***A. Lehman, H. Altana:*** ***R1:*** *I think yes, the business is affected by climate* ***Kurt Baumgartner, Scuol*** ***R1:*** *Yes, I think we are affected but I think we are positively affected.* ***R2:*** *Our ski area is high, starts at around 2'000m and we are sure we have snow in the future.* ***R5:*** *Compared with other areas which are quite down, we are not negative affected.* ***Ski instructor, Scuol*** ***R1:*** *Yes, climate change definitely affects us in particular the fact that the region in autumn / early winter is no longer guaranteed snow* ***Ski school, Zuoz:*** ***R1:*** *On the one had the ski school is affected by climate change* ***Snowsport, Scuol:*** ***R1:*** *Yes*	Yes, affected Positive/negative	Main code *Yes, affected* has been scaled in two sub-codes: Positive and Negative		(Wyss, Abegg, & Luthe, 2014) (MoE, 2011), Koenig and Abegg (1997)
Hotel Astras ***R1:*** *Of course we feel some differences, but our hotel personally, is not really affected* *R2 (Q2): The winter starts too late, but people know that it is not the hotel's fault* ***R4:*** *Here is Scuol, the people come the whole year because we have the spa, and people can walk.*	Not affected			
BZ: ***R2:*** *There are less tourists coming when it is less snow* ***A. Lehman, H. Altana:*** ***R8****: not necessarily less guests, although this year yes* ***Hotel Astras:*** ***R3:*** *It is true that in our restaurant we had less to work, but not in the hotel* ***Marco de Gennaro, Hotel Fili*** ***R3:****We have had a big drop this year (2016) in the first 3 weeks.* ***Ski school, Zuoz:*** ***R3****: when the people see everything green and only one white stripe, it is not that attractive to come up and to take the lessons.* ***R5****: Also people don't feel safe when*	Problem with less tourists			(Wyss, Abegg, & Luthe, 2014) (MoE, 2011), Koenig and Abegg (1997)

they only see the white stripe. They told us in December that if they fall out of the slope they can get injuries.				
Hotel Astras: ***R3:*** *We don't feel that there are less guests coming because there is warm.*	No problem with less tourists			
BZ: ***R4:*** *The tourists are going where the snow is.*	Tourists go somewhere else			(Scott & McBoyle, 2007) Elsasser and Burki (2002)
A. Lehman, H. Altana: ***R9:*** *economic factors, such as exchange rate Euro-CHF* ***Hotel Astras:*** ***R5****: We are more affected by the strong Swiss Franc* ***Ski school, Zuoz:*** ***R2****: we are affected by the strong Swiss Franc*	There are other factors			
A. Lehman, H. Altana: ***R10****: strictly referring to the weather the people book shorter holidays.*	Tourists book shorter holidays			
A. Lehman, H. Altana: ***R3:*** *you cannot properly say if the [...] last 2 years with low snow or no snow incoming is due to climate change.* ***R6****: It is hard to prove that there is a climate change although I am convinced there is a climate change.* ***Marco de Gennaro, Hotel Fili*** ***R1****: I do not know whether it is climate change. We have had just 2 winters with very late snowfalls*	Not sure about climate change			
Snowsport, Scuol: ***R2:*** *at the moment we have losses in December, so we could not have so much teachers (instructors) this time. We are getting smaller and smaller.*	Business becomes smaller			
C. Daguati: ***R16:*** *we had the world cup event, the cross country ski event in Val Mustair last year, and we had no snow and we had to produce all the snow for the event. It was a challenge because the temperatures were too high and the cost for snow making is high. 15-20% of our budget of approximately 1 million CHF for the event was used for snow making.*	Increasing costs			

Appendix 24: Analysis of sub-sectors vulnerability from the tourism experts' perspective

