

Destination adaptation in the Mont Blac area

Is the tourism system adapting to climate change?

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Abstract

Mountain areas all around the world are extremely vulnerable to climate change. In Europe, local livelihoods are closely linked to tourism, which will not only be strongly affected by climate change, but will also contribute to these changes. Based on twenty-three interviews, this thesis uses Actor Network Theory to define the tourism system and to analyze destination adaptation in the Mont Blanc area (Western Italian Alps). The findings show a strong interest in adaptation, especially through deseasonalisation, diversification and communication. However, actors from hotels and bars have conflicting views on deseasonalisation, while municipalities and ski resorts have little interest in diversification and focus only on short-term strategies such as snowmaking. Indeed, the lack of collaboration leads to exclusively individual actions and poor solutions for potential maladaptation. In conclusion, increased cooperation and communication are needed to ensure sustainable adaptation for tourism.

Keywords: Actor Network Theory, Maladaptation, Diversification, Deseasonalisation, Collaboration, Local livelihoods

Word count: 11.998

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1 Introduction

According to the second chapter of the IPCC Special Report "The Ocean and Cryosphere in a Changing Climate", high mountain areas around the world are extremely vulnerable to climate change (Hock et al., 2021). In fact, surface air temperature in these areas is warming faster than the global average, affecting the cryosphere and consequently water resources (Hock et al., 2021). These changes will impact water availability and increase conflicts over water use between different sectors, such as agriculture, civil use, hydropower, industrial use, and tourism (Hock et al., 2021). In addition, changes in the occurrence of landslides, avalanches, and floods will raise safety concerns (Hock et al., 2021). In high mountain ecosystems, species composition and abundance are already shifting, and these trends will continue to alter future ecosystem services (Hock et al., 2021). Finally, the cryosphere provides aesthetic, cultural, and recreational services that are essential to local livelihoods and tourism (Hock et al., 2021). Winter activities in high mountain areas, such as skiing, have already been negatively affected by reduced snow cover, while safety and seasonality of summer activities, such as glacier tourism and mountaineering, have already been altered by glacier retreat and permafrost thaw (Hock et al., 2021). These shifts in the environmental conditions that currently define winter and summer tourism will have a major impact on alpine economies: in Europe, under a 2°C scenario and compared to the period 1971-2000, annual economic losses for hotels are projected to be EUR 560 million (Hock et al., 2021).

1.1 Problem and research question

In 1991, the Alpine Convention was founded with the recognition that the European Alps are *"one of the largest continuous unspoilt natural areas in Europe, which, with their outstanding unique and diverse natural habitat, culture and history, constitute an economic, cultural, recreational and living environment in the heart of Europe, shared by numerous peoples and countries"* (Alpine Convention, n.d., p.54). Given the impact of climate change on the ecological function of the alpine region, the conservation and protection of this environment must be a priority (Alpine Convention, n.d.). As introduced above, climate change will also strongly affect the socio-economic functioning of local populations, particularly with respect to tourism. Indeed, the European Alps host the largest ski industry in the world and are highly dependent on tourism for their alpine economic development (Hock et al., 2021). Therefore, adaptation to climate change in this sector will be essential for local livelihood.

Nevertheless, while tourism is a necessary sector for local economies, it also has social and environmental impacts that should not be neglected. Since the 1950s, mass tourism has contributed

significantly to alpine economies, but this has quickly led to the problem of intensive development of the traditional alpine landscape and disparities with rural areas, raising the need for solutions and careful management of the tourism sector (Barker, 1982; Gios et al., 2006). Indeed, mass tourism is associated with high consumption and careless use of resources, leading to increased energy use, waste production and increased emissions, mainly from transportation and housing (Karim et al., 2023; Streimikiene et al., 2021; UNTWO and UNEP, 2008). Mass tourism is therefore associated with environmental degradation, disturbance of biodiversity and pollution (Karim et al., 2023). Finally, tourism affects the quality of life for locals by disturbing the socio-cultural equilibrium and creating problems of traffic and overcrowding (Martini et al., 2017; Karim et al., 2023; Streimikiene et al., 2021). Taking into account these social and environmental impacts and the importance of natural resources for the attractiveness of tourism itself, it is crucial to study how tourist destinations are adapting to climate change and how they are managing the risks of potential maladaptation (Alpine Convention, 2005; Gios et al., 2006).

The alpine arch is characterized by a high degree of natural, economic and cultural diversity, which means that each destination will have different challenges and development opportunities (Alpine Convention, 2005). Therefore, in order to thoroughly examine the possible adaptation pathways, this thesis will focus on a specific case study: the Mont Blanc massif, which is the highest peak in the European Alps and a major tourist destination (VdA, 2014). This thesis will use Actor-Network Theory to study tourism destination adaptation in the Italian side of the Mont Blanc massif and to answer the following overarching research question:

How is the tourism system in the Mont Blanc area responding to the impacts of climate change?

That will be divided into the following specific research questions:

1. *How is the current system shaped, by what relations and by which actors?*
2. *How is the tourism system adapting to climate change?*

2 Literature Review

In order to better assess local perceptions of climate change, this section analyzes existing literature on its impacts in the Aosta Valley: the Italian region that hosts the Mont Blanc. In addition, literature on tourism adaptation specific to Alpine regions is reviewed from the perspective of tourists and destinations to understand similarities and differences with similar tourism settings. Particular attention is given to which actors are usually present and how they relate to each other. Finally, the current adaptation measures in place in the Aosta Valley are described, as they represent the framework of institutional objectives.

Relevant literature was searched in Google Scholar, Scopus and Web of Science using the following strings: "climate change" AND "Aosta Valley"; "climate change" AND "Mont Blanc"; "tourism" AND "adaptation"; "climate change" AND "perceptions" AND "Alps"; "tourism" AND "adaptation" AND "Alps"; "tourism" AND "Mont Blanc". Google Scholar was mainly used to access books, grey literature and to understand the research context before selecting more precise keywords. Moreover, the official website of the Aosta Valley was used to reach the relevant adaptation documents. Once the articles were selected on the basis of title and abstract, some additions were made by looking at references and relevant authors. The articles were then summarized in a document and classified by type of literature and topic to allow for easy analysis of the content.

2.1 Climate change impact in the Aosta Valley

One of the most studied aspects of climate change is glacier retreat. According to the latest glaciological report, 98% of the measured glaciers are currently retreating with a record mass loss documented in 2022 [Figure 1] (Baroni et al., 2023). This is mainly attributed to changes in accumulation and ablation processes caused by decreasing snowfall in winter and extremely high temperatures in summers (Calmanti et al., 2007; Baroni et al., 2023). Glacier variation due to climate change has been present throughout history, demonstrating the strong link between temperature and precipitation on glacier mass [Figure 2] (Cerutti, 1985; Sacco, 1934). Moreover, especially during hot summers, the increasing amount of water that flows through and under glaciers, potentially causes ice to suddenly detach and fall down the slope (Chiarle et al., 2021). A clear example of this is the Planpincieux glacier in the Mont Blanc area, which is constantly monitored for its risk of falling toward the highly touristic Val Ferret (Chiarle et al., 2021). Finally, the lowering of glacier surfaces and thawing of permafrost reduces the stability of rocks surrounding glaciers, leading to increased rockfall and erosion (Baroni et al., 2023; Bollati et al., 2019; Courtial-Manent et al., 2024).

Other factors that contribute to rock falling in different seasons are morphological conditions, elevated temperatures, alternation of the freeze-thaw cycle, and water from precipitation infiltrating the rocks (Frasca et al., 2020; Palomba et al., 2015; Savi et al., 2021; Bajni et al., 2021). Rockfall is a major concern, especially in the vicinity of inhabited areas, as it causes damage to both people and infrastructure (Cignetti et al., 2021).

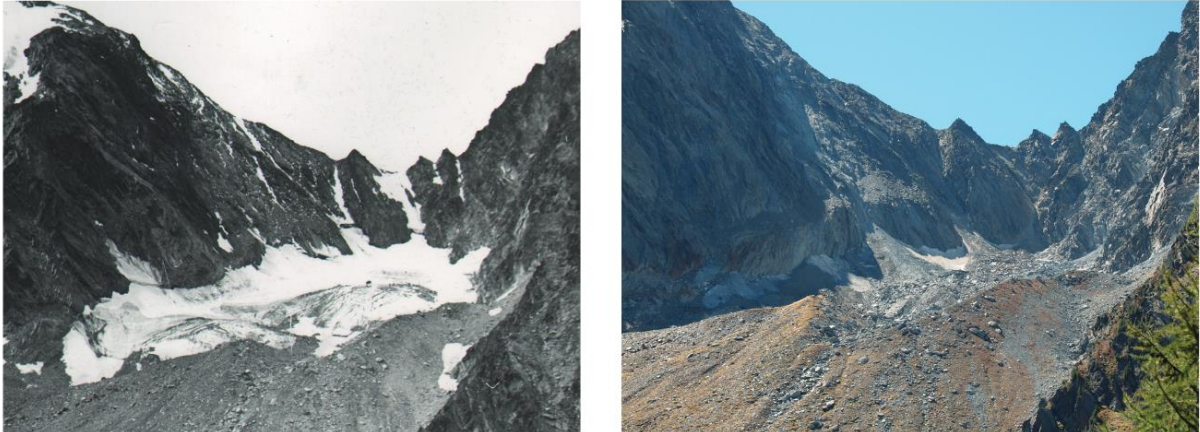


Figure 1. Testa di Paramont Glacier 1960-2022

These pictures taken from Barone et al. (2022) show an example of glacier mass loss in the Mont Blanc area. This glacier is now considered extinct while it was still well developed in the 1960s.

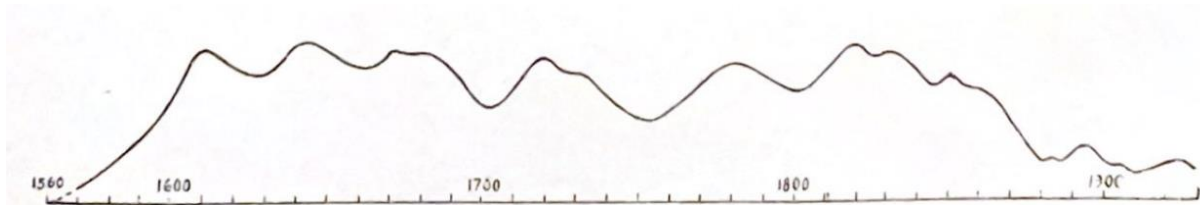


Figure 2. Mont Blanc glacier variation

This graph is taken from Sacco (1934) and it represents how glacier mass variation in the Mont Blanc massif since the 1560s have been studied in the previous century. The accuracy and lack of units of measurement of the graph are a clear limitation, but it comes to show the importance of this topic for the region in the past.

Climate change also impacts the hydrological cycle. In particular, while annual precipitation is not expected to vary, the seasonality will change significantly (ARPA VdA, 2021). Winter and autumn will be characterized by higher water precipitation with decreasing snowfall, increasing the need of reorganization of ski supply in the region (ARPA VdA, 2021; Joly and Ungureanu, 2018). On the other hand, summer and spring precipitation is expected to decrease with strong impacts on water availability and, as a consequence, on hydropower plants, especially those without reservoirs, which are the main source of energy in the region (VdA, 2023c; Maran et al., 2014; ARPA VdA, 2021).

Hydropower water demand during the summer months will also be affected by alternative water uses, resulting in potential conflicts between sectors (Maran et al., 2014).

Finally, increased temperatures affect the season for vegetation growth, which is becoming longer (Orusa and Mondino, 2021). However, there is evidence of increased evapotranspiration from vegetation and increased water demand, which can be problematic during the summer months (Orusa and Mondino, 2021). These shifts have implications for agriculture, both positively and negatively due to limited water availability (VdA, 2021b). Changes in temperature also affect mountain species composition and tree line altitude (Vacchiano and Motta, 2015).

2.2 Tourism adaptation

As explained above, climate change affects a wide range of environmental variables essential to tourism, including shifts in seasonality, landscape, weather, water availability, and increased hazards (UNWTO and UNEP, 2008). These impacts may be positive or negative depending on the destination, but the vulnerability of winter sports and glacier tourism destinations is well established (UNWTO and UNEP, 2008). It is therefore crucial to study how the tourism sector adapts to climate change, both from the perspective of tourists and destinations, as divided in the literature (UNWTO and UNEP, 2008). The concept of destination adaptation and adaptive capacity are explained in the theoretical approach section.

2.2.1 Tourists adaptation in the Alps

Tourists are considered to have the highest adaptive capacity in the tourism sector as they can easily change their plans, location and activities (Kaján and Saarinen, 2013). However, the way in which they adapt can vary from one tourist to another, and, therefore, tourists are often classified according to different variables in the literature. For example, recreational alpinists with higher climate change awareness are more likely to change their behavior because they understand the increased hazards of certain routes (Salim et al., 2023). However, certain behaviors, such as risk-taking, are also influenced by skill level of mountain tourists (Pröbstl-Haider et al., 2016). In terms of weather, relaxation- and activity-oriented tourists benefit more from increased sunny days compared to nature-oriented ones (Pröbstl-Haider et al., 2015), and experience-driven tourists are more resilient to reduced snow than leisure driven ones (Cocolas et al., 2016). Finally, glacier retreat, nature degradation, lack of snow, and some adaptation strategies, such as snowmaking, negatively affect landscape attractiveness (Salim et al., 2021a). In winter sports-oriented destinations, snowmaking is usually accepted by tourists as a way

to increase snow reliability (Pütz et al., 2011), however, it may be counterproductive if enjoyment of the natural environment is also an important tourism feature (Bausch et al., 2019).

2.2.2 Destination adaptation in the Alps

Destinations have the least adaptive capacity due to their static character, therefore, it is essential to understand whether they are willing to adapt to climate change and to the likely shift in tourism demand (Kaján and Saarinen, 2013). It is important to note that local perceptions of climate change are not only economic, but also highly emotional and linked to culture, identity, and well-being (Jurt et al., 2015; Whitaker, 2023). Compared to tourists, the local population is more aware of climate changes, although there is a common narrative of climate cycles, rejection of worst-case scenarios and tourist blame (Garavaglia et al., 2012; Jurt et al., 2015; Morrison et al., 2013). In general, even in cases where changes are evident, appropriation of the climatic phenomenon is often limited (Clivaz & Savioz, 2020).

The main concerns of the tourism industry are related to snow production and stability of infrastructure, while diversification does not seem to be a top priority (Morrison et al., 2013; Einhorn et al., 2015; Bausch and Gartner, 2020). Changes in the tourism sector are still not taking place, as stakeholders focus on maintaining the status quo and consider changes to be driven by demand rather than climate (Wyss et al., 2014; Hill et al., 2010; Abegg et al., 2008). Indeed, climate change is a low priority for some stakeholders and scientific reports are considered too dramatic (Behringer et al., 2000). Furthermore, ski area operators strongly believe in their capacity to adapt to changes, with a clear preference for short-term strategies such as snowmaking (Abegg et al., 2008). Adaptation takes place individually, for example through changes in the activities of stakeholders such as alpine guides, whose work is closely linked to environmental conditions (Salim et al., 2019; Mourey et al., 2020; Abegg et al., 2008). In this respect, there are some interesting cultural differences between France and Italy related to the client-guide relationship (one-day client vs. loyal client), which influences how easily guides can change a plan at the last minute (Salim et al., 2019).

Overall, the adaptation of tourism operators can be facilitated by increased cooperation and by sharing more and better information on the impacts of climate change (Matasci et al., 2014; Wyss et al., 2015; Salim et al., 2021b). It is also important to think long-term and proactively to prepare for the changes that will occur (Salim et al., 2021b; Salim et al., 2021c).

2.2.3 Tourism adaptation strategy in the Aosta Valley

The region currently has an adaptation strategy in place that is in line with the reference framework of the National Climate Change Adaptation Strategy (SNACC), but an actual plan with specific measures is yet to be approved (VdA, 2021b). The main objectives of this strategy are to minimize risks and focus on opportunities in agriculture and tourism (VdA, 2021b). In particular, as tourism is a key sector, the region relies heavily on the competitive advantage of its high-altitude ski resorts compared to other Italian regions (VdA, 2021b). In this context, snowmaking is considered a central strategy to ensure snow reliability, although conflicts over water use with other sectors are high (VdA, 2021b). Other measures proposed are the reorganization of the tourist offer through deseasonalisation and diversification through the search for new recreational sports (VdA, 2021b). The aim is to promote a mountain environment that is attractive all year round and that is not strictly linked to seasons (VdA, 2021b). However, the desired diversification partly contradicts the region's SMART specialization strategy, which still focuses on skiing and hiking as "star" products (VdA, 2021a).