Vulnerability of tourism sub-sectors in the SNP region – tourism experts

Phrase	Codes	Reduction/Explanation/Scaling	Comment	Link to literature
B. Abegg: ***R1:*** *The most vulnerable are the sectors and enterprises that are directly dependent on snow, meaning the ski instructors* ***C. Conradin:*** ***R1:*** *Most affected are the winter activities providers* ***H. Lozza:*** ***R3:*** *I would say that [accommodation] and winter sport providers are the most vulnerable [but also the restaurants].* ***Reto Rupf:*** ***R1:*** *I think the activity providers are the most vulnerable* ***R6:*** *I consider that activities providers are the most vulnerable and affected. If there is no snow, the ski school is closed* ***Claudio Daguati:*** ***R1:*** *I would say the ski schools, ski instructors. If there is now snow, they sit and wait, they are not paid.*	Activities providers	R. Rupf's statements have been reduced into the same code for having the same meaning.		MoE (2011)
B. Abegg: ***R1:*** *The most vulnerable are the sectors and enterprises that are directly dependent on snow, meaning the transportation companies.* ***R6:*** *Also for the cable car companies, people were there, but they spent less money – they went up the mountain, buying only a ticket, not a pass* ***Ms. Lehmann:*** ***R1:*** *First of all there are the cable cars they need high investments* ***R7:*** *The cable cars are really the most important actor and the others are dependent of the cable cars*	Transportation	B. Abegg's statements have been reduced into the same code for having the same meaning. Ms. Lehmann's statements have been reduced into the same code for having the same meaning.		MoE (2011) Koenig and Abegg (1997), Hoffmann et al. (2009)
C. Conradin: ***R1:*** *(Most affected are the winter activities providers) then the hotels* ***H. Lozza:*** ***R3:*** *I would say that accommodation [and winter sport providers] are the most vulnerable [but also the restaurants].* ***Ms. Lehmann:***	Accommodation			MoE (2011) Koenig and Abegg (1997),

R5: *[If the business of transportation providers is not doing well], the next affected is the accommodation sector*				
H. Lozza: ***R3:*** *But also the restaurants.*	Restaurants			MoE (2011)
B. Abegg: ***R3:*** *Less vulnerable are the accommodation providers.* ***R4:*** *In terms of numbers it was ok for accommodation* ***R9:*** *Now people doing winter holiday don't go skiing that often.* ***R10:*** *Maybe skiing isn't that important anymore*	Less vulnerable	B. Abegg's statements have been reduced into the same code for having the same meaning.		MoE (2011)
H. Lozza: ***R1:*** *Vulnerable is the whole tourism sector, because if the tourists don't come, they don't consume, don't sleep, don't eat* ***Ms. Lehmann*** ***R6****: [If the business of transportation providers is not doing well, the next affected is the accommodation sector], and all other actors, the whole supply*	Whole sector			MoE (2011)

Appendix 25: Analysis of sub-sectors vulnerability from the tourism providers' perspective

Vulnerability of tourism sub-sectors in the SNP region – tourism providers

Phrase	Codes	Reduction/Explanation/Scaling	Comment	Link to literature
B.Z.: ***R1:*** *I think it is like a circle: if the snow does not come, the tourists don't come so the hotels won't stay well and so on. We don't know how to stop it. For the whole valley Engadine climate change is a big problem.* ***Hotel Altana:*** ***R1****: I think the whole region is vulnerable. If the guest doesn't come in the valley, everybody loses.* *R6: Very few people which are somehow not connected to tourism. We all together live from tourism* ***Hotel Filli:*** ***R1:*** *All the sectors are equally vulnerable.* ***Skischool Zuoz:*** ***R1:*** *I would say all of them. They have to work together because they are in the same situation.*	Whole sector			Wyss et al. (2014)
Ski instructor, Scuol: ***R1:*** *The most vulnerable are the activities providers.*	Activities providers			MoE (2011)
Ski instructor, Scuol: ***R1:*** *The most vulnerable are the activities providers, then probably the hotels*	Accommodation			Koenig and Abegg (1997)
Hotel Altana: ***R1:*** *If we have fewer guests, we have fewer funds to keep and maintain the area, so nature itself will suffer.*	Nature			
K. Baumgartner: ***R1:*** *For our region I am not that worried, at least for the next 30-50 years. As I told you our ski areas are quite high in altitude. I think Scuol is not affected by climate change right now.*	None			