Another key step in the strategy is to raise awareness and communicate risks and impacts to both tourists and the local population (VdA, 2021b). It is essential that tourism operators are made aware of the risks, impacts and opportunities related to climate change and that their role as an adaptation and education vector for tourists is valorized (VdA, 2021b). In this context, a better interaction and collaboration between different tourism resources is needed to increase the attractiveness of the destination and to compensate for possible losses (VdA, 2021b). With regard to the Mont Blanc area, this sense of collaboration is highlighted by the Espace Mont-Blanc, a cooperation between Italy, France and Switzerland, based on the sharing of experiences to manage responses to climate change in a unified way (Espace Mont-Blanc, 2013). Specific to tourism, the focus of the cooperation is on managing flows and resources, increasing mobilization and accessibility, and promoting local culture and products, which is in line with the strategy of the Aosta Valley (Espace Mont Blanc, 2013).

2.3 Research gap

As presented above, most of the current literature focuses only on specific actors in the tourism sector, particularly in relation to the ski industry, and a multi-perspective approach is still developing. Overall, there is a clear distinction and little integration between natural and social sciences, which raises the problem of how different actors are integrated at a system level. For example, the Mont Blanc area has been extensively studied from a natural science perspective, but a social science approach is still underdeveloped. Finally, most of the case studies presented are from the Swiss, Austrian and French Alps, which represent different socio-economic environments compared to the Italian Alps. This thesis

will contribute to the current literature by applying a network perspective to Italian alpine regions in order to understand how different actors relate to each other and how the tourism system is adapting to climate change. By using Actor Network Theory, a multi-perspective approach will be applied, which will allow the inclusion of non-human actors. Finally, tourists may be included as actors in the system, but the focus will be on understanding how the destination is shaped and adapts to the problem of climate change.

3 Theoretical Approach

3.1 Post-structuralism

Post-structuralism emerged as a critique of structuralism's use of centers, binary oppositions, and the creation of truth regimes (Woodward et al., 2009). One of the main aspects of this approach is the rejection of a priori knowledge and structures (Woodward et al., 2009). Indeed, post-structuralism argues that the real world is constructed through context and perceptions, and that "truth" is a product of power (Woodward et al., 2009). It is therefore important to understand the difference between the real and its social mediation: representations (Woodward et al., 2009).

One of the binary oppositions critiqued by post-structuralism is that between the social and the natural (Dujardin, 2020). In the context of climate change adaptation, the binary distinction between social change (adaptation) and natural change (climate change) is criticized as false and unhelpful (Dujardin, 2020). Rather, climate change should be considered as socio-natural, with the aim of highlighting the implications of actors' framing of climate change and treating adaptation as an internal process (Dujardin, 2020). As each discourse creates its own truths, a multi-perspective approach is essential to develop a common understanding of the problem (Dujardin, 2020). In addition, special emphasis should be placed on addressing the more than human relationships between individuals and structures (Dujardin, 2020).

3.2 Actor-Network Theory

Actor-Network Theory (ANT) is a social theory based on relationalism, which describes the world as a heterogeneous mix of relations and practices in which both humans and non-humans are considered actors (van der Duim et al., 2013). The way in which agency is defined for actors is through the ability to make a difference in the course of other actors' actions (Latour, 2005). Agency is thus dissociated from a sense of intentionality allowing non-human actors to be included in the network (Latour, 2005). Indeed, non-human actors obey their own rules and, through them, they become an integral part of the functioning of the network (Latour, 2005). In this sense, the behaviors and rhythms within a community are also dictated by non-human actors, even though humans ultimately enforce these rhythms (Robins, 2007).

Consistently with post-structuralism, ANT builds on the idea of multiplicity, or principle of generalized symmetry, as reality exists but it is only made possible through different networks and relations (van der Duim et al., 2013; Callon, 1984). Therefore, it is important to study the different realities in which our world is constructed (van der Duim et al., 2013). ANT follows the principle of free association,

according to which all a priori structures and distinctions between the social and the natural should be abandoned (Callon, 1984). Finally, according to the principle of agnosticism, there should be impartiality when interacting with different actors, as all perspectives are valid and play a crucial role in the network (Callon, 1984).

In the context of the tourism sector, the goal is then not to understand why things are done in a certain way, but how the system is constructed, how it works, and how it can fall apart (van der Duim et al., 2013). ANT builds on the concept of translation: the process by which actors share and "translate" meaning with each other according to four key moments shown in Table 1 (Deason et al., 2022, Callon, 1984).

Table 1. The four moments of translation

Moments	Definition
Problematization	Emergence of a problem that allows the translator to help overcome it
Interessement	Actors become interested in the problem
Enrollment	Roles are defined
Mobilization	Actors are enrolled and aware of their parts

The definitions are taken from Deason et al. (2022) and they will be the guiding line throughout the paper.

The process through which the system uses translation to stabilize and reorganize itself, is called ordering, and ANT aims to discover the multiple orderings through which the world emerges (Deason et al., 2022; van der Duim et al., 2013). Indeed, no single translation plan prevails over the others and orderings are the resulting effect of this multiplicity (van der Duim et al., 2013).

3.3 Application of theories

In the context of this thesis, post-structuralism serves as a lens to examine adaptation as a socio-natural phenomenon. Indeed, as explained above, the multiple framing of the actors of the problem of climate change can influence how adaptation can be developed. Moreover, the rejection of a priori knowledge is done by prioritizing the actors' point of view. From this follows the focus on multiple actor perceptions, which has been a main attribute of this thesis since the fieldwork. ANT will be used mainly for the analysis part of the thesis. Particular attention will be given to the definition of the current system and the inclusion of non-human actors. Subsequently, in order to follow the moments

of translation, the ordering of the tourism system in the Mont Blanc area when adapting to climate change will be analyzed. The aim is to understand at which moment of ordering the tourism system is currently at and the perceptions of locals over different orderings. The specifics of the use of ANT through coding are described in the methodology section.

3.4 Destination adaptation

Adaptation is defined by the IPCC as *“the process of adjusting to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities”* (IPCC Glossary, n.d.). This leads to the concept of adaptive capacity, which is the ability to adapt to these changes (IPCC Glossary, n.d.). Destination adaptation focuses on how tourism destinations adapt to climate change, taking into account the limits of their adaptive capacity, mainly due to their static nature (Kaján and Saarinen, 2013). Indeed, compared to tourists who can easily change their behavior by traveling to a different place, destinations are spatially constrained and cannot suddenly change their attractiveness (Kaján and Saarinen, 2013). Other limiting factors for adaptation can be economic, technical, biological or social parameters (Kaján and Saarinen, 2013; Adger et al., 2009). For the scope of this thesis, the focus is mainly on social parameters such as ethics, knowledge, risk and culture (Adger et al., 2009). Indeed, when making decisions for future adaptation, stakeholders are influenced by knowledge of past climate, present situation and future predictions, so the way in which they understand climate change can directly influence how much they are willing to adapt (Asger et al., 2009).

Finally, it is important to introduce the concept of maladaptation which is defined by *“actions that may lead to increased risk of adverse climate-related outcomes”* (IPCC Glossary, n.d.). Maladaptation is a common unintended consequence of adaptation (IPCC Glossary, n.d.). In this sense, it is crucial to understand the potential for maladaptation and what efforts are being made by the destination to avoid maladaptation.

4 Methodology

4.1 Design and strategy

This thesis takes a qualitative design as it aims at making sense of climate change adaptation in the Alps (Alvesson and Sköldbberg, 2018). By using this approach, I am able to focus on the opinions, perspectives, and behaviors of the subject under study in their natural setting and how they give meaning to the phenomenon (Alvesson and Sköldbberg, 2018). The strategy for doing so is to focus on a specific case study, which is an effective method to answer "how" questions and analyze contemporary events (Yin, 2009). The choice of the Mont Blanc area as a case study is linked to the research problem and to the literature gap, while the context and geographical borders of the case are described below. The use of a case study within a limited geographic space allows me to uncover the richness of the social phenomenon and the complexity of the tourism system within its context (Yin, 2009). In fact, it facilitates the use of concrete illustrations and specificity in the analysis, while remaining at a manageable size, which is especially important given the temporal and spatial limitations of this work (Yin, 2009).

4.1.1 Case study

The Mont Blanc area [Figure 3], also known as Valdigine, is part of the autonomous region Aosta Valley (VdA)¹ and it includes five municipalities: Courmayeur, Morgex, La Salle, Pré-Saint-Didier and La Thuile (Unité des Communes valdôtaines VALDIGNE-MONT-BLANC, 2015).



Figure 3. Aosta Valley and Mont Blanc area

These images show where the Aosta Valley is located in Italy, and how it can be divided into different areas. The pictures are taken from Wikipedia (n.d.) and VdA (2014).

¹ For the sake of clarity, the term "area" will be used only for the Valdigine area, while the term "region" will refer to the whole Aosta Valley.

The Aosta Valley is the smallest and least populated Italian region with a total population of 123,130 while the Val d'Aosta area has a population of 8,459 (ISTAT, 2024; VdA, 2021a). Tourism is the sector that brings the highest added value to the region and the Mont Blanc area hosts the highest number of tourists each year (VdA, 2021a; VdA, 2024). In 2023, a total of 368,727 tourists visited the area, almost forty-four times the number of residents (VdA, 2024). The region has a strong local identity, which is also reflected in its autonomy status (VdA, 2021a; VdA, 1948). Indeed, the region has two official languages (Italian and French) with a local culture that revolves around craftsmanship (especially wood), food (especially wine and bovine derivatives), traditional clothing, mountain sports (alpinism, skiing, climbing and hiking) and other local traditions like sports and festivities (VdA, 2023a). The region is characterized by an extremely mountainous landscape as it has an altitude ranging from 343m to 4810m with 60% of the region above 2000 m (VdA, 2021a). While the mountainous landscape and the widespread presence of glaciers are considered an important part of local identity, this morphology has a strong impact on services and accessibility, especially in the lateral valleys (Simaraglia, 2006; VdA, 2021a). Important historical changes in accessibility were brought about by the construction of the highway and the Mont Blanc Tunnel, which "opened" the valley and made it an important bridge to France and the rest of Europe (TMB, n.d.). This allowed more people to reach the region and contributed to the development of tourism (TMB, n.d.). Most of the tourists are Italian, although international tourism is quickly growing especially after the COVID-19 pandemic which, due to mandatory closures of ski resorts, brought more attention towards summer and intermediate season (VdA, 2023b). Additionally, tourism is crucial for other sectors such as agriculture and craftsmanship as it is the means to promote local products (Espace Mont Blanc, 2008).

4.2 Data collection

I used semi-structured interviews for data collection - 23 interviews were conducted with different actors of the local population from the 17th of January to the 26th of February 2024. Moreover, for one actor in the skiing industry it was not possible to organize an interview and therefore I relied on a written communication by e-mail that will be included to the limit of this form of data collection. The choice to include this different type of data is due to the importance of the ski industry for the case study. Finally, some secondary data was used to gain a more complete understanding of the case study. In particular, actors' websites and visits to museums, fairs and conferences were used to gather additional information and to understand how they are presented to visiting tourists. The information

from these data sources is included and evaluated in the analysis, within the limits of these different types of data.

4.2.1 Participants selection

In order to maintain an impartial approach to the process and incorporate multiple perspectives, participants were selected from a variety of areas and backgrounds. Given my familiarity with the case, this selection was initially made through personal connections with specific participants, and then the network was built through snowball sampling. Contrasting views were included by looking for potential different interests based on the type of job and the place where the participants lived. In addition, as I became familiar with the participants' relationships, the fame that some of them had in the system allowed me to broaden my sample and include other conflicting perspectives. The associations and businesses involved in the interview process and the specifics of the interviewees are described in Appendix A. In the case of workers in shops, bars, hotels and food producers, the specific business is not mentioned to ensure anonymity. The participants were not strictly divided into groups and were allowed to fluctuate between different macro-groups. By following this selection strategy, I was able to include in the process the relevant actors for tourism in the Mont Blanc area.

4.2.2 Interview setting and questions

The setting of the interviews was kept informal, and the meetings were conducted in Italian, either at the interviewee's workplace or at the local café where the local population primarily meets. The aim of this type of setting was to ensure clear communication with the interviewees, to provide a safe space and to be immersed in the local culture. Moreover, I relied on notes rather than recording the interviewees in order to respect the interviewees preferences and to avoid potential discomfort. The guiding questions were related to perceptions of changes in the system regarding climate change, adaptation, and relational shifts [Appendix B]. This allowed me to understand the history of the system and what the future might look like from the perspective of the local people. In addition, questions about identity and place attachment were included to understand the values and priorities of different actors. The questions asked were open-ended to allow respondents to describe the issue as they saw fit, and follow-up questions were asked to avoid misunderstanding and expand on the answers.

4.3 Analysis and use of ANT

The analysis of the data was done by applying ANT through the use of NVIVO coding. With this method, I was able to code all of the interviews and additional material collected during the fieldwork, partly deductively and partly inductively.

In particular, the deductive codes were divided between the two sub research questions [Figure 4] in order to work with a clear temporal distinction. Instead, the definition of the different Actors was done inductively following the framing done by the interviewees. Similarly, the definition of the different phases of Ordering was done inductively to better represent the interviewees' description of adaptation. This is essential to avoid using pre-existing grids and to follow the ANT principle of free association. The induced codes were then organized to find the most common themes [Figure 4]. Finally, I analyzed the interviews a second time to focus on the dynamics between the actors and on who said what. The goal of this process is to understand the differences and similarities between the actors' orderings of the same system. Indeed, multi-perspectivity is essential for ANT's principle of general symmetry. Special attention has been given to the explanation of non-human actors and how they are currently perceived, especially those that are essential in an adaptation perspective.

DEDUCTIVE	INDUCTIVE	
Current System	Current System	Ordering
Actors	<u>Actors</u>	<u>Problematization</u>
Relation	Sports providers	Glacier
Ordering	Nature	Flora and Fauna
Problematization	Governmental institutions	Snow
Interessement	Environmental associations	Seasonality
Enrollment	Hotels, bars, shops	Temperature
Mobilization	Journalists	Hazard and Safety
	Mont Blanc Tunnel	Water
	Social capital	Wind
	Tourists	Human Impact
	Food producers	<u>Interessement</u>
	QC terme	Deseasonalization
	Skyway	Diversification
	<u>Relation</u>	Communication
		<u>Enrollment</u>
		Collaboration
		Municipality
		<u>Mobilization</u>

Figure 4. Deductive and Inductive Coding

This figure shows the deductive and inductive codes used in NVIVO. The inductive codes shown here are already organized and refined to avoid thematic redundancy and allow for a clear representation (Own illustration).

4.4 Positionality and ethical considerations

Regarding ethical considerations, all interviewees were asked for consent and were informed about my role as a researcher, the treatment of data collected, and the withdrawal of consent. The questions asked did not cover particularly sensitive areas, and interviewees were informed in advance of the topics that would be covered. Moreover, during my fieldwork I tried to reflect my positionality as much as possible. In fact, while being Italian myself and being familiar with the place allowed me to understand specific dynamics, on the other hand it is important to be aware of my preconceptions about the problem. In particular, as a regular tourist in the area myself, I had to be aware of my past experiences with the tourism system and how they might influence my perception of it. To limit this bias, I tried to immerse myself as much as possible in the local culture and to remain open to their description of the system, even when different or negative points were raised. Moreover, my background and my role as a sustainability researcher pose possible threats of objectivity towards the interviewees' perceptions of climate change and adaptation. Therefore, I tried to keep the focus on their experiences and point of view, while avoiding expressing my personal opinion.

5 Findings

5.1 Current system – RQ1

The definition of the current system is a representation of the framing done by the interviewees and it displays the relevant actors and their relations. The interview quotes below are followed by the role of the interviewee in parentheses to provide more context on their perceptions.

Among the main actors included in the system are those that attract tourists, either tourism operators or non-human actors that serve as tourist attractions. In this respect, sports activities were the most frequently mentioned by all interviewees. In particular, downhill skiing is considered the leading activity for winter tourism, with alternatives still related to snow sports such as cross-country skiing, ski mountaineering, snowshoeing and ice climbing. Downhill skiing is usually operated by ski resorts which in the Val digne area are present in Courmayeur and La Thuile, cross-country skiing is mainly practiced in Val Ferret where a track is operated every winter. Ski mountaineering, snowshoeing and ice climbing do not require a structure to be practiced and are usually services offered by alpine guides or the CAI (Italian Alpine Club). For summer tourism, the main activities are hiking, trail running, climbing, mountaineering, biking and moto trial. In this context, the Tour de Mont Blanc, which consists of a circular route around Mont Blanc, was highlighted by the interviewees. This activity is regulated by a network that allows participants to book accommodation and plan their route. For trail running, the main competitions take place in late summer/early autumn and are under the organizations of UTMB, TORX and Arrancabirra. Biking is mostly regulated by rental stores (especially for e-bikes) or done individually with Val Ferret and Val Veny as main destinations. Indoor climbing is offered by the Service Centre of Courmayeur (CSC), while rock climbing and mountaineering are usually done individually or offered by alpine guides and CAI. Finally, moto trial is usually practiced at lower altitudes in La Salle and Morgex but it was mentioned by only a few interviewees.

Additional activities are related to the enjoyment of nature, both forests and glaciers. Indeed, nature can be considered as a non-human actor of tourism, since it directly influences the attractiveness of the destination by providing essential ecological functions, as well as aesthetic, cultural and recreational ones. It is interesting to note how, among the interviewees, there was a strong tendency to personify the mountain and its characteristics.