Appendix 26: Analysis of drivers

Drivers- tourism providers

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
Ski instructor Scuol: ***R1:*** *the ski school is only our secondary occupation in winter*	Dependence on the business			Hoffmann et al. (2009)
BZ: ***R1****: If there is no snow, [tourists don't come].* ***Hotel Altana:*** ***R1:*** *Less snow* ***Hotel Filli*** ***R1:*** *The lack of snow* ***Skischool Zuoz:*** ***R1:*** *We have to diversify somehow the offer, to offer an alternative due to the lack of snow*	Less amounts of snow			Matasci (2012)
Kurt Baumgartner: ***R1:*** *The money. We get the money back from the Government if we do some things about CO2 reductions so we can get in return money of less oil we use; we have to spend less money on oil*	Ecnomic situation	K. Baumgartner's answers are related to the mitigation measures his hotels have implemented		Matasci (2012)
BZ: ***R1****:[If there is no snow], tourists don't come* ***Hotel Altana:*** ***R1:*** *less guests means to acquire guests from other places* ***Ski school Zuoz:*** ***R2****: Also because tourists may be afraid to go on the slopes with few artificial snw*	Changes that occure in the demand side			Matasci (2012)

Appendix 27: Analysis of tourism providers' awareness

Are the tourism providers of the SNP region aware of climate change?- Tourism experts

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
B. Abegg: ***R1:*** *Most of them are.* ***C. Conradin:*** ***R1****: The big tourism providers are aware.* ***H. Lozza:*** ***R1:*** *Many of them are* ***T. Lehmann*** ***R1:*** *Yes, of course. They know a lot about climate change.* ***R.Rupf:*** ***R1:*** *Some of them are aware*	Yes	The answer Yes has been scaled into the next 5 sub codes		Elsasser and Bürki (2002).
B. Abegg: ***R1:*** *One reason is because this subject is in the media all the time*	Yes – Reason: Media popularity			
B. Abegg: ***R1:*** *Another thing is their experience*	Yes – Reason: Their experience			
C. Daguati: ***R1:*** *Well you can see the investments that are made now.*	Yes – Reason: Investments			
H. Lozza: ***R7:*** *Maybe they are aware, but they don't do a lot.* ***T. Lehmann*** ***R2****: However, knowing and acting is not the same. They know but they do not really act like they should.*	Aware but not acting			
R.Rupf: ***R1:*** *Some of them are aware and are looking for alternatives*	Aware and acting			Elsasser and Bürki (2002).
H. Lozza: ***R1:*** *Maybe they still believe that the situation will go like it was before.*	Sceptical about CC			

Appendix 28: Analysis of adaptation measures, from the tourism experts' perspective

Adaptation measures – Interviews with tourism experts

Phrase	Codes	Reduction/Explanation/Scaling	Comment	Link to literature
B. Abegg: ***R1:*** *the most popular adaptation measure is making snow and of course they implemented snow making.* ***R4****: They (Scuol ski area) improved and enlarged the snow making capacities* ***C. Conradin:*** ***R1****: They use snow making machines since 10 years ago* *R1: Recently, they have connected pipelines to the water supply.* *R3: Many providers such as Minschun (ski area) began to make snow earlier, around October* ***R5:*** *They create a big mountain of snow and when the ski season starts they take the snow and put it on the slopes* ***H. Lozza:*** ***R4:*** *In region Tschierv – Val Mustair they do a lot of investments, [they want to make a new track to go up] and more technical snow*	Snow making	B. Abegg's statements have been reduced into the same code for having the same meaning. C. Conradin's statements have been reduced into the same code for having the same meaning.		Koenig and Abegg (1997), (Tranos & Davoudi, 2014) Abegg et al. (n.d.) Scott and McBoyle (2007)
B. Abegg: ***R6:*** *So they (Scuol ski area) try to move the operations higher on the mountain and to include north facing slopes* *R5: As compensation, they are willing to give up some of the low line parts of the ski area.* ***H. Lozza:*** ***R4****: In region Tschierv – Val Mustair they do a lot of investments, they want to make a new track to go up* ***Reto Rupf:*** *Now they have a project to build a cable car from Tschierv to the ski area.*	Development of higher skiing areas + Development of north facing slopes		These codes have been put together as they are very similar.	Koenig and Abegg (1997) Abegg et al. (n.d.) Scott and McBoyle (2007) OECD (2007)
C. Conradin: ***R10****: Also the accommodations maybe try to provide some alternatives, to diversify their offers.* ***R. Rupf:*** ***R2:*** *There were some*	Diversification	Diversification code has been scaled into the next sub-codes		Koenig and Abegg (1997) Scott and McBoyle (2007) Hoffmann et