“The Mont Blanc is a sacred mountain, it has its energy between crystals and fluorites. It attracts souls that want to evolve” (cultural tourism)

“I’m never alone, I’m surrounded by extraordinary mountains. Mountains talk to you when no one is around and you can hear their sounds” (alpine guide)

“Snow excites children, it’s everyone’s dream” (hotel)

“Glaciers are the smiles of mountains” (glaciologist)

This shows the importance that the interviewees attached to nature itself and, indeed, most of the activities mentioned above do rely on nature. For tourism specific to the Mont-Blanc massif, the Skyway is considered a key actor, as it offers the possibility of easy access to its glaciers to everyone. Moreover, relaxing activities such as spas were mentioned, with particular reference to the Pré-Saint-Didier QC Terme. Another type of attractiveness is Eno-gastronomic tourism and, in this sense, food producers and restaurants play a crucial role. Finally, tourism related to culture and castles is also considered as important in the area, although it does not have the same potential as other activities.

Other actors included in the tourism system are hotels, bars/restaurants and shops that deal directly with tourists visiting the area. Indeed, they form the hospitality sector of the destination and the periods in which they are kept open reflect tourism high periods. Moreover, the type of stores and bar can serve as an attraction and entertainment for tourists. These actors are multiple, usually family-run, and well distributed throughout the area at different altitudes. As an alternative to hotels, holiday houses that host regular tourists are extremely important especially for Italian tourists. Related to this hospitality infrastructure, are construction agencies and real estate agencies that determine the number and the type of hotels and houses.

In fact, some actors have a direct influence on the system, even if they are not strictly related to tourism. For instance, municipal, regional and national governments define the legal framework within which the system evolves. In particular, municipalities are responsible for building permits, transportation, road and service closures, track maintenance, communications, and other local services. Some of these responsibilities are shared with regional and interregional associations, such as ARPA and AINEVA, which carry out environmental assessments, particularly in relation to risks. At the municipal level, however, alpine guides, Forestry Corps and Fondazione Montagna Sicura play a crucial role in evaluating these regional assessments and helping the municipality decide which closures are necessary. In this regard, the role of journalists in communicating these risks and closures is essential to avoid alarmism and ensure clear communication. The municipality is also responsible for public transport, which is free in some valleys during certain seasons. These closures and transportation decisions then affect what activities can be done and where people can go. Another actor related to this accessibility is the Mont Blanc Tunnel, which regulates the flow between Italy and

France. In fact, neighboring countries such as France and Switzerland are also mentioned as relevant actors in the system because of their different approach to managing tourism, but also for the tourists themselves who visit the area. Similarly, nearby cities are considered crucial as most Italian tourists come from Milan and Turin. In this sense, visitors are obviously part of the tourism system, both national and international.

Finally, another important non-human actor is that of local identity. Local identity, as framed by the interviewees, revolves around traditions, attitudes and language, and it is reflected in their attachment to the place. Its role as a non-human actor is defined by the patterns and the pace of local life as well as the strong feeling of belonging and the difference it makes in the behaviors of local people. Indeed, all interviewees, independent of age, education or profession, were extremely attached to the feeling of home, to the well-being of living in such a place and to the natural environment around them. The majority of the interviewees would not live anywhere else in the world, and this is true both for older generations who have lived in the area all their lives and for younger generations who have tried to live in cities like Turin for their studies. However, there was a shared feeling that the local identity was being “sold” to attract urban people and to make the destination look as similar as possible to what urban people are used to. Identity loss can be observed in the gradual loss of traditions and of French as a language. Almost all interviewees commented on this phenomenon and on the desire of municipalities like Courmayeur to become “city” even in the type of stores present. The result is a lack of passion and the spread of a business and urban attitude among some locals. Indeed, the strong difference between the mountain mentality and the urban way of approaching the mountain, services and activities was highlighted by the interviewees.

“The mountain is stronger than the man. A mountaineer knows it and is used to not being able to do activities because there are bad conditions or to remain blocked somewhere waiting for the weather to be better. This is difficult to accept for urban people that can always do everything. The mountain has its times and rhythms” (municipality)

“If you were not born here, it is difficult for you to feel the syntonny with the mountain” (alpine guide)

“Young people want to go to the mountains less and less, they want to go to the city [...] they wait for the weekend to go out like urban people do” (transportation)

“Tourism here is mostly Italian, and very Milanese (around 70%), and you offer them the same stores that they have in Milan? Why do you have to lose your identity to this level? Why should you do it in favor of those who come to visit?” (cultural tourism)

These quotes and the perceived loss of identity already show part of the relations in the system and, in particular, between the destination and the tourists from Milan and Turin. Indeed, the interviewees pointed out less integration and communication between locals and tourists compared to the past. Regarding the relations among the local population, there are different perspectives. On the one hand, the place is relatively small and people feel like they actually belong and know everyone that lives there. This translates to being considered as a person and not a number and being able to create connections with everyone. On the other hand, everyone is “living in its own world” and they seem to struggle to collaborate. This is also influenced by tourism seasons: when the tourists are away, local people can build their relations and network, however, most people take advantage of low seasons to relax or go on holiday. Moreover, this divide is extremely present with business owners who come from the city. All interviewees seemed to be aware of these conflicts and were happy to initiate discussions on this topic.

“Collaboration with local sectors has been a positive experience, but it really depends on the issue discussed” (environmental association)

“We should work together with other companies to create a common view. We should do it to preserve the environment we are in, which also means to preserve ourselves. But everyone works individually here” (transportation)

“Everyone lives in their own hotel and shop. There are few interactions between associations and there are no collaborations” (other sports)

Following this description of the system, the interviewees could be divided into macro-groups according to their role in the system (e.g. institutions, tourism operators specific to mountain environment, general tourism operators). However, most of the interviewees do not belong to one specific group and have multiple activities or live and work at different altitudes, making a clear classification difficult [see Appendix A]. In this sense, participants were not divided into specific groups, but their different roles were taken into account and linked to the corresponding quotes to better represent their contributions.

5.2 System ordering – RQ2

After having defined the current system, questions related to current adaptation and the future of the valley allowed me to understand how the process of ordering is proceeding. This section will therefore be divided into the four moments of translation, including the perceptions of different actors.

5.2.1 Problematization

This phase is characterized by how actors problematize climate change and what challenges or problems they identify. All interviewees agreed on the existence of climate change and focused on similar aspects of these changes, albeit to varying degrees. Indeed, the actors who work directly with the mountain (alpine guides, Forestry Corps and food producers) and environmental associations were focused in describing the changes observed through their work, while other actors relied more on their personal perceptions mostly related to visible changes and weather conditions. In general, climate change has been accepted and it is perceived as a reality that they are facing today and not as a future projection. Most interviewees mentioned that climate change is becoming more and more intense with increasing worries for safety.

Glaciers were mentioned by almost everyone not only for their visual loss, as in the case of the Brenva glacier [Figure 5], but also for their associated risks. Indeed, the interviewees that live or work under glaciers claim to hear the sounds of the melting ice and crevasses fractures. On this matter, there is also an art exhibition in the Skyway Museum with a room that plays the sounds of melting ice and collapsing glaciers. A special case is the Planpincieux glacier, which is closely monitored due to the risk of collapse. Safety concerns related to glaciers, permafrost thaw and rockfalls are common to almost all interviewees, but especially to those whose work is strictly related to the mountain environment.



Figure 5. Brenva Glacier 1897 - 2014

This picture taken from Riso (2019) shows the visual loss of the Brenva glacier on the Mont Blanc massif. The Glacier used to extend almost all the way to the valley and nowadays it only reaches the tree line limit and rocks divide its upper and lower part. Today it is still possible to observe where the glacier used to be in the past.

Another aspect of climate change mentioned is precipitation: all interviewees agree that there has been a decrease in the amount of snowfall, which was mostly derived from recalling activities they could do as children that are no longer possible, such as sledding down the street after school. An interesting fact mentioned by more than a third of interviewees is the succession of rain and snow, which leads to a general confusion between the different seasons as the climate becomes less reliable. Seasonal changes were also mentioned by interviewees who work closely with the mountains in terms of when certain activities can be done. In general, it has become more difficult to interpret mountain conditions, which are becoming less predictable leading to increased risks.

“It snows, then it’s windy, then it’s hot and it rains, then it’s cold and it snows again and then you have sand coming: you don’t understand what’s happening anymore” (alpine guide)

The presence of wind was also mentioned by some interviewees as a new feature of the recent years. Temperature increases are also evident, particularly in relation to hotter summers, but also warmer winters. A common observation made by shop and bar owners is the lighter clothing needed and used by tourists during winter. While water appears to be abundant in the area, changes in water availability have been mentioned for La Salle municipality and for mountain hut high in the mountains where access to water is limited. Interviewees from institutions and food producers mentioned the potential for future water conflicts between different uses, also driven by a lack of responsible water use.