occasions this year, in a cable care there were mountain bikers, skiers, hikers and snowboarders all together. ***C. Daguati:*** ***R1:*** *There is the diversification of offers.*				al. (2009)
H. Lozza: ***R1:*** *There are much more winter walking possibilities* ***R. Rupf:*** ***R3 (Q5):*** *In Zernez they are related to the Swiss National Park. This winter, because it was no snow the SNP opened their trails*	Diversification - Develop winter/summer hiking trails			Hoffmann et al. (2009)
H. Lozza: *R17: In Scuol, they try to promote health tourism; this can be an alternative for people who don't want to ski to come here. They made good steps in this direction last years.* ***Ms. Lehmann:*** ***R1:*** *diversification of supply, like wellness in Scuol, [biking in the valley of Mustair]* *All these measures are so called "low regret options", meaning that if climate change does not occur as predicted, the measures are still helpful for the development of the region* ***Reto Rupf:*** ***R1 (Q5****): Some of them are aware and are looking for alternatives, like wellness*	Diversification – Health and wellness spas			Scott and McBoyle (2007)
Reto Rupf: ***R2 (Q5):*** *Hotel Castle in Zuoz is strong related to arts and they have guests who love arts very much.*	Diversification - ART			
Ms. Lehmann: ***R1:*** *diversification of supply, like [wellness in Scuol], biking in the valley of Mustair*	Diversification – Biking			Scott and McBoyle (2007)
R. Rupf: ***R2:*** *Some change the season, focus more on summer.*	Diversification – summer tourism			Hoffmann et al. (2009)
R. Rupf: ***R7:*** *There were no snow in the skiing areas in the Alps, or just artificial snow but they had the frozen lakes. And they "forced" their guests to go for ice skating.* ***C. Daguati:*** ***R2:*** *A good example was this*	Diversification – skating			Scott and McBoyle (2007)

winter in Sankt Moritz on the frozen lakes				
C. Daguati: ***R16:*** *They did also for the ski school during Christmas, so one day they did llama trekking, one day they did painting so for kids was very good*	Diversification – painting + llama trekking			Horseback riding – very similar activity with llama trekking mentioned by Scott and McBoyle (2007)
C. Daguati: *R13: In the morning was skiing and in the afternoon one day was sledging, one day cross country ski, the other day was snow shoes walking.*	Diversification – sledding, cross country ski, snow show walking			Scott and McBoyle (2007) Hoffmann et al. (2009)
H. Lozza: ***R2:*** *I don't see a different tourism. It is still based on winter sports, because winter sports are economically profitable, but also very cost intensive.* ***R12****: For Scuol skiing is very important, without ski, it would collapse*	Business as usual	H. Lozza's statements have been reduced into the same code for having the same meaning.		Elsasser and Burki (2002)
H. Lozza: ***R10:*** *Scuol Tourismus tries to convince more people to come by public transportation through attractive ticket rates* ***R19****: In Zernez, through the program Zernez Energia 2020 they try to reduce the consumption of fossil fuels and to use alternative energy.* ***Ms. Lehmann:*** ***R2 (Q5):*** *good examples of mitigations, like the Energy Plus hotel in Muottas Muragl (in Samedan), there are several photovoltaic systems* ***R4 (Q5):*** *Scuol for example has this luggage transport – you can give your baggage to the train and go to the destination without baggage*	Reduce energy consumption → mitigation	H. Lozza's statements have been reduced into the same code for having the same meaning. T. Lehmann's statements have been reduced into the same code for having the same meaning.	This are mitigation actions and not necessarily adaptation measures	
R. Rupf: ***R12:*** *I think about 5 years they started to think about climate change actions.* ***C. Daguati:*** ***R6:*** *I would say that these actions started this winter, because last years the snow came.* ***H Lozza*** ***R8:*** *Winter walking started 10-*	Time			

15 years ago to be more attractive				

Appendix 29: Analysis of adaptation measures, from the tourism providers' perspective

Adaptation measures - tourism providers

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
BZ: ***R1:*** *We can just make snow, we cannot do anything else*	Snowmaking			Koenig and Abegg (1997), (Tranos & Davoudi, 2014) Abegg et al. (n.d.) Scott and McBoyle (2007)
C. Daguati: ***R9:*** *We send to hotels some briefings, what they can offer, alternative programs, that are not dependent on snow, like museums, walking paths.*	Cooperation			
A. Lehmann, Hotel Altana: ***R1:*** *We definitely recommend the guests alternatives towards what they can do with the current snow situation*	Diversification	Explanation: By "current snow situation" A. Lehmann refers to a low level of snow. Diversification code has been scaled into the next 3 codes		Koenig and Abegg (1997) Scott and McBoyle (2007) Hoffmann et al. (2009)
A. Lehmann, Hotel Altana: ***R2:*** *So, instead of selling the guests ski pass included, we say to the guest that if they cannot go skiing, we have the option of cross country ski, winter walking, hiking, ice climbing,*	Diversification – Cross country skiing, winter walking, hiking, ice climbing			Scott and McBoyle (2007)
Astras: ***R1:*** *We have program of activities for our guests we play eisstock,*	Eisstock			Scott and McBoyle (2007)
Hotel Filli ***R1:*** *We have offered a wide variety of events for our guests for the days without ski.* ***Ski school Zuoz:*** ***R1:*** *We had an event*	Diversification - Events			Hoffmann et al. (2009)

on the 30th of December, a duathlon, we started a race where the people had to go up by mountain bike, and then to come down by skiing				
Kurt Baumgartner ***R1****: We have a program through which we should reduce the fossil energy consumption. We are using alternative energy, solar power, isolate more the houses, and so try to consume less oil* ***R6****: We have on our agenda some steps to reduce the oil consumption.*	Mitigation actions	K. Baumgartner's statements have been reduced into the same code for having the same meaning.		
Astras: ***R4:*** *We don't do anything to reduce energy consumption, because we don't have the money for it* ***Ski instructor:*** ***R1:*** *No* ***Snow sport Scuol*** ***R1:*** *We can't make the snow; this is an action of the lift company, not ours.*	No mitigation/ adaptation actions			Elsasser and Burki (2002)

Appendix 30: Analysis of barriers, from the tourism experts' perspective

Barriers - experts

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
B. Abegg: ***R7:*** *One barrier is money, it is very simply* ***C. Conradin:*** ***R1****: One of barrier is the cost.* ***H. Lozza:*** ***R9:*** *Money can be another aspect: if you don't earn money with conventional tourism, you cannot invest in other forms. At the moment nobody is willing to invest* ***R. Rupf:*** ***R1:*** *The lack of money to make investments. It is difficult to gain money to make investments.* ***C. Daguati:*** ***R1:*** *Cost is a big barrier. Resorts such as Scuol, Samnaun have other possibilities to invest compared with the Val Mustair. The smaller resorts will face a challenge to invest in facilities.*	Insufficient funds	H. Lozza's statements have been reduced into the same code for having the same meaning.		Matasci et al. (2014)
B. Abegg: ***R8:*** *Another barrier can a short time frame thinking. Climate change is already happening but it will continue. Many companies are struggling to keep up the daily business.* *They do not have the capacities to do some long term thinking.* ***T. Lehmann:*** ***R8 (Q5): [****You have other problems, like the strong Swiss franc, and you think in the short run that the tourists have to come at your place], and you might not have time to think for the long term problems, like climate change*	Lack of long term perspective			Matasci et al. (2014)
T. Lehmann: ***R8 (Q5):*** *You have other problems, like the strong Swiss franc,[and you think in the short run that the tourists have to come at your place, and you might not have time to think for the long term problems, like climate change]*	Strock Swiss Franc			Matasci et al. (2014)
C. Conradin: ***R2:*** *Another barrier is the nature based NGOs, like Pro Natura.* ***R4:*** *These NGOs don't want that artificial snow is produced* ***H. Lozza:*** ***R2:*** *Others can say that the environmental organization is responsible for the ecological problems of the region because they try to avoid more technical installation* ***C. Daguati:***	Opposition from public and/or environmental groups	C. Conradin's statements have been reduced into the same code for having the same meaning.		Scott and McBoyle (2007), OECD (2007)