“People from the Aosta Valley live surrounded by water, but you don’t realize its importance until it’s gone” (food producer)

Finally, changes in flora and fauna were mentioned by specific actors that work with them on a daily basis like Forestry Corps, food producers and environmental associations.

While climate change is widely accepted, the human impact on the climate is questioned by a third of interviewees from surprisingly diverse backgrounds. Indeed, in the area there is a common narrative of alternating natural cycles and that humans do not have a strong impact on them. This leads to the belief that we are currently in a warm period but that colder periods will return as it is just part of a cycle that we cannot control. Some of the interviewees were more vocal than others in expressing this opinion, but it seems to be a widespread doubt. However, all interviewees notice some human impacts in terms of excessive construction and pollution, which can be easily observed in the natural environment in which they live. Indeed, such an impact is easier to associate with humans compared to increasing temperatures.

5.2.2 Interesement

All interviewees showed interest in dealing with the problem of climate change to varying degrees. In particular, some adaptation strategies were suggested and their relations in the system are presented below and summarized in Figure 6.

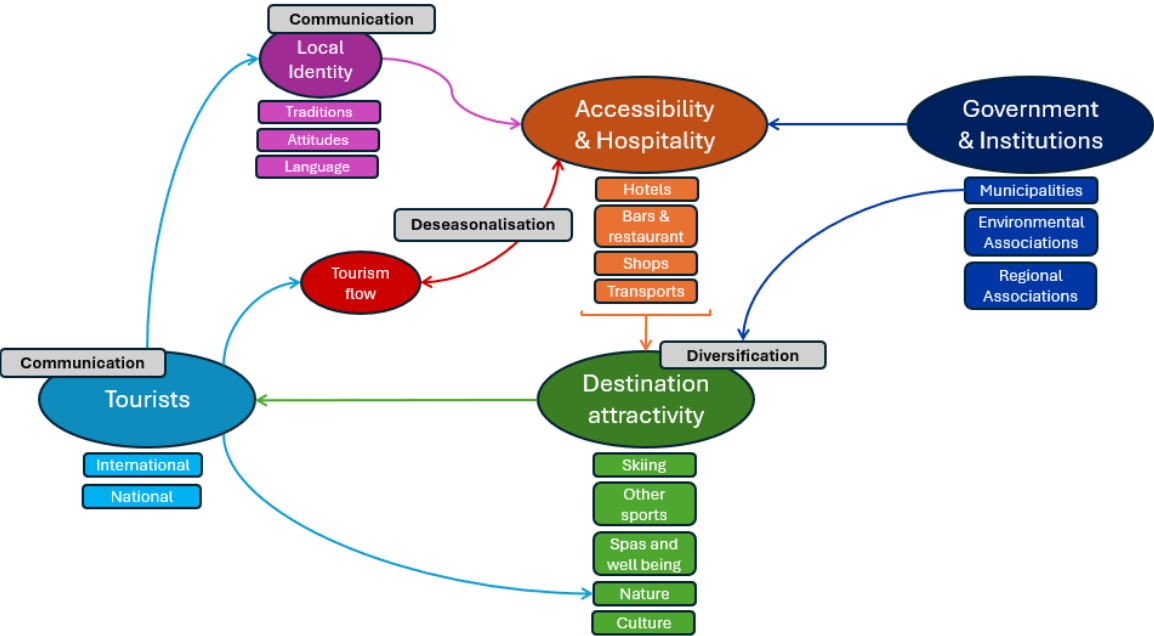


Figure 6. Tourism system and adaptation strategies

This figure summarizes the proposed adaptation strategies (grey boxes) and how they interact with the system defined in the previous sections. The arrows show the direction of influence and they represent both positive and negative effects. The colors are for visual purposes only and have no inherent meaning (Own illustration).

Deseasonalisation

One of the main suggested pathways is that of deseasonalisation. Indeed, the tourism system is highly seasonalized with consequences for the quality of services. An example of this is the municipality of Courmayeur that goes from 2,000 residents to 30,000 people during the peak season, which means that services like wastewater treatment, transport and parking are periodically put under pressure. This is especially true for cable cars and ski resorts given the extremely high number of people that you can already find on the slopes during the high seasons. These seasonal differences are partly due to weather conditions and national holidays, which cause people to leave at the same time and focus on weekend stays rather than taking a whole week off.

In the face of climate change, which will lead to more uncertainties, especially for snow, attracting tourists regardless of seasonal conditions is seen as a great opportunity. In addition, with climate change, the summer season is becoming longer and it is important to take advantage of the increased

window of good weather. The potential year-round attractiveness of the area is recognized by all interviewees, who agreed on the beauty that nature can offer in all seasons, even in off-peak periods.

*“Autumn is extremely beautiful, it’s really photogenic with its colors, the snow and long shadows”
(hotel)*

*“May is wonderful with green grasslands that create a contrast with the mountain top still white”
(alpine guide)*

From this recognition follows a desire to share this beauty with tourists and to develop year-round tourism. However, there are conflicting views on how to approach the low season. These "dead" periods are seen as moments for residents to enjoy nature, connect with each other, and recover from an intense tourist season.

“Tourism denaturalizes us, but we have the luck of months where you can really enjoy life with no one around” (other sports)

Particularly, those interviewees who work directly in contact with tourists, such as bar and hotels, enjoy having moments of peace where they can rest. Interestingly, hotels and bars owners still had an interest in deseasonalisation, since they were complaining about reduced profits during the low season, but they are the first ones to work against such a shift by staying closed as soon as the peak season ends. Indeed, their interest still seems to be in maximizing the seasons that are already profitable, instead of starting to offer a service and motivate people to come all year round.

“It’s ok to extend the tourism season, but you should first focus on filling the seasons that are already working in terms of restaurants and rentals” (bar)

*“You can extend the touristic season, but then try to find an open bar or shop in October”
(transportation)*

“If you offer a service then it grows and you find other people willing to come. If everything is closed in May, you are not encouraged to visit. In July and August, they heavily milk the tourists and they lower the quality, then they say that in October is not profitable to stay open.” (alpine guide)

This shows a partial Interessement in solving the problem of high seasonality, however, a lack of proactivity. Indeed, maximizing the tourism season will lead to more intense tourism with increasing social and environmental impacts. On the other hand, a more spread out tourism allows the destination to have less intense seasons, reducing the need for recovery. To justify their position, bar

and hotel owners mentioned that the mountain also needs to rest and enjoy these “dead” periods, but no opinion was given on how to deal with the impacts of mass tourism.

“The mountain lives its periods in which no one is around. Workers recover in those periods but so does the mountain” (bar)

An alternative suggested by a couple of interviewees was also to have a closed number of tourists and to aim for exclusivity rather than mass tourism, in order to reduce the overall impact of tourism on both the population and the environment.

Diversification

Another important aspect of adaptation of the tourism systems is diversification. All interviewees mentioned this concept as a necessity to attract tourists when snow is not a certainty. However, the alternatives proposed and the timescale of this Interestement did vary among the participants. The focus of all interviewees was on winter tourism, as skiing and snow-related activities will be most affected, and the proposed substitutes are mostly already present to a lesser extent. Biking and hiking (on snow or simply in nature) were frequently mentioned as strong alternatives for tourism, especially e-bikes, which are similar in physical effort to downhill skiing and therefore a good and a accessible option. Mountaineering skiing is also mentioned as it can be easily transferred to higher altitudes where snow will still be present, along with glacier tourism and the Skyway cable car.

Other alternatives presented are feasible, but are unlikely to match the numbers that skiing brings in, and thus were not a top priority for the interviewees. An example promoted mainly by food producers and bar owners is food and wine, which already seems to attract international tourists to the area. The aim will be to also attract tourists with local traditions and to create a stronger picture of the locality, like the example of “Discover Morgex” event. This focus on local traditions would also be an important response to the loss of local identity and the "selling out" of municipalities to attract tourists. On the same line of thought, cultural tourism is presented as a valid option by a third of the interviewees, mainly from institutions and environmental associations. The focus should then be on the high number of castles in the region, as well as the potential for conferences and increasing opportunities to share scientific knowledge. Finally, another alternative is also related to QC Terme and well-being.

Most of the alternatives presented by the interviewees, although already present in the system, will strongly affect the functioning of the system, especially in the long term, if they become substitutes for skiing. Indeed, most of the interviewees who work directly with tourism took a long-term view of the problem. However, the timeframe used by municipalities and ski resorts is mainly for short-term

adaptation rather than long-term system change. The options proposed by these actors are then snowmaking and shifting ski resorts at higher altitudes, while the potential of the alternatives presented above is dismissed. They tend to share a mentality of “we will deal with the problem when the problem arises” and therefore postpone such decisions. Concerns about water consumption were also raised, despite the fact that they are promoting snowmaking, which is extremely water-intensive, highlighting the contradictions of these actors:

“We need to change habits like the use of water. Here we have enough, but if we use it all there is none left downstream” (municipality)

“Removing skiing now it’s impossible, but we shouldn’t demonize it. Also the consumption of water for snowmaking are irrelevant compared to other factors” (municipality) (Rota, 2024)

Communication

For both deseasonalisation and diversification, interviewees from institutions mentioned the importance of communicating and educating both tourists and local people. This was particularly emphasized in contrast to the mentality of the French neighbors, who are more adventurous and better manage their destinations.

“We are as lucky as France in terms of environment and resources, but we have an Italian way of doing things” (shop)

“The French better understand the potential of things, they have a clearer idea of mountain business” (transportation)

It is also necessary to communicate with the local population about respecting the mountain instead of exploiting it to attract tourists and make money. This is also related to the way in which climate change is problematized, and it is a concept that has been highlighted by those who work with the mountain or with culture.

“The mountains are exploited without thinking about the future. They are not taken care of and they are being excessively exploited” (alpine guide)

“There are two categories of people: those that to this day still think that the mountains should be preserved and those that exploits them as much as possible” (cultural tourism)

“The only goal is making money, and in the valley you do so with tourism” (glaciologist)

Therefore, sensibilization is needed so that local people understand the importance of collaborating with nature and adapting to changes in weather and seasons. Such communication can be difficult, especially when the impacts are directly related to people's lives and businesses, but it is essential for local people to accept such changes and become agents of sustainable adaptation. In this shift of mentality, a concept that was considered important by the interviewees is the respect for the mountain and its dominance over man.

“We have to be careful. We need to respect the mountain’s rules. We would like a mountain that adapts to us, but it’s the other way around. There is no medicine for the mountain” (alpine guide)

“We need to change our awareness and learn how to cooperate with nature” (cultural tourism)

Likewise, tourists can change their attitudes towards the mountains with increased communication. This was suggested in response to the change in tourist mentality noted by more than a third of the interviewees who work closely with tourists. Indeed, current tourism is more linked to appearance rather than love for nature and the mountains and this is mostly a reflection of the changes happening in nearby cities like Milan and Turin.

“There are no longer the tourists of the past who love the mountains and seek contact with nature. Now tourism is a way of appearing and it’s obsessive.” (transport)

In addition to the goal of changing attitudes, communication should also involve accepting changes and differences in feasible activities. One of the problems most often raised by alpine guides is what to tell tourists, especially since they can no longer offer the same activities due to different conditions and safety concerns. Indeed, tourists should be aware of the increased risks without being alarmed, which was a point of particular concern for municipalities that do not want to scare away tourists. Indeed, mountain environments always carry risks which are now increasing due to climate change, and it is important that tourists understand such risks and how to deal with them. A common observation made by tourism operators, both in the mountain and in the hospitality sector, is that during the high season there is a lack of knowledge about how to approach the mountain and its risks. This increased after the COVID pandemic, when people were looking for tranquility in nature and many started to go to the mountains without precautions. As a result, the number of incidents has increased and more people are putting themselves in unnecessarily dangerous situations.

5.2.3 Enrollment and Mobilization

There seem to be many limitations in moving from actors' interest in the problem to actual enrollment and mobilization. Indeed, as described in the current system, there is a problem of lack of coordination and cooperation, and while people are aware of this limitation, it seems that few solutions are actually proposed to help a division of roles. There is a lack of collaboration both between different actors and within the same organization, such as among alpine guides, who each go their own way and adapt separately. In fact, most of the proposed answers are seen from a very individual point of view, such as businesses expanding or changing their offer (e.g. Skyway moving from cable car to experience and museum), while the responsibility of managing substantial changes from a network point of view is left to "other" actors. These individual actions are good, but almost all interviewees mentioned that it is essential to act as a team to meet the challenges of climate change.

"We either become a system or we destroy each other. We need to team up" (environmental association)

In addition to this lack of teamwork, the central role of the municipalities hinders possible cooperation. When asked what the municipality is doing in terms of adaptation, several criticisms were raised about the lack of interest in alternatives. This is reflected in their short-term mentality and lack of initiative both for deseasonalisation and diversification. In fact, while municipalities allow individual actors to try new alternatives, more active engagement would be appreciated. This active engagement could take the form either of proposing new alternatives or of facilitating greater cooperation between the various actors. The interests are still to keep the system as it is and to get through the 5-year mandate, exploiting the geographical competitive advantages. On the other hand, the region seems to be more willing to promote other types of tourism such as cultural tourism.

"We need long-term planning in general. But it is a problem with the administrators that only think at the 5 years of their mandate" (environmental protection)

Some enrollment attempts have been done to promote collaborations, however, they were criticized for a lack of inclusiveness, mainly due to the choice of time and date, which made it impossible for most actors to participate. I would say that the system is currently in the enrollment phase, as most actors are interested, but clear roles have not yet been defined. As enrollment is missing, some actors are starting to act and individually adapt their businesses. This could be seen as a beginning of individual mobilization, while system mobilization is far from happening.

6 Discussion

From the findings it is clear how the tourism system is still in the ordering process, however, some conclusions can be drawn on the different perceptions of Interestment in the area. The proposed solutions are in line with the current adaptation strategy of the region, particularly, the focus on year-round tourism seems to be generally approved by the local population (VdA, 2021b). However, concerns regarding the benefits of “dead” periods have been raised mostly by hotels and bars. This interest is mainly driven by business choices of wanting to maximize the profits when tourists are present, and then enjoy some quietness or go on holidays, thus keeping an intensive tourism system. A focus on peak seasons merely to allow for slow periods afterwards increases the risk of maladaptation as it contributes to the negative impacts that mass tourism currently has. Indeed, it is crucial to consider the social and environmental impacts of mass tourism as it exists today (Barker, 1982; Gios et al., 2006). Mass tourism can heavily impact natural environment, which is not only needed as touristic attraction, but it provides ecological and social functions that should be preserved (Karim et al., 2023; Streimikiene et al., 2021). Moreover, mass tourism leads to higher pressure on the population and on existing services (Karim et al., 2023).

The need for diversification described in the strategy is also supported by the local population, with multiple alternatives being proposed (VdA, 2021b). However, municipalities and ski resorts still seem to push for ski-focused tourism and have a very short-term approach. This is similar to the SMART strategy, which still considers ski as the “star” product and could hinder possible diversification (VdA, 2021a). Yet again, this is a potential risk for maladaptation, as it shifts the attention away from long-term effects of climate change and focus on resource-intensive strategies, like snowmaking, that further contributes to impacts and conflict in the area (Maran et al., 2014; Mariani and Scalise, 2022). The lack of active involvement by municipalities in creating new alternatives can be a major step backwards, as a long-term approach and a proactive response to climate change are essential (Salim et al., 2021b; Salim et al., 2021c). While actors have the power to adapt individually, the central role of municipalities gives them the opportunity to support adaptation at the system level, for example by increasing safety and accessibility of alternatives (Cremonese et al., 2019).

The findings show an interest in better communication for both tourists and the local population, which is in line with the adaptation strategy (VdA, 2021b). In particular, it is interesting to point out the need for a different attitude and mentality towards the mountains, in order to ensure a greater cooperation and respect between human and nature. Indeed, the way in which climate change is problematized, including knowledge of its human causes, can play a crucial role in the behavior of the

local population (Adger et al., 2009). Adaptation is currently framed in terms of the economy, while the importance of the environment is only partially highlighted in the findings. This creates a dilemma of saving the economy or saving nature, and, while tourism is essential to local livelihoods, it is important for the network to fully understand such dynamics. Indeed, using a post-structuralism approach, adaptation should be considered as an internalized socio-natural process resulting from the coevolution of human values and the environment (Dujardin, 2020). This means rejecting the idea of climate change as an external problem to be controlled and managed (Dujardin, 2020). This dilemma was of particular concern to those actors who work closely with the mountains and culture, and who see the effects that a lack of respect and excessive exploitation by tourists can have on nature. By fighting for preservation, these actors enforce the agency of nature as a crucial non-human actor, and, compared to the position offered by hotels and bars, they aim to reduce mass tourism, thus limiting potential risks of maladaptation. To facilitate communication and to find a proper sustainable adaptation strategy, additional initiatives should be taken to improve cooperation and involvement of the local population (Hill et al., 2010). In fact, similar to other cases, the local population is small enough for people to form strong ties with each other, but the lack of a clear hierarchy and of cooperation networks makes it difficult for actors to work together (Wyss et al., 2014; Hill et al., 2010). These dynamics are also evident in the first research question, where the system relations are defined. Finally, given the differences in adaptive capacity between tourists and destinations, communication with tourists will be necessary to ensure that they accept the changes that are occurring and do not further limit the adaptive capacity of the destination (Kaján and Saarinen, 2013). Indeed, given the changes in tourists' attitudes in recent years, it is important to share the need to respect the natural environment. A change in tourists' attitudes and mentality is therefore essential to avoid maladaptation, also in terms of preserving local identity. In this sense, focusing on communication and cooperation with nature are crucial steps in tourism adaptation (Matasci et al., 2014; Wyss et al., 2015; Salim et al., 2021b).