R4: *Other barrier can be the nature protection. In Val Mustair we are in a biosphere, and here we have to work with these nature protection organizations, like Pro Natura. In a biosphere we are more restricted that in other regions.*				
T. Lehmann ***R8 (Q4):*** *Moreover with this artificial snow, there is the question of how sustainable this strategy is.*	Unsustainable strategy for the long term			OECD (2007)
B.Abegg: ***R6 (Q1):*** *In the ski area of Scuol they are struggling to have enough water to make snow* ***T. Lehmann*** ***R10 (Q6):*** *A third of the water used in Scuol is for making artificial snow.* ***R. Rupf:*** ***R4:*** *This year it was also a problem with water supply, because the summer was very dry and the autumn also quite dry* ***C. Daguati:*** ***R7:*** *At the moment, water supply is also a barrier too* ***R6 (Q3):*** *There was not enough water in Val Mustair. In Scuol and Zuoz they produced snow and they could open the ski resort.* ***H. Lozza:*** ***R10 (Q3):*** *if it will continue to be so dry we will have a problem with not enough water*	Water resources	C. Daguati's statements have been reduced into the same code for having the same meaning.		OECD (2007), Scott and McBoyle (2007) Pütz et al. (2011)
H Lozza: ***R12 (Q3)*** *At the moment the question is if the tourists come to do winter sports on technical snow,*	Low acceptance of tourists for artificial snow			Pütz et al. (2011)
B. Abegg: ***R1:*** *They need to keep their core business – that of transporting people. This can be a challenge for them to come up with new offers that bring money* ***R12:*** *Another barrier is that many of them are so much depending on winter tourism that they cannot even think of something else. They are on a track and it is not possible for them to leave it.*	Winter tourism is the main source of income and employment and cannot be discarded	By "they" Bruno Abegg refers to the cable car companies B. Abegg's statements have been reduced into the same code for having the same meaning.		OECD (2007)
H. Lozza: ***R4:*** *There are also some people who say that climate change does not exist, and it has been invented by some environmental organization. This is the main barrier.*	Difficulty to identify the changes that already happen or to identify the impacts of these changes (Barriers obstructing			Matasci et al. (2014)

	social feasibility)			
T. Lehmann: ***R3:*** *[The structure of the destination is often historical]; people won't change anything in the structure. It is a little bit characteristic to the Swiss people in the Alps to be conservator, they don't like to change too much, and there is a resistance to change.*	Population is not willing to accept certain adaptation measures (Barriers obstructing social acceptability)			Matasci et al. (2014)
T. Lehmann: ***R1:*** *there is really a lack of innovation capability to develop new products or to shift from the winter season to the summer season*	Lack of innovation			

Appendix 31: Analysis of barriers, from the tourism providers' perspective

Barriers - tourism providers

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
Astras: ***R3 (Q3):*** *[We don't do anything to reduce energy consumption, because] we don't have the money for it*	Insufficient funds			Matasci et al. (2014)
K. Baumgartner: ***R3:*** *Costs for being part of this program can be another obstacle. Some hotels which don't have money at the moment cannot invest in this program* ***BZ:*** ***R1:*** *Then there is the cost, but if we don't make snow, then we don't have any income.*	Substantial investments, Costly measures			Scott and McBoyle (2007), OECD (2007)
K. Baumgartner: ***R1:*** *The oil price is so much down right now; nobody is interested to reduce the oil consumption. [But this is a short view.]*	Not profitable measures			Matasci et al. (2014)
Hotel Altana: ***R1:*** *There might be different points like political issues, laws which prohibit certain*	Institutional barriers			Matasci et al. (2014)

things, like you might not be allowed to make a walk through this or that area due to wild protected areas. That might be obstacles for alternative offers.				
K. Baumgartner: ***R1: [****The oil price is so much down right now; nobody is interested to reduce the oil consumption.] But this is a short view.*	Lack of long term perspective			Matasci et al. (2014)
BZ: ***R2:*** *At the moment we don't have big problems with the water supply*	Water resources			OECD (2007), Scott and McBoyle (2007) Pütz et al. (2011)
BZ: ***R1:*** *The temperature is a big barrier*	High temperatures			OECD (2007), Scott and McBoyle (2007) Pütz et al. (2011)
Hotel Altana: ***R3:*** *Other things are local political things, like people are not working as well together as they could, low cooperation.*	Low cooperation			Koenig and Abegg (1997), Pütz et al. (2011), Matasci et al. (2014), Wyss et al. (2014)
Hotel Filli ***R1:*** *There is no barrier for us to do these events.*	No barrier			
Ski school Zuoz: ***R1:*** *It is a lot of work to do these kind of events*	Lot of work			

Appendix 32: Analysis of consequences, from the tourism experts' perspective

Consequences - Interviews with tourism experts

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
C. Daguati: ***R1:*** *If you have these alternatives, there were not a lot of complaints from tourists* ***C. Conradin:*** ***R2:*** *For the tourists, there are some who don't like the artificial snow and that everything is brown and only one slope white, and others who don't care if it is artificial snow* ***H. Lozza:*** ***R4:*** *Regarding tourists, the question is if they accept the new offers from the providers, or just move and go skiing in some other resorts.* *For example, if you are a sustainable region and do not produce technical snow, you can lose guests who want to ski.*	Tourists' satisfaction Increases or decreases	Main code *tourists' satisfaction* has been scaled into: Increased satisfaction and Decreased satisfaction		
R. Reto: ***R1:*** *I think that in the future the interest of tourists for ski and winter sports will be smaller* ***B. Abegg:*** ***R7:*** *Skiing is not so important in the Swiss culture as in the past. Providers are already struggling for customers.* ***C. Conradin:*** ***R3(Q3):*** *It could be that the behavior of tourists will change (there would be tourist willing to do hiking and which are happy that there is no snow). This takes time, and maybe in 50-100 years ski and snowboarding will not be that popular anymore*	Decrease popularity of winter sports			
C. Daguati: ***R4:*** *Another consequence is given by the rising costs, of course, for the whole snow making, water, energy, and then the tickets become more expensive* ***C. Conradin:*** ***R1:*** *For the tourism providers there is more cost, for making the snow.* ***B. Abegg:*** ***R4:*** *Skiing is relatively expensive and can become more expensive due to additional transportation facilities and snow making*	Rising costs	T. Lehmann's statements have been reduced into the same code for having the same meaning.		