The diverse perceptions presented above are a clear example of multiplicity in the system and of the numerous ways in which translation processes can take place when the problem of climate change is presented to different actors (Deason et al., 2022; van der Duim et al., 2013). These differences highlight the need for collaboration between actors and the importance of including multiple perspectives. In fact, all actors' opinions are valid at the system level, and the interests for conflicting adaptation strategies are a crucial part of allowing multiple orderings of the system, even in cases that may lead to maladaptation (van der Duim et al., 2013).

6.1 Relevance for Sustainability Science

Sustainability science aims at solving complex problems deriving from socio-natural interactions using an interdisciplinary approach (Jerneck et al., 2011). This work contributes to sustainability science by expanding on the concept of climate change adaptation using a solution-oriented approach. Indeed, adaptation to climate change in mountain regions around the world will be a necessity given the high vulnerability of these environments (Hock et al., 2021). These environmental changes will heavily impact tourism, which is a crucial sector for the economic development and livelihood of alpine regions in Europe (Hock et al., 2021). The sustainability issue addressed in this thesis is adaptation of local livelihoods to climate change. This thesis then focuses on the interaction between climate change and tourism, highlighting the potential for maladaptation and the impacts of tourism on the environment and local identity. While some individual adaptation measures are already taking place, this study contributes by offering a system evaluation of the Western Italian Alps system. Through the use of ANT, the current tourism system is defined and the challenges in stabilizing it to climate change are highlighted. Moreover, the participatory approach of the study, carried out through the involvement of the local population, ensures the inclusion of multiple perspectives and different actors. In fact, the differences between the adaptation strategy and its perception are highlighted, offering points for reflection in order to strengthen the cooperation between actors.

6.2 Limitations

A number of limitations associated with the study were identified and will be presented in this section. A first point might be raised against the research design and theory used. One of the main criticisms of ANT is that it considers all actors on the same level (Alcadipani & Hassard, 2010; Kolli & Khajeheian, 2020). Indeed, while the type of actors and relations in a system represent some kind of power relations, ANT has a tendency of not representing other factors like positionality and pre-existing structures that can impact power relations (Kolli & Khajeheian, 2020). Other criticisms are raised in the application of the theory, in particular that it is difficult to really include non-human actors in the research and to have a critical perspective in the analysis of reality compared to its representations (Alcadipani & Hassard, 2010; Mwenya & Brown, 2017). In order to limit these risks in this thesis, I tried to allow for multiple realities to co-exist at the same time and allow for actors to critically describe their point of view. Moreover, non-human actors were considered for the current system, however, I could only rely on perceptions and descriptions made by human actors during interviews to enforce their agency. In this sense, the type of data collection can be seen as a limitation, in particular, while

the use of different data sources works well for qualitative studies, it can limit a fair representation of the actors involved.

Moreover, by focusing on a case study and on destination adaptation I was spatially limited in my selection of actors, from which followed the exclusion of tourist interviews. A qualitative analysis of a case study may still have potential for generalization in similar alpine tourism systems, however, cultural and social differences may play a crucial role in the adaptation potential of a different destination. This is also highlighted in the findings where differences with neighboring countries have been brought forward. Finally, time constraints and word count were a great limitation in the writing process and in the selection of methodology used. In this sense, also the number of interviews and data sources can be considered an important limitation in the representation of the system.

7 Conclusions

This thesis analyses how the current tourism system in the Mount Blanc area is adapting. By using ANT, it takes a system perspective and it includes different opinions and multiple perceptions of current and future adaptation to climate change. Moreover, the system is defined including also non-human actors like nature and local identity and the role that they play in this process.

It is clear that there is strong individual interest in adapting to this change through deseasonalisation, diversification and communication. However, hotels and bars still want to maximize already high periods and enjoy “dead” periods when no one is around. In this way, they are working against deseasonalisation and towards more intensive tourism, which may lead to maladaptation. On the other hand, when it comes to diversification, municipalities and ski resorts have a very short-term perspective, rejecting potential alternatives and focusing on resource-intensive strategies such as snowmaking, which will lead to increased conflict. These positions increase the risk of maladaptation because the environmental and human impacts are not thoroughly considered. Therefore, as expressed by the actors who work in close contact with the mountains and culture, it is necessary to communicate among the local people in order to re-evaluate the importance and respect towards the mountains and nature, and to determine which strategies are appropriate to preserve the local environment. In order to reach a sustainable adaptation, it will be crucial to ensure increased collaboration among actors so that enrollment and mobilization can be achieved at a system level and not only individually. Increased communication will also be needed with tourists so that they become more willing to accept such changes in activities and therefore relatively increase the adaptive capacity of the destination. Furthermore, changes in tourists’ attitude will also be essential to ensure respect for the natural environment and local identity, and to help the destination adapt in the right direction.

Future studies may focus on different cases to account for cultural and regional differences, with the inclusion of tourist perspective and possibly more in-depth interviews to better understand the dynamics and the reasoning behind the results. Moreover, a focus on communication and collaboration for climate change and the impacts of tourism on these changes might be an interesting starting point for similar alpine regions.

8 References

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9 Appendices

Appendix A – Participants

Name	Description	Data collection
Courmayeur municipality	Biggest municipality in the area	A14, A19, A21, A22
La Salle municipality	Lower altitude municipality	A13
Fondazione Montagna Sicura	Study of mountain phenomena and problematics	A15
ARPA Valle d'Aosta	Regional Environmental Protection Agency	A17
Comitato Glaciologico Italiano	Italian Glaciological Committee	A01
Società Guide Alpine Courmayeur	Local alpine guides society	A11, A20, A23
Corpo Forestale Valle d'Aosta	Regional Forestry Corps	A02
Courmayeur Mont Blanc Funivie	Ski resort company	Written communication
SkyWay	Mount Blanc cable car	On site visit, A09
Forte di Bard and Castello di Saint-Pierre	Museums and castles	On site visit
Sant'Orso	Local craftsmanship fair	On site visit
Shops and Rentals	-	A05, A12, A18
Hotels	-	A12, A16
Bars and Restaurants	-	A04, A05, A16, A19
Food Producers	Mainly agriculture (wine) and bovine	A13, A05
High altitude infrastructures	Mountain huts and others	A20, A09, A19, A16
Transportation	Tunnel Mont Blanc and services	A06, A08
Other sports	Trail running and others	A06, A07, A12, A22
Journalist	-	A10
Cultural Tourism	Festivals and other events	A03, A14, A12

Each interviewee has been assigned a code made of the letter A and a number of two digits. This is to identify anonymously the participants while showing their role in the system and how some of them are part of different businesses and associations.

Appendix B – Guiding questions

What does the Aosta Valley mean to you?

- Are there any places of particular value to you?
- What are the places that you feel most attached to?

What are the changes in terms of climate and environment that you have been observing?

- [experts] Based on your knowledge, what are the most evident process and phenomena? Can you explain how they are related to climate?
- In what ways are these changes impacting your lifestyle?
- Are there any precautions that you think you will have to take?

Did you notice any differences from an economic and working point of view?

- Activities that you can do in your business?
- What differences you observe in the system?
- How is tourism changing?
- [municipalities] how are these changes viewed by the municipality?

What are your priorities for adaptation?

- What the most important aspect to protect?
- What do you think of the future of the valley [experts in particular]
- Do you have any economic concerns about adaptation?
- How do you think the system is adapting? Is the mentality changing?
- [municipalities] what are the municipalities priorities and proposed solutions?
- What are your opinions on how the municipalities are dealing with these changes?

Is there anything you would want to add?

This image shows the guiding questions used throughout the interviewees. The questions were adapted based on the participants I was interviewing to better capture their perspective. In square brackets are some examples of how some questions were tailored to specific participants.