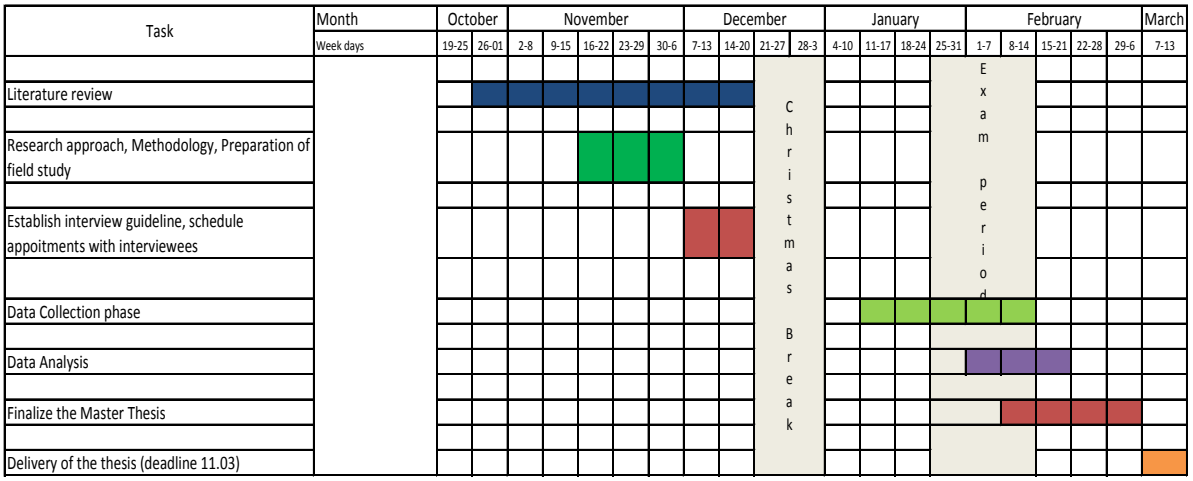
machines that they potentially need in the future ***T. Lehmann:*** ***R1****: Investments for adaptation measures will be enormous to maintain the snow guarantee* ***R5:*** *For my PhD I asked some experts and they said that in winter the investments for climate change should be at around 10-20% for the year 2030*				
C. Daguati: ***R7:*** *Impact to the landscape it is also a consequence (a lot of ski lifts, and the ground were they made the pipelines is affected, the grass is not growing)*	Impact on the landscape			
H. Lozza: ***R1:*** *Scuol Tourismus wants to have a more sustainable tourism and try to persuade guests to do other activities, therefore with the time they would be less snow dependent*	Reduce dependence on snow			

Appendix 33: Analysis of consequences, from the tourism providers' perspective

Consequences - tourism providers

Phrase	**Codes**	**Reduction/Explanation/Scaling**	**Comment**	**Link to literature**
BZ: ***R1:*** *For the tourists I think there is no difference whether there is artificial or natural snow. It is very important to have snow. I don't think people ask there if the snow is artificial or not.* ***Hotel Altana:*** ***R1:*** *The guests discover the Lower Engadine in a different way. Tourists start to know the valley from a different point of view, apart from the ski area.* ***Hotel Fili:*** ***R1:*** *Guests were occupied and consequently less frustrated that they could not ski.* ***Ski school Zuoz:*** ***R1****: Tourists were very excited, some of them were "Wow, we go biking in the winter!"*	Increased tourists' satisfaction			
Hotel Altana: ***R6:*** *Currently there are no direct benefits for your business, but the measures increase the guests' satisfaction.*	No direct benefits for business			
K. Baumgartner: ***R1:*** *I hope the reputation of our hotels goes up* ***R3:*** *It is a good image of our hotels in front of the customers.*	Reputation	K. Baumgartner discusses consequences of **mitigation** measures implemented by his hotels		
H Altana: ***R6:*** *We will probably have further bookings from the same guests.* ***K. Baumgartner:*** ***R3:*** *I am not sure if the clients book or not because of this reason.*	Tourists' bookings	K. Baumgartner discusses consequences of **mitigation** measures implemented by his hotels		
K. Baum: ***R5:*** *Another consequence is that we pay less money so we have less costs, I have to use less oil.*	Cost reduction	K. Baumgartner discusses consequences of **mitigation** measures implemented by his hotels		

Appendix 34: Timetable



Declaration

I herewith declare that this is my independent work written by me and using only admissible aides and no other sources than those given. I have marked as such, all passages which have been taken literally or analogously from another source. I am aware that if this is not the case, the executive board of the university of applied sciences is entitled to rescind any qualifications awarded or any title bestowed based on this work.

Date: Signature